ENVIRONMENTAL MONITORING PLAN

US ECOLOGY NEVADA

March 2010

Revised May 2011

SECTION 13

ENVIRONMENTAL MONITORING PLAN

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SECTION 13

ENVIRONMENTAL MONITORING PLAN

13.1.0 OVERVIEW OF ENVIRONMENTAL MONITORING DATA

The US Ecology Nevada environmental monitoring system includes data from three sources:

- 18 groundwater monitoring wells,
- Four pairs of leachate sumps, and
- A soil gas extraction well

The groundwater monitoring system uses eighteen wells in the Upper Water-Bearing Zone to monitor semi-annually for releases from landfill Trenches 11, 12 and the pre-RCRA Solid Waste Management Units (SWMUs) including Trenches 1 through 10. Water levels are measured in all wells at the time of each monitoring event to determine groundwater gradients. Samples are collected and analyzed for constituents as specified in the facility permit and as delineated below.

Leachate from Trench 11 and Trench 12 is sampled semi-annually from at least one sump in each Trench and analyzed for specified constituents. Leachate monitoring establishes a baseline of constituents present in leachate for comparison with groundwater monitoring data in the unlikely event of a release. In addition, leachate levels and pumping volumes are recorded and analyzed for compliance with permit conditions, and to assess the overall effectiveness of the leachate collection and detection sumps. Leachate data will also be used to assess the performance of alternative covers permitted for construction on Trench 11 and Trench 12.

Organic vapors have been detected in the vadose zone located under the facility, and a Soil Vapor Extraction (SVE) system has been installed to remove organic vapors. Extracted vapors are pumped through a carbon filter and monitored daily with a calibrated Photo ionization Detector (PID) that tests for volatile organic compounds (VOCs) exiting the filter system. In addition, weekly PID readings are recorded from a point between the wellhead and the carbon filter, and a summa canister sample is collected annually to quantify all constituents in the vadose zone. The performance of the SVE system is evaluated through monitoring of groundwater for selected VOCs.

13.2.0 GENERAL HYDROGEOLOGY INFORMATION

Numerous reports (Appendices A through F, References 1 through 5) contain information on site stratigraphy, physical and chemical properties of the vadose and upper saturated zones, and relationships with the confined gravel aquifer. The following sections briefly review regional and site geology and hydrology.

13.2.1 Regional and Site Geology

The US Ecology Nevada (USEN) Facility is located in the Amargosa Desert basin which was formed by normal block faulting, which displaced the surrounding strata upward with respect to the crustal block underlying the valley. This widespread structural process formed the characteristic topography of the entire Basin and Range province. Erosion of the uplifted areas, during and after their displacement, has filled the basin with a variety of sedimentary deposits. These deposits have reached a depth of 1000 feet in the center of the basin near Lathrop Wells.

The sediments of the valley floor are unconsolidated to partly indurated and Tertiary to Quaternary in age. Deposited as alluvial fans, debris flows, streambeds, dunes, and lake or marsh beds, they exhibit a very, wide range of shapes and grain size distributions. The mineralogy of the sediments varies widely as well, reflecting the diversity of their source rocks.

Details on the nature of the unconsolidated strata beneath the facility have been determined from the various borings and well installations, which have been made since 1961. Extensive hydrogeologic investigations have been conducted at the site to determine the soil properties and hydrologic characteristics.

Stratigraphic information derived from the site characterization and monitoring well installation programs for the RCRA disposal facility describe a sequence of deposits consistent with alluvial fan and playa depositional processes. Deposits from the ground surface to a depth of approximately 300 feet beneath the RCRA facility are alluvial in nature. The alluvial sediments are predominantly gravelly sands with poorly sorted gravel or sand deposits which occur in discontinuous intervals. The gravelly sand extends deeper (approximately 350 feet below ground surface) at the southwestern area of the LLRW facility (Figure 3).

Generally, the next 50 to 150 feet of deposits beneath the RCRA facility consist of silt, clay and indurated deposits. The fine-grained sediments are typical of playa deposits and may change composition relatively quickly with depth.

The silt-clay deposits were also observed in borings 001 and 002. The upper surface of the silt-clay unit is relatively flat beneath the northern half of the RCRA facility and appears to deepen to the southwest beneath the LLRW facility.

Drilling investigations indicate that the upper saturated zone occurs near the contact of the silt-clay and indurated sediments with the overlying gravelly sands. The confined aquifer occurs in a sandy gravel formation underlying the silt-clay deposits.

This sandy gravel generally becomes coarser as it extends to depths exceeding 650 feet below ground level. The deeper gravels, cobbles, and boulders represent a higher energy, fluvial environment.

13.2.2 Regional Groundwater Flow Patterns

The surficial drainage area of the Amargosa Desert covers about 2600 square miles and is part of two regional groundwater systems (see Figure 13-3):

These two groundwater systems converge in the Amargosa Desert and probably continue to the south into Death Valley. Groundwater flow directions in the Amargosa Desert are generally to the southeast and southwest. Summaries of previous work on regional groundwater flow in this part of Nevada can be found in Elliott (1982) and Feeney, et al. (1987). Groundwater flow is controlled by alluvium, volcanic rock, and carbonate rocks. Thick volcanic sequences associated with calderas of the Nevada Test Site and areas to the west become less significant to the south, and thick carbonate rock sequences are assumed to be present beneath the Amargosa Desert (Feeney et al., 1987).

13.2.3 Site Hydrogeology

13.2.3.1 Saturated Zone

The degree of continuity of the hydrogeologic units beneath the site is illustrated in the cross-sections of Figures 13.5 and 13.6. At the 300-series well locations, saturation begins near the top of a 50-150 foot thick sequence of partially cemented to well-indurated clays, silts and sand. The depth to saturation from the ground surface ranges from near 285 feet on the north side of the site to > 360 feet at the southwest corner of the LLRW facility (see Appendix A). The interbedding of clays and cemented silts and sands at these depths serves to separate the upper saturated zone from the confined gravel aquifer beneath into discrete hydrogeologic units.

The gravel aquifer is encountered beneath the fine-grained deposits at a depth of 380 feet or more. It consists of sandy gravel with some cobbles and boulders, and is > 250 feet thick at the southern boundary of the site. The piezometric level measured in this aquifer occurs near 315 feet below ground surface, indicating a confined condition. The groundwater gradient in both the upper saturated zone and confined gravel aquifer is to the south and southwest, following the trend of the Amargosa Valley. This gradient is consistent with regional data, as reported by Nichols (1987) and Kilroy (1991).

Appendix A is a site plan showing water table contours in 2009. Groundwater gradients increase to the south beneath the RCRA facility and are generally uniform to the southwest beneath the LLRW facility. All wells and borings drilled to sufficient depth have encountered a confined gravel aquifer. A piezometric contour map of the confined aquifer is provided as Appendix B. Groundwater flow in the confined aquifer is generally to the south-southwest.

Numerous studies have been conducted which estimate hydraulic conductivities and transmissivities for this facility. Appendix C provides the calculations used to determine an average hydraulic conductivity for the upper aquifer of 6.63 $\times 10^{-4}$ feet/sec. Hydraulic gradients based on March 1995 groundwater elevations range from 0.028 ft/ft on the eastern side of the facility to 0.058

ft/ft in the central to western portion. Groundwater velocity estimates using March 1995 information ranges from 5.3 x 10^{-5} ft/sec to 1.1 x 10^{-4} ft/sec (using an average effective porosity of 0.35, as calculated in Appendix C). The measured hydraulic conductivities are consistent with samples lithologies and are considered representative of the upper saturated zone. Lithologies vary both laterally and vertically; however, groundwater velocities will be predominantly near the low end of the range given, as a result of the high clay and silt contents of the upper saturated zone.

Pumping test data from earlier studies (References 1 and 5) indicate the confined gravel aquifer has a transmissivity ranging from about 1,900 to 3,000 gpd/ft. Assuming these values are representative of the screened intervals of the 600-series wells, and using gradients derived from Appendix B, a groundwater flow velocity of about 30-50 ft/year is considered typical of the confined aquifer (calculations are presented in Appendix C). The heterogeneity of the sediments in the confined aquifer suggests somewhat smaller or larger velocities may be possible on a local scale.

13.2.3.2 Vadose Zone

As discussed earlier, the thickness of the vadose zone beneath the USEN Facility varies from 285 feet to > 360 feet. The moisture contents of sediments in the vadose zone are, in general, < 10% by weight, as determined from core samples (Reference 1) and in-situ neutron probe measurements (Fischer, 1992). Fisher (1992) also concluded that the potential for contaminant transport by water flow through the vadose zone is minimal under conditions observed at the facility. The extreme dryness of subsurface sediments is further characterized by water potentials from -10 to -60 bars, measured at the U.S. Geological Survey (USGS) study site near the southwest corner of the LLRW facility (Nichols, 1987; Fischer, 1990 and 1992).

An environmental pathways analysis performed for the Beatty LLRW facility used physical property data of site sediments and assumed a conservative recharge rate of 0.5 mm/year. Calculated travel times for vadose zone water from trenches to the upper saturated zone ranged from 13,000 to 24,000 years.

13.3.0 GENERAL GROUNDWATER MONITORING REQUIREMENTS

13.3.1 Groundwater Monitoring Wells

The USEN groundwater monitoring program yields representative samples from upgradient and downgradient wells. The groundwater monitoring system consists of detection monitoring (point of compliance) wells and background wells screened in the upper aquifer. Table 13-1 lists the wells, the well application, and current condition.

Table 13-1 - Monitoring Well Designations		
Well Identification	Designation	Aquifer
001	Point of Compliance	Upper
002	Point of Compliance	Upper
308	Point of Compliance	Upper
309	Point of Compliance	Upper
310	Point of Compliance	Upper
311	Point of Compliance	Upper
313	Background	Upper
315A	Point of Compliance	Upper
316	Point of Compliance	Upper
317	Point of Compliance	Upper
318	Background	Upper
319	Background	Upper
320	Point of Compliance	Upper
322	Point of Compliance	Upper
324	Point of Compliance	Upper
325	Point of Compliance	Upper
326	Point of Compliance	Upper
327	Point of Compliance	Upper
600	Supplemental	Lower
601	Supplemental	Lower
603	Supplemental	Lower
604	Supplemental	Lower
605	Supplemental	Lower

Three (3) monitoring wells (MW-320, MW-322, and MW-324) were installed in 2008 along the western perimeter of the site downgradient of Trench 12.

13.3.2 Sampling and Analysis Plan

A sampling and analysis plan is included as Appendix D. This document describes in detail the procedures and techniques employed for sample collection, preservation and shipment. The plan also describes the procedures utilized for sample analysis and chain of custody control.

13.3.3 Statistical Procedures

The purpose of the USEN groundwater monitoring program is to determine if the facility has had a significant effect on groundwater quality. To determine if a statistically significant increase has occurred, groundwater data is initially compared with the groundwater quality standards in Table 13-2. These standards are based on an analysis of groundwater quality data from 2003 to 2009 comparing up gradient and down gradient wells. The statistical analysis method used by AquAeTer is outlined in Appendix 13-E.

13.4.0 DESCRIPTION OF DETECTION MONITORING PROGRAM

13.4.1 Analytical Parameters

The analytical parameters in the USEN detection monitoring program are listed in Table 3-2.

13.4.2 Frequency of Sampling and Statistical Evaluation

The Background Wells and Point of Compliance Wells in the upper aquifer are monitored quarterly for the constituents in Table 13-2 Statistical evaluations are made on groundwater analytical data from Point of Compliance Wells for each sampling event. The supplement wells will be maintain but not sampled. Justification for elimination of sampling the supplemental wells every five quarters is included in Appendix 13-G.

Table 13-2 – Groundwater Protection Standards	
Ground Water Constituents	**Ground Water Protection Standard**
Arsenic	0.0152 mg/L
Barium	0.240 mg/L
Cadmium	0.0053 mg/L
Chromium	0.185 mg/L
Lead	0.0297 mg/L
Mercury	0.002 mg/L
Selenium	0.0039 mg/L
Silver	0.0627 mg/L
Sodium	324 mg/L
Cyanide	0.010 mg/L
Chloride	106 mg/L
Fluoride	5.5 mg/L
Nitrate-Nitrite as N	2 mg/L
Sulfate	274 mg/L
pH (std. units)	7 to 8.7
Specific Conductance	1,398 umhos
Total Organic Halides (TOX)	0.007 mg/L
Total Organic Carbon (TOC)	7.46 mg/L
Gross Alpha	22 pCi/L
Gross Beta	25 pCi/L
Radium 226/228*	5 pCi/L (Combination of Radium 226 & 228)
Tritium*	250 pCi/L
Endrin**	0.0002 mg/L
Lindane**	0.004 mg/L
Methoxychlor**	0.10 mg/L
Toxhaphene**	0.005 mg/L
2,4 – D**	0.1 mg/L
2,4,5 – TP Silvex**	0.01 mg/L

* From 2005 permit ** Established in 40 CFR §264.94

In addition to the constituents outlined in Table 13-2 groundwater will be analyzed to meet the requirements of 40 CFR §761.75 (b)(6)(iii).

13.4.3 Background Values

The upper aquifer "background" values for the parameters presented in Tables 13-2 were developed from the statistical analysis of groundwater samples collected from 2003 to 2009.

13.4.4 Determination of Groundwater Flow and Direction

Groundwater flow rate and direction in the upper saturated zone and the confined aquifer are determined and reported annually.

13.4.5 Other Source Demonstration

Once groundwater analysis results have been collected and subjected to a data quality review, the data is compared to the facility background value. To determine if a statistically significant increase has occurred, groundwater data is initially compared with the groundwater quality standards in Table 13.2. These standards are based on an analysis of groundwater quality data from 2003 to 2009 comparing up gradient and down gradient wells.

USEN also uses additional lines of evidence to evaluate whether liquids have been released from the landfill to groundwater. Leachate generation rates, leachate data, and landfill gas data are evaluated and compared with groundwater data to determine whether a source other than a currently-operating regulated unit caused the increase or that the increase resulted from error in sampling, analysis, evaluation, or natural variation in the groundwater. For example, constituents detected in leachate provide an indication of constituents that could be expected to be observed in groundwater if liquids were released from the site. USEN provides the results of this analysis in semi-annual reports to the NvDEP.

13.4.6 Detection Verification Procedure

Point of Compliance wells are evaluated statistically each time the wells are sampled. If a potential statistically significant increase (SSI) is identified, the results are verified during the next scheduled sampling event. Each semi-annual report includes analytical results for all environmental samples, and a discussion of any significant statistical increases.

13.4.7 Corrective Action Program

The facility submitted a Corrective Action Plan (CAP) in September 1998 and implemented a Corrective Measures Study (CMS) in March 1999. Prior investigations had determined that trace organic constituents detected in upper aquifer groundwater were attributable to gas migration from regulated units and solid waste management units. The selected remedy was extraction of waste constituents from the soil vapor in the overlying vadose zone. This work has now been competed with installation of a pilot SVE system. A final CMS report was submitted in April 2003. The CAP is included as Appendix E To evaluate the effectiveness of corrective measures, upper aquifer monitoring wells are sampled and analyzed semi-annually for the constituents in Table 13-3

Table 13-3 – Corrective Measures Evaluation

Ground Water Constituents	Ground Water Protection Standard (mg/L)
Carbon tetrachloride	0.005
Chloroform	0.005
Tetrachloroethene	0.005
Toluene	0.005
Trichloroethene	0.005
Trichloroflouromethane	0.005

13.5.0 LEACHATE MONITORING

On a quarterly basis samples will be collected and analyze from the Leachate Collection and Removal System (LCRS) and Leachate Detection and Removal System (LDRS) in both Trench 11 and Trench 12 (any leachate sump generating liquids will be sampled). Samples are analyzed for the parameters found in Table 13-4. The results of these analyses are submitted with the semi-annual report. .

Table 13-4 Leachate Sample Analysis

Arsenic	Endrin
Barium	Lindane
Cadmium	Methoxychlor
Chromium	Toxaphene
Lead	2,4-D
Mercury	2,4,5-TP Silvex
Selenium	
Silver	Chloroform
Cyanide	Tetrachloroethene
Fluoride	1,1,1- Trichloroethane
Sodium	Toluene
Sulfate	Acetone
Chloride	All chlorinated organics from EPA Method 8260
TOX	Total PCBs
TOC	
pH	Gross Alpha
Specific Conductance	Gross Beta
Nitrate-Nitrite as N	Radium 226/228
	Tritium

13.6.0 SOIL GAS MONITORING

Extracted soil gas is pumped through a carbon filter and monitored daily with a calibrated Photo ionization Detector (PID) that tests for volatile organic compounds (VOCs) exiting the filter system. In addition, weekly PID readings are recorded from a point between the wellhead and the carbon filter, and a summa canister sample is collected annually to quantify all constituents in the vadose zone. (See table 3-5.)

13.7.0 REPORTING REQUIREMENTS

This section describes the general record keeping and reporting requirements for the Facility's environmental monitoring program.

13.7.1 Records

The facility maintains the following information on-site:

- Field records concerning environmental measurements, sampling events, and related information
- All lab analyses of samples collected from all sources.
- Copies of semi-annual reports

	Table 3-5 Soil Vapor Extraction Annual Summa Canister Analysis Compounds Analyzed	
Hexane	Chloroform	Chlorobenzene
o-Xylene	Dichloromethane (Methylene chloride)	Chloroethane (Ethyl chloride)
Trichlorofluoromethane	1,1,2,2-Tetrachloroethane	cis-1,2-Dichloroethene
Ethylbenzene	1,1,2-Trichloroethane	cis-1,3-Dichloropropene
1,2-Dichloropropane	1,2,4-Trichlorobenzene	Dichlorodifluoromethane
Benzene	1,2,4-Trimethylbenzene (Pseudocum)	Dichlorotetrafluoroethane
m&p-Xylene	1,2-Dibromoethane (EDB)	Hexachlorobutadiene
Chloromethane (Methyl chloride)	1,2-Dichlorobenzene	Styrene
1,1,1-Trichloroethane	1,2-Dichloroethane (EDC)	Tetrachloroethene (PCE)
Carbon tetrachloride	1,3,5-Trimethylbenzene/4-Ethyltoluene	trans-1,2-Dichloroethene
1,1-Dichloroethane	1,3-Dichlorobenzene	trans-1,3-Dichloropropene
Trichloroethene (TCE)	1,4-Dichlorobenzene	Vinyl chloride
1,1-Dichlorethene	Benzyl chloride	
Trichlorofluoroethane	Bromomethane (Methyl bromide)	

13.7.2 Environmental Report Content

USEN submits narrative reports for each sampling event 90 days after the analytical information is received and verified. Reports include descriptions of the groundwater flow conditions and groundwater quality conditions, as described below.

- Executive Summary – brief summary of the report, emphasizing key results and conclusions.
- Alternative Source Notification (if required)
- Groundwater Quality Conditions – groundwater sample data and data evaluation
    - Summary of Detection Monitoring Results, including identification of statistically significant increases.
    - Background data evaluation;
- Leachate data, including leachate removal rates, comparison with Action Leakage Rate, leachate levels, and leachate analytical data.
- Soil gas monitoring data
- Groundwater gradients
- Tables, Figures and Appendices, including field and analytical data for the sampling events and corrective measures.

13.8.0 REFERENCES

Currie L.A., 1968. Limits for qualitative detection and quantitative determination: application to radiochemistry. Analytical Chemistry, 40, 586-593.

Elliot, B. 1982. An investigation of selected quality parameters in the Amargosa drainage basin. Desert Research Inst. Publ. 45039, DOE/NV/10162-18, 20 pp.

Feeney, T.A., Campana, M.E., and Jacobson, ILL. 1987. A deuterium-calibrated groundwater flow model of the western Nevada Test Site and vicinity. Desert Research Inst. Pub145057, DOE/NV/10384-16, 46 pp.

Fischer, J.M., 1990. Geohydrology of the near-surface unsaturated zone adjacent to the disposal site for low level radioactive waste near Beatty, Nevada. Safe Disposal of Radionuclides in Low Level Radioactive Waste Repository Sites; U.S. Geological Survey, Circular 1036, pp 57-61.

Fischer, J.M., 1992. Sediment properties and water movement through shallow unsaturated alluvium at an arid site for disposal of low level radioactive waste near Beatty, Nye County, Nevada. U.S. Geological Survey, Water Resources Invest. Report, 92-4032.

Gibbons, R.D., 1987. Statistical models for the analysis of volatile organic compounds in waste disposal sites. Ground Water, Vol. 25, No. 5, pp. 572-580.

Gibbons, R.D., 1994. Statistical methods for groundwater monitoring. John Wiley & Sons.

Hubaux, A., Vos, G., (1970). Decision and detection limits for linear calibration curves. Analytical Chemistry, 42, 849-855.

Kilroy, K.C., 1991. Groundwater conditions in Amargosa Desert, Nevada-California, 1952- 87. U.S. Geological Survey. Water Resources Invest. Report, 89-4101.

McKinley, P.W., Long, M.P., and Benson, L.V., 1991. Chemical analyses of water from selected wells and springs in the Yucca Mountain area, Nevada and southeastern California. U.S. Geological Survey. Open-File Report 90-355.

Nichols, W,D., 1987. Geohydrology of the unsaturated zone at the burial site for low level radioactive waste near Beatty, Nye County, Nevada. U.S. Geological Survey. Water- Supply Paper 2312.

Daniel B. Stephens and Associates, Jan. 1989, Laboratory Analyses of Soil Hydraulic Properties for the Beatty, Nevada Project.

USEPA, 1992. Draft Addendum to Interim Final Guidance – Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities.

13.8.1 Additional References

The following list of references corresponds to reports previously submitted to the Nevada Division of Environmental Management.

Reference 1 Exploratory Boring and Monitoring Well Installation Program, US Ecology, RCRA Facility, Beatty, Nevada; The MARK Group, 2 Volumes, April, 1989.

Reference 2 Drilling, Sampling and Installation of Two Monitoring Wells at the US Ecology, Inc., Beatty, Nevada Facility Rad Site; Geraghty & Miller, Inc., Dec., 1990. (This report was included in the RCRA Facility Investigation (RFI) report submitted on April, 1992)

Reference 3 Drilling and Installation of Six Monitoring Wells at the US Ecology, Inc., Beatty, Nevada Facility Chemical Site; Geraghty & Miller, Inc., May, 1991 (included in RFI report).

Reference 4 Completion Report Vadose Zone Monitoring Well 500 and 501 Beatty, Nevada, IT Corp., July, 1991 (included in RFI report).

Reference 5 Beatty, Nevada Aquifer Test Review; J.L. Grant & Associates, 1990

Reference 6 Statistical Analyses of Groundwater Data at Background Well 313, AquAeTer, 1999

FIGURE 13-1

REGIONAL GROUNDWATER FLOW PATTERNS IN THE AMARGOSA DESERT AND VICINITY

Fig 13-1

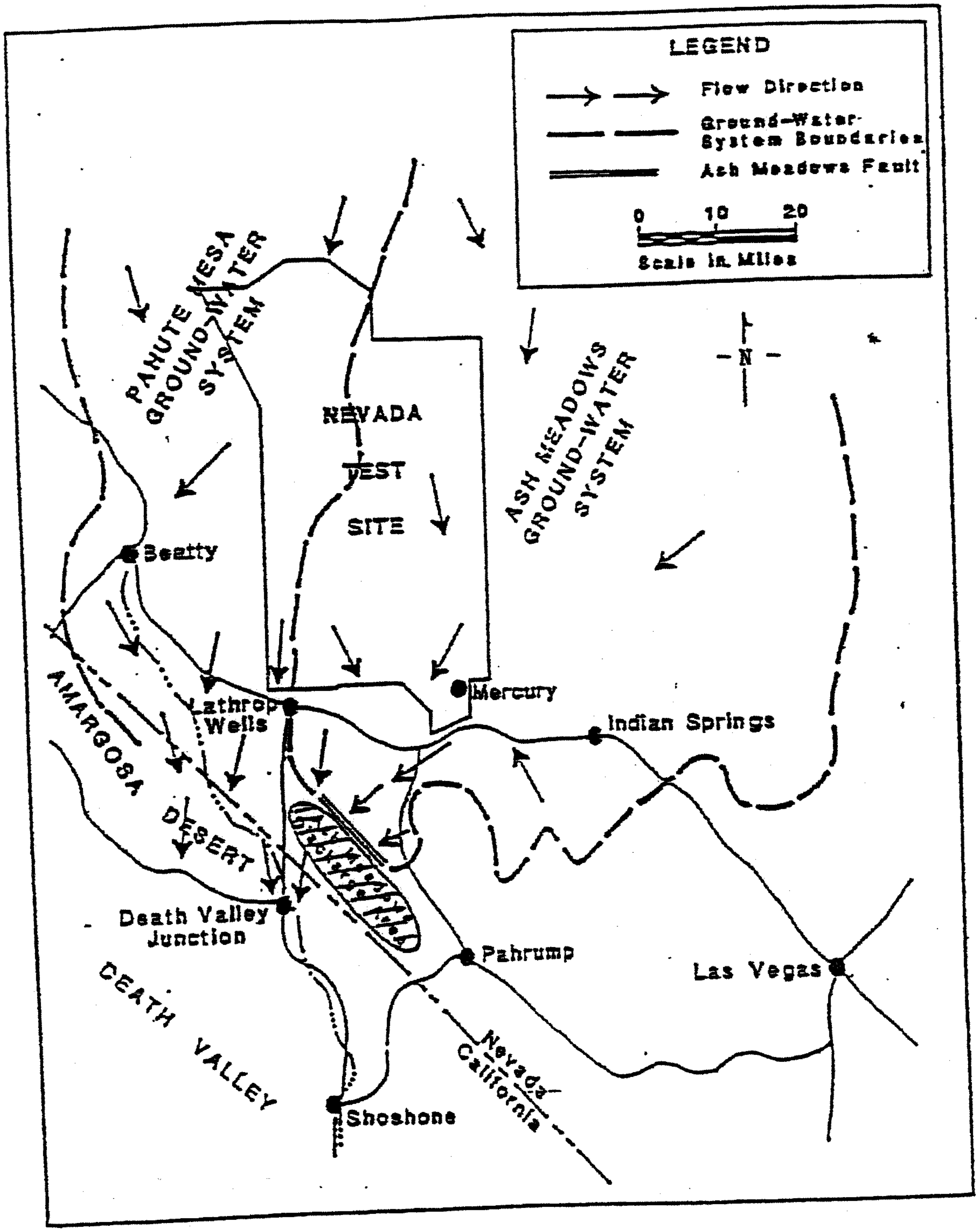
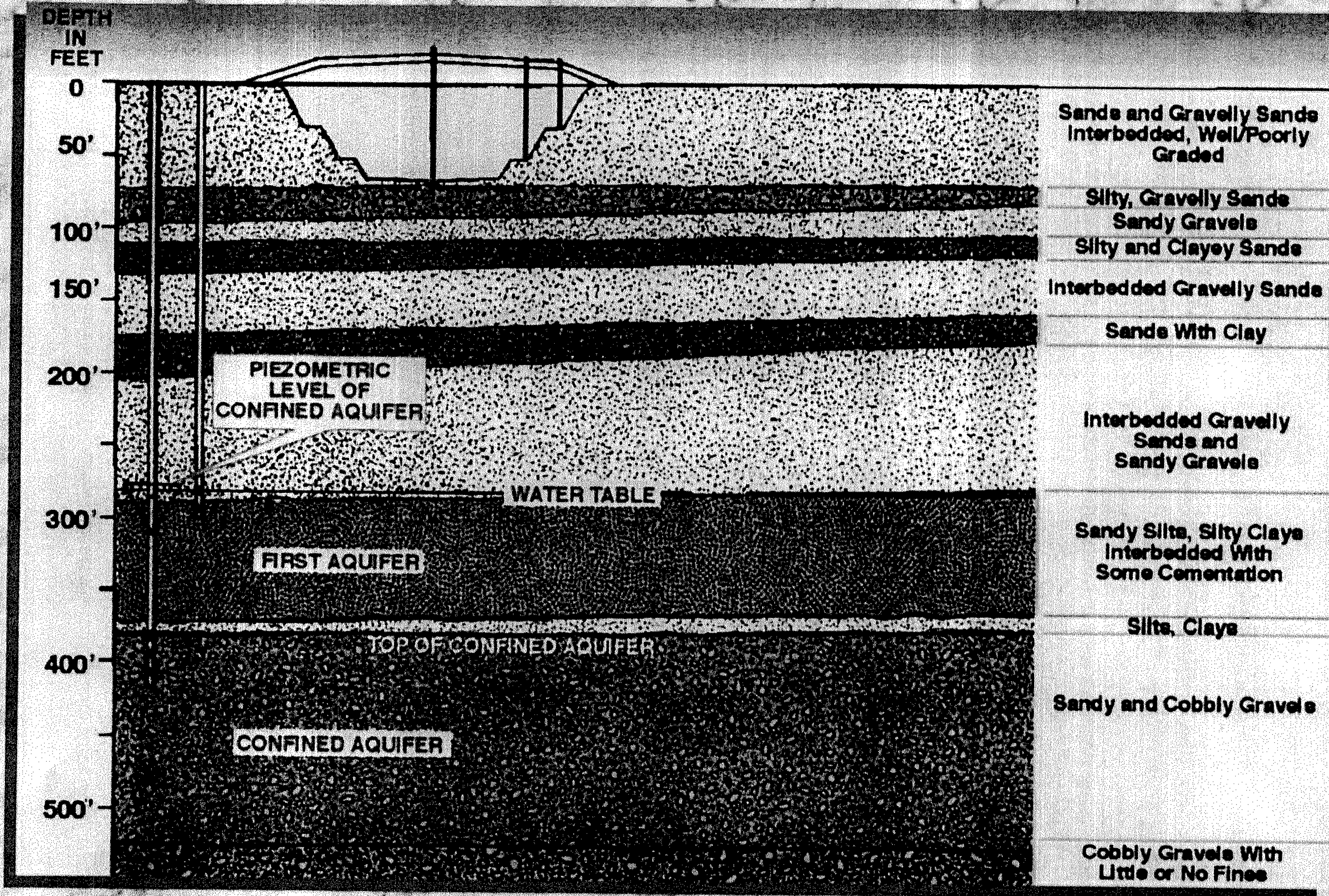


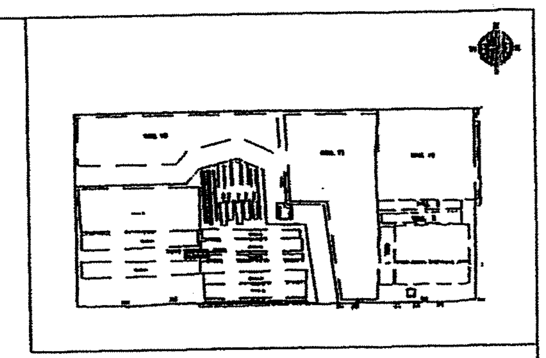
Figure 1. Regional groundwater flow patterns in the Amargosa Desert and vicinity (from Elliott, 1982).

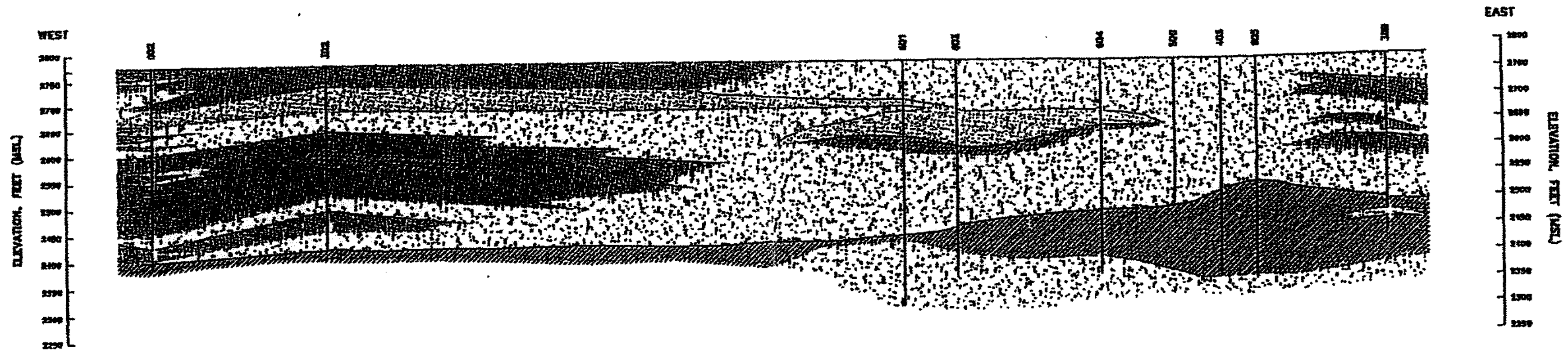
FIGURE 13-2

SITE STRATIGRAPHIC PROFILES

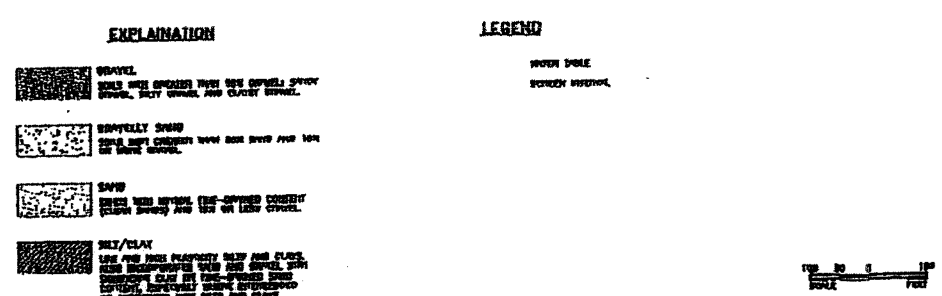
Conceptual Subsurface Profile







EAST/WEST STRATIGRAPHIC PROFILE



REVISIONS	
American	Drawn By:
	Checked By:
	Appr. By:
	Date: 11/93
Reference Drawings: NY-153-GMS-004	

SITE STRATIGRAPHIC PROFILE

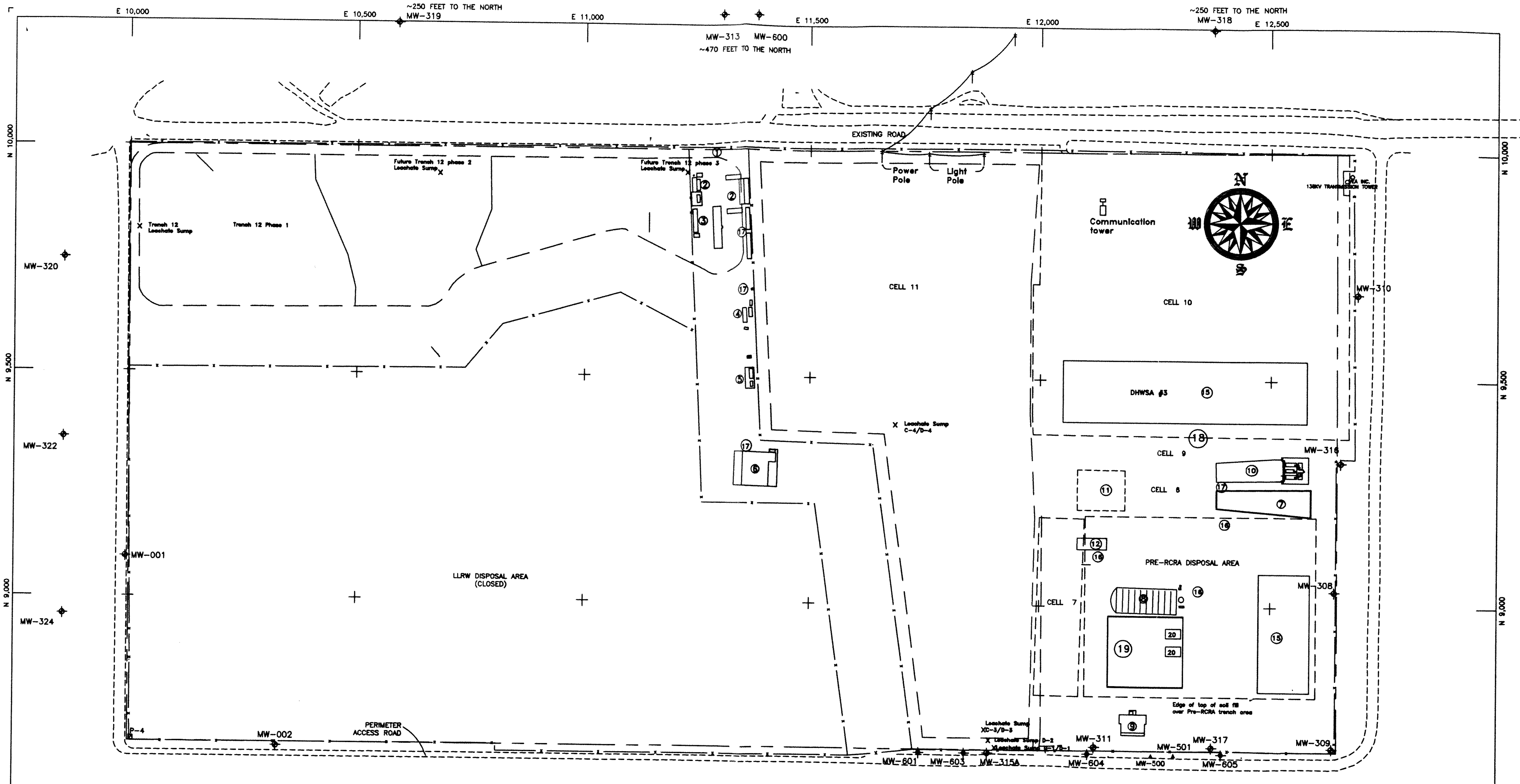
U.S. Ecology

Drawing No. NY-163-GMS-005

Figure 1-3

FIGURE 13-3

Groundwater Monitoring System/Point of Compliance



MW-325

MW-326

MW-327

LEGEND

Monitoring Well Coordinates – WGS84
(September 21, 2006)
Garmin etrex GPS unit (Accuracy per unit 15–18')

PERMIT LINE	
FENCE LINE	
UNIMPROVED ROAD	
SITE COORDINATE SYSTEM MARKER LOCATION IN NORTHING AND EASTING	
Landfill Leachate Management Sump	
MW-002	DETECTION MONITOR WELL LOCATION AND NUMBER
MW-603	SUPPLEMENTAL MONITOR WELL LOCATION AND NUMBER
MW-500	VADOSE ZONE MONITOR WELL LOCATION AND NUMBER
B96-1	CORRECTIVE ACTION BORING LOCATION AND NUMBER
○	TO BE ABANDONED OR REMOVED FROM SAMPLING
□	TO BE ADDED

1. MAIN SITE ENTRANCE
2. ADMINISTRATION OFFICES
3. DRIVERS LOUNGE
4. LABORATORY AND LAB STORAGE
5. FUEL STORAGE
6. MAINTENANCE SHOP
7. LTTD – Removed & Closed
8. TRUCK PARKING PAD (CMU #7)
9. EVAPORATION TANK (T-11)
10. PCB BLDG (CMU #1)
11. STABILIZATION TANKS 2 & 3
12. STABILIZATION TANK 1
13. Removed
14. Removed
15. DRY HAZARDOUS WASTE STORAGE AREA
16. REAGENT STORAGE SILOS
17. FIRE CONTROL HYDRANT
18. SVE Well
19. CMS BLDG (CMU #16)
20. Treatment Tanks 4 & 5

Description

SCALE 100 50 0 100 FEET

Rev Date	Description
12-05-08	Added Trench 12 leachate sumps. Labeled future leachate sumps (phase 2 and 3). Updated MW 320, 322, 324 label.
4-8-09	Added buffer zone details.
4-2-10	General updates for permit renewal / LTTD Removal.
5-18-10	General updates for permit renewal

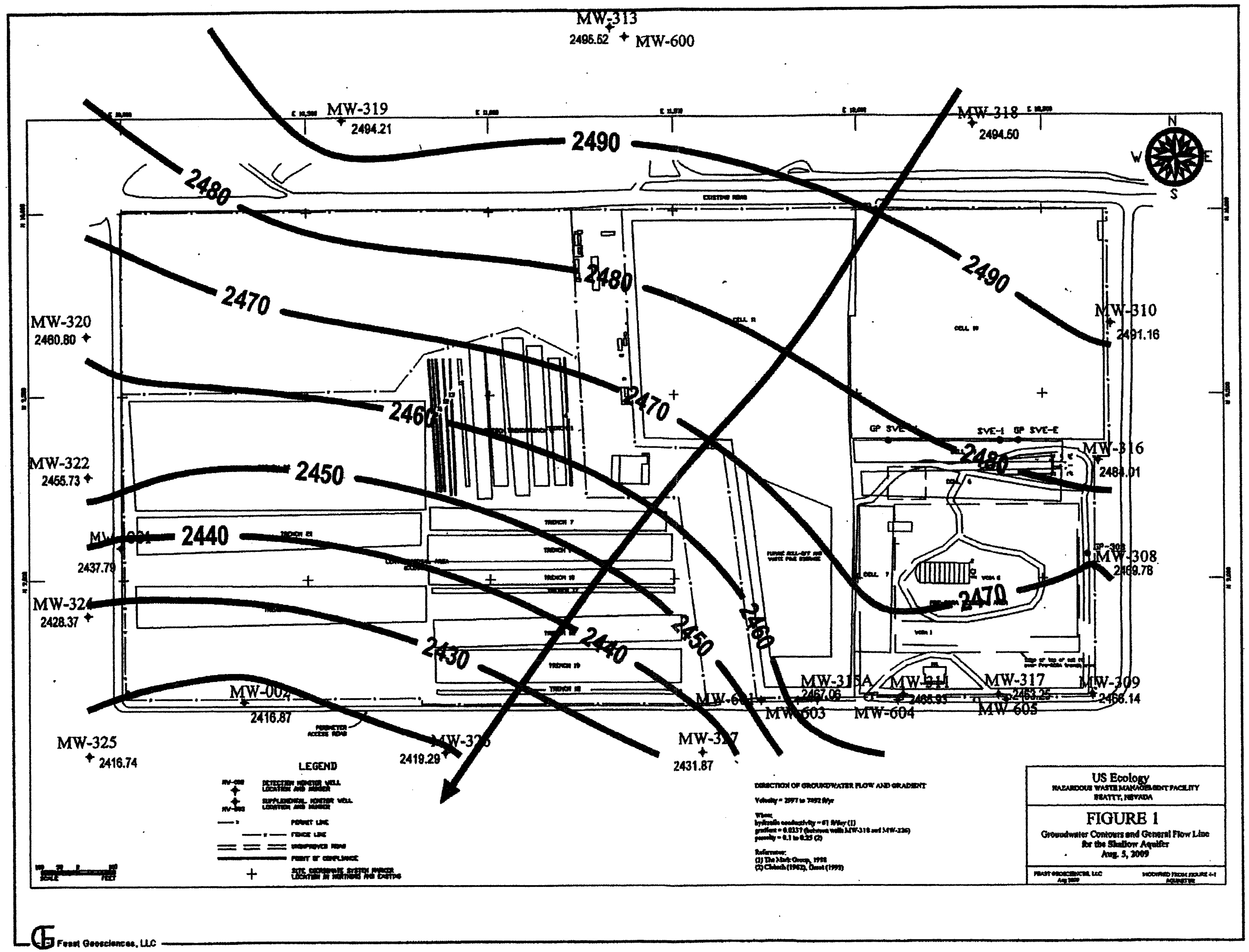
REVISIONS

Drawn By:	LAM
Checked By:	CAB
Appr. By:	PAZ
Date:	3/99
Scale:	AS SHOWN
Project No.:	010917

UPDATED: 05/18/2010

US Ecology Nevada, Inc.
HAZARDOUS WASTE MANAGEMENT FACILITY
BEATTY, NEVADA 89003

Drawing NO. 1



DIRECTION OF GROUNDWATER FLOW AND GRADIENT

Velocity = 2977 to 7452 ft/yr

Where:
hydraulic conductivity = 61 ft/day (1)
gradient = 0.0237 (between wells MW-318 and MW-326)
porosity = 0.1 to 0.25 (2)

References:
(1) The Mark Group, 1998
(2) Clebsch (1962), Grant (1995)

US Ecology
HAZARDOUS WASTE MANAGEMENT FACILITY
BEATTY, NEVADA

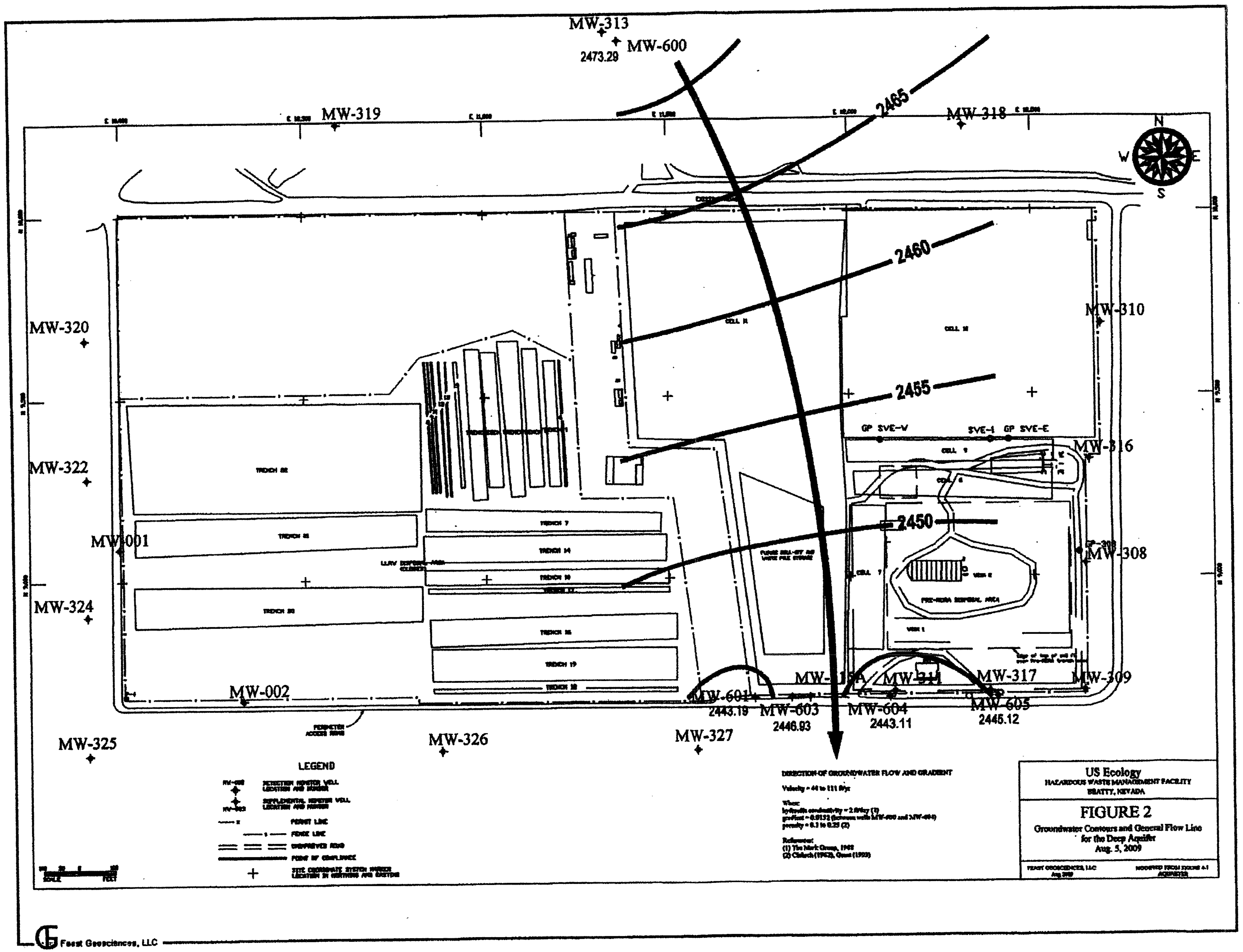
FIGURE 1
Groundwater Contours and General Flow Line for the Shallow Aquifer
Aug. 5, 2009

FEAST GEOSCIENCES, LLC
Aug 2009

MODIFIED FROM FIGURE 4-1
AQUIFER

Appendix 13 B

Confined Aquifer Potentiometric Contour Map


MW-313
2473.29
MW-600
MW-319
MW-318
2465
2460
2455
2450
MW-320
MW-322
MW-001
MW-324
MW-002
MW-325
MW-326
MW-327
MW-310
MW-316
MW-308
MW-309
MW-317
MW-311
MW-604
2443.11
MW-605
2445.12
MW-601
2443.19
MW-603
2446.93
GP SVE-V
SVE-I
GP SVE-E
LEGEND
DIRECTION OF GROUNDWATER FLOW AND GRADIENT
Velocity = 44 to 111 ft/yr
Where:
References:
(1) The Mark Group, 1968
US Ecology
HAZARDOUS WASTE MANAGEMENT FACILITY
BEATTY, NEVADA
FIGURE 2
Groundwater Contours and General Flow Line
for the Deep Aquifer
Aug. 5, 2009
Feast Geosciences, LLC

Appendix 13 C

Hydraulic Conductivity and Porosity Calculations

Calculations of
Hydraulic Conductivities
Upper Aquifer

1. Reference : Law Engineering, 1981

   Transmissivity (T) = 7,000 gpd/ft
   Average Saturated Thickness (h) = 11 feet (Mark Group, 1989)
   Hydraulic Conductivity (K) = T/h
   K= 7,000/11 = 636 gallons per day (gpd)/ ft^2

   Converting to feet/ sec
   gpd/ ft^2 X 1.55 X 10^{-6} = ft/sec (Freeze & Cherry)
   636 gpd/ ft^2 X 1.55 X 10^{-6} = 9.86 X 10^{-4} ft/sec

2. Reference: Mark Group, 1989
   K= 184 gpd/ ft^2

   Converting to feet/ sec
   184 gpd/ ft^2 X 1.55 X 10^{-6} = 2.85 X 10^{-4} ft/sec

3. Reference: Mark Group, 1989
   K= 455 gpd/ ft^2

   Converting to feet/ sec
   455 gpd/ ft^2 X 1.55 X 10^{-6} = 7.05 X 10^{-4} ft/sec

4. Reference: Emcon, 1973
   K= 500 gpd/ ft^2

   Converting to feet/ sec
   500 gpd/ ft^2 X 1.55 X 10^{-6} = 7.75 X 10^{-4} ft/sec

5. Reference: Grant, 1990
   T= 4,000 gpd/ft
   Average Saturated Thickness (h) = 11 feet (Mark Group, 1989)
   Hydraulic Conductivity (K) = T/h
   K= 4,000/11 = 363.6 gallons per day (gpd)/ ft^2

   Converting to feet/ sec
   363.6 gpd/ ft^2 X 1.55 X 10^{-6} = 5.64 X 10^{-4} ft/sec

Average K = 9.86×10^{-4} ft/sec
2.85×10^{-4} ft/sec
7.05×10^{-4} ft/sec
7.75×10^{-4} ft/sec
5.64×10^{-4} ft/sec

32.15×10^{-4} ft/sec/ 5 = 6.63×10^{-4} ft/sec

Porosity Calculations

Reference: Freeze & Cherry

$N = 1 - Pb/Ps$

Using the samples taken from the 400, 402c and 403 borings

From boring 400 at a depth of 273 feet Pb = 1.45 Ps = 2.22 so
$N = 1 - (1.45/2.22) = 0.35$

From boring 402 c at a depth of 271 feet Pb = 1.62 Ps = 2.38 so
$N = 1 - (1.62/2.38) = 0.31$

From boring 403 at a depth of 279 feet Pb = 1.38 Ps = 2.31 so
$N = 1 - (1.38/2.31) = 0.4$

The average porosity is then computed to be 0.35

Appendix 13 D

Sampling and Analysis Plan

SAMPLING AND ANALYSIS PLAN

US ECOLOGY NEVADA

May 2010

Revised May 2011

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LIST OF APPENDICES

GROUNDWATER SAMPLING AND ANALYSIS PLAN

1.1 PURPOSE

This plan details the sampling, maintenance, and analytical methodologies and procedures which assure consistent groundwater quality data from a representative network of monitoring wells at the US Ecology Nevada Facility (USEN) located near Beatty, Nevada. This document complies with the requirements of 40 CFR Part 264, Subpart F and 270.14(c)(6)(iv), and is in accord with procedures described in the 1992 RCRA Groundwater Monitoring Technical Enforcement Guidance (TEGD) published by U.S. EPA Office of Solid Waste. This plan also describes the procedures used to collect leachate samples once the leachate has been pumped from the landfill.

1.2 APPLICABILITY

This plan applies to ground water sampling at US Ecology Nevada.

1.3 REQUIREMENTS

Groundwater sampling is conducted in a manner to ensure that representative samples have been collected.

1.4 SAFETY

Groundwater sampling is conducted in a safe manner based on procedures reviewed and discussed prior to beginning the work.

1.5 EQUIPMENT AND MATERIALS

Sampling equipment and materials are decontaminated as described in the decontamination section of this document.

The following equipment is required to conduct groundwater sampling:

- Clean sample containers with required labels and preservatives. (These containers may be supplied by an independent laboratory).
- Devices for measuring water level, well depth, and for detection of immiscible layers.
- Portable pH, conductivity, turbidity and temperature meters, and applicable standards and buffer solutions for calibration.
- Field Log Book (information must be recorded in ink).
- Non-phosphate detergent and deionized water from facility laboratory for decontamination of equipment (deionized water should be replaced daily when using for decontamination).
- Portable air compressor to drive sampling pumps.
- Dedicated sampling discharge hose (composed of inert material, e.g., Teflon).
- Coolers and ice packs for transport to the laboratory.
- Containers for purge water storage (where necessary due to potential contamination).

- Purge water discharge hose.
- Disposable gloves and paper towels.
- Chain-of-Custody forms and security seals.

1.6 PRECAUTIONS

- Smoking is prohibited during well sampling.
- All monitoring will typically begin at the upgradient well; downgradient wells will typically not be sampled prior to the upgradient well unless dedicated equipment is used in downgradient wells.
- All instruments used for in-situ or field measurements are calibrated each day prior to use in the field according to the manufacturer's specifications. Each calibration and calibration check must be noted in the field log book or other record. Recalibration is required only when the calibration check shows drift outside of the manufacturer's specifications.
- A new pair of gloves must be worn when sampling each well.
- Water levels (see Section 2.3, 2.4, and 2.5) at all wells will be measured before any of the wells are purged or sampled.
- Place the generator or air compressor as far away downwind from the well opening as possible to prevent the potential for detection of hydrocarbons from the exhaust fumes.
- Recalibrate equipment if erratic readings are encountered during sampling (i.e., are not within the expected range as compared to the previous sampling event).

2. SAMPLING PROCEDURE

Activities that occur during groundwater sampling are summarized as follows:

- pre-arrangement with testing laboratory for sample bottles and coolers,
- inventory and check integrity of sample bottles
- assembly and preparation of equipment and supplies,
- well head inspection
- water-level measurements
- visual inspection of water
- purging and sampling equipment to well
- on-site measurement of parameters
- groundwater sampling,
- secure and package samples
- sample labeling
- completion of sample records
- completion of Chain-of-Custody records, and
- sample shipment

Detailed sampling and analysis procedures are presented in the following sections.

2.1 ARRANGEMENTS WITH ANALYTICAL LABORATORY

Prior to sampling, arrangements are made with an analytical laboratory that conducts the sample analyses. The requirements for the laboratory are included in the analytical procedures and Quality Control (QC) procedures included in this document.

The laboratory provides a sufficient number of sample containers for the wells to be sampled and the blanks to be included. The laboratory selects the proper type and size for the containers, based upon the analyses to be conducted. For samples requiring chemical preservation, preservatives are added to containers. Shipping containers, ice chests with adequate container padding are sent to the facility with the containers.

2.2 OBSERVATION OF WELL CONDITION

During groundwater sampling events, the integrity and operation of monitoring wells is checked if possible. The items to be observed include:

- weather conditions for each sampling date
- ground-surface conditions, with typical notations to include, but not limited to flooding, ground subsidence, and presence of desiccation cracks, and
- the surface casing and/or locking mechanism inspection for deterioration of casing or tampering, and
- the locking mechanism, if present, will be lubricated periodically with a graphite lubricant.

These comments are recorded in the Field Log Book.

2.3 PREPARATION FOR SAMPLING FOR MONITORING WELLS

Prior to the sampling episode, equipment is assembled, checked-out, and calibrated in accordance with the procedures included in this document. Equipment (e.g. water level indicator and non-dedicated pumps and sampling equipment) is cleaned prior to and after obtaining a sample in accordance with the decontamination procedures included in this document.

2.4 DECONTAMINATION PROCEDURES

Water used for equipment cleaning will be the distilled or de-ionized water from the site laboratory and non-potable water obtained from the site well. As practical, equipment cleaning fluids will be collected, stored, and disposed of in a manner consistent with local, state, or federal rules or regulations.

Portions of sampling and test equipment that contact the sample will be thoroughly cleaned before use for sampling. Equipment must be cleaned before and after a sample is taken. This includes water-level tapes or probes, non-dedicated pumps, tubing, and test equipment for field parameters. The procedure for cleaning pH, specific conductance, temperature, and turbidity field measurement equipment is a thorough de-ionized or distilled water rinse between wells. The procedures for equipment cleaning are as follows, unless otherwise specified by the manufacturer:

- rinse with distilled or de-ionized water,
- air dry, and
- use equipment immediately, or pack equipment in plastic wrap or bags, or in aluminum foil.

Any necessary deviation from these procedures will be documented in the Field Log Book.

2.5 SAMPLING PROCEDURES

Special care is exercised to prevent water-quality changes to the groundwater and extracted samples during the sampling activities. The three primary ways in which such impacts can occur are:

- contamination of a sample through contact with improperly cleaned equipment; or
- cross-contamination of the groundwater through insufficient cleaning of equipment between wells, and
- impacts of purge and sampling procedures as observed through changes in turbidity.

Sampling equipment is cleaned before and after field use and between uses at different sampling locations according to the decontamination procedures in this document. In addition to the use of properly cleaned equipment, three further precautions are followed:

- a clean pair of new, disposable latex (or similar) gloves will be worn each time a different well is sampled, and
- sample collection activities will progress from the up-gradient to the down-gradient area. Wells described as "background" or "up-gradient" wells will be sampled first unless dedicated purging and sampling equipment is used.
- A minimum of one gallone of well water is discharged through the sample hose prior to filling samples bottles.

The following paragraphs present procedures for the several activities that comprise groundwater sample acquisition. These activities are performed in the order presented. Exceptions to this procedure are noted in the permanent sampling record.

2.5.1 Preparation of Location

Prior to starting the sampling procedure, the area around the well will be cleared of foreign materials such as brush, debris, etc to reduce the possibility of surface materials contaminating the sampling equipment or the well.

2.5.2 Water-Level Measurement

The first sampling operation is water-level measurement. An electrical probe is used to measure the depth to groundwater below the datum to the nearest 0.03 foot (0.01 meters). The datum, is the top of the sounding tubes in most wells or the top of the pump support plate in wells with out sounding tubes. The measurement and datum used should be entered in the Field Log Book.

Water levels will be measured in all monitoring wells prior to any quarterly purging and sampling event. The water level-probe will be cleaned in accordance with the decontamination procedures described in this document with distilled or de-ionized water rinse between usage at different wells. For wells with extended sampling frequency (e.g., the 600-series wells), the water level measurements will be recorded prior to the sampling event, or during the total well depth measurement once every two years, if no other sampling is scheduled for the year.

2.5.3 Total Depth Measurement

USEN will measure the total depth of the monitoring wells once every two years. The water level will be measured as described above prior to the total depth measurement. Once the water level has been measured and recorded, the water-level probe or a weighted tape will be lowered slowly to the bottom of the well. The depth to the bottom will be measured and recorded in the Field Log Book to the nearest 0.1 foot. The probe or tape then will be withdrawn slowly from the well. The bottom of the probe or tape will be observed after withdrawal for evidence of any immiscible materials. Observations, and measurements if possible, of such materials will be made from observation of the probe or tape.

2.5.4 Immiscible Layer Observations and Measurements

Immiscible layers are reflective of gross contamination in the groundwater. Groundwater containing low concentrations of organic contamination would not be expected to exhibit immiscble layers. Personnel at USEN will monitor groundwater sampling results and conduct an immiscible layer check on any well having concentrations of organic contaminants greater than 1% of the constituents solubility in water if the organic contaminants presence are verified in the groundwater. Example threshold concentration limits for some common waste constituents are attached in Table 1.

Table 1 - Solubility Based Indicator of Possible LNAPL / DNAPL

Constituent	Solubility Limit (mg/L)	NAPL Threshold Limit (mg/L)
Carbon Tetrachloride	800	8
Chloroform	9300	8.22
Tetrachloroethene	150	1.5
Toluene	510	5.15
100	1	

Notes: Threshold limit based on 1% of solubility limit from "Estimating Potential for Occurrence of DNAPL at Superfund Sites."

In the event that an organic contaminant exceeds the limits in Table 1, the following procedure for checking for immiscible layers will be followed.

Prior to the next well sampling event a check for the presence of immiscible layers should be performed before well purging using an electronic interface meter. The meter shall be calibrated in the laboratory prior to the sampling event following manufacturer's instructions. The measuring device must be properly decontaminated in accordance with the procedures included in this document with a nonphosphate detergent followed by tap water and deionized water rinses.

The interface meter must be lowered slowly into the well and the meter response monitored continuously (as detailed in the device's instruction manual). The probe shall respond with different warnings if immiscible layers are detected. The probe must be slowly raised and lowered to determine if the appropriate response is occurring at both the surface of the groundwater and at the bottom of the well. The results of the measurement of the top of the phase and the bottom of the phase for either LNAPL (Light Non-Aqueous Phase Liquid) or DNAPL (Dense Non-Aqueous Phase Liquid) must be recorded in the Field Log Book. If non-aqueous phase liquids are detected, the Facility Manager or designee must be contacted immediately. The Facility Manager or designee shall contact NDEP within seven days of confirmation of immiscible layers. If immiscible liquids are detected, obtain a sample using a bailer. If the immiscible layer is a LNAPL, slowly lower the bailer until contact is made with the surface of the LNAPL. The bailer should then be lowered to allow a sample of the LNAPL to be collected, but not to submerge the top of the bailer. The sample should be placed in a 40 ml VOA vial (see Appendix 1 for a description of sampling containers). A double check valve bailer may be necessary to sample a DNAPL. To collect a DNAPL sample, the bailer should be slowly lowered to the bottom of the well, and the fluid sample collected. Care must be taken to prevent loss of the fluid during recovery. The bailer should be recovered through the water column in a smooth, continuous fashion to prevent the check valves from releasing the liquid.

2.5.5 Visual Inspection of Well Water

At the start of well purging, a small quantity of water is collected in a clean container for visual inspection. The water is inspected for clarity and odor. These observations regarding clarity or are recorded in the Field Log Book.

2.5.6 Well Bore Purging

Water contained within, and adjacent to, the well casing potentially can reflect chemical interaction with the atmosphere (by diffusion of gases down the casing) or the well construction materials (through prolonged residence adjacent to the casing). This water is removed (purged) from the well prior to sampling.

The volume of water contained within the well bore at the time of sampling is calculated, and three times the calculated volume is removed from the well. Decontaminated bailers, decontaminated pumps, or dedicated pumps are used for well bore purging.

Calculation of the volume of water to be evacuated is done as follows:

Volume of water in well:

$$V_w = \frac{3.142\,(d_w^2)\,(L_w)\,(7.48)}{4}$$

3 casing volumes

for 6" diameter wells = 4.4 x L_w

for 4" diameter wells = 2.0 x L_w

where:

V_W = water volume in well (gallons)

d_W = inside diameter of well (ft)

L_W = length of water column in well (ft).

The calculated water volume is recorded in the Field Log Book.

Purge rates for wells have been calculated and are located in the Field Log Book. Purge wells at rates of 1.0 to 1.3 gallons per minute and record the rate in the Field Log Book for each sampling event. The directions in the pump operating manual must be followed in purging the calculated volume of water. Record any problems with the pump or equipment in the Field Log Book.

Initially and approximately every 5 to 10 gallons (use larger intervals on high volume wells),obtain field readings for temperature, specific conductance, pH, and turbidity. A minimum of three readings will be obtained. Purging shall cease when the following equilibration/stabilization has occurred between successive readings:

- a minimum of 3 casing volumes
- pH plus, or minus, 0.1
- turbidity < 2.0 NTU plus, or minus, 10%
- conductivity, plus, or minus, 3%

For wells that have dedicated pumps, if, after three well volumes, the above parameters do not achieve the above equilibration, continue purging, taking readings every three minutes. For wells that are bailed, if, after three well volumes, the above parameters do not achieve the above equilibration, continue purging taking a sample from each new bail volume. If stabilization does not occur after a maximum of five well volumes is removed, purging will cease and the well will be sampled. Record all measurements in the Field Log Book including the notation that stabilization was not achieved. A maximum of five volumes is allowed for purging. Any additional purging will result in overdevelopment of the well.

For wells that can be evacuated to a dry state, the well is evacuated completely, and the sample taken as soon as sufficient water for sampling is present in the well within 24 hours. Wells incapable of yielding the calculated purge volume will be pumped to dryness, and so noted in the Field Log Book. Field samples are to be taken at each well volume obtained prior to the well going dry and one set must also be obtained after the well sample has been obtained. Field samples should be recorded in the Field Log Book. Sample compositing, or sampling over a lengthy period by accumulating small volumes of water at different times to eventually obtain a sample of sufficient volume, is not allowed.

Purge water from wells will be collected and placed in the wash pad.

2.5.7 Sample Collection

Dedicated pumps and one non-dedicated pumps are used to collect water samples from the wells. Wells shall be sampled as soon as practical after purging. For low-yield wells (i.e., wells pumped to dryness), samples should be taken as soon as sufficient volume is available, if feasible. Purging and sampling of low-yield wells must be completed within a 24-hour period.

A down-hole, positive displacement pump is used in the wells where a dedicated pump is used for sampling. A non-dedicated pump is used for purging and sampling wells without dedicated pumps. In both situations the pump intake is positioned in the lower portion of the screened interval.

The procedures in the pump operating manual must be followed to avoid damage to the pump, however, the pump must be operated in a manner that does not compromise the samples (the pump fluctuation should be kept to a minimum). Handling of pump level controls and other fittings shall be minimized. Clean sampling gloves will be required before handling the lids of sampling containers if prolonged handling of controls, which require lubrication, is performed. All air hose quick-connections must be checked for a secure fit, and hoses must not be disconnected while still under pressure.

Appendix 1 describes the sample container and preservatives required for the parameters to be analyzed. Once sample containers have been filled they should be refridgerated as soon as possible. For shipment the samples shall be placed in a cooler with sufficient ice to ensure that the sample is kept chilled. Sample containers should not be allowed to remain in direct sunlight once they have been filled.

Prior to use, sampling containers received from the laboratory should be stored in a clean environment. Sampling containers should come from the laboratory that will be performing the analysis. Avoid using containers that have been cleaned on-site whenever possible (with the exception of field analysis containers).

The samples should be transferred directly from the pump discharge tube into the sample container, minimizing contact with the outside air. It is not an acceptable practice to pour samples into a wide-mouth container and then transfer to another sample container.

Samples shall not be obtained at a rate that exceeds the purge rate. When sampling for volatile organic compounds (VOCs), the pump should be reduced to the minimum sustainable rate.

Use caution when filling sampling containers that contain preservative to prevent sampler contact with the preservative and to possible loss of preservative. When sampling for VOCs, each vial should be filled until there is a meniscus over the lip of the vial. After tightening the lid, the vial should be inverted and tapped to check for air bubbles. If any bubbles larger that 1 mm (based on visual estimation) are present, the vial must be refilled or sample added to minimize bubbles.

The samples collected by bailer should be collected in the order of volatilization sensitivity, as follows:

- Volatile Organic Compounds (Method 8240/8260)
- Semi-volatile Compounds (Method 8270)
- Organochlorine Pesticides and PCBs (Method 8082)
- Chlorinated Herbicides (Method 8150)
- Metals and Total Cyanide
- Major water quality cations and anions
- Radionuclides

Sample order is not significant when sampling by dedicated pumps. Each container must be capped securely and labeled. Labels should be legible and sufficiently durable even when wet. The label should be affixed to the sample container prior sampling, or use containers pre-labeled by the independent laboratory conducting the analysis. The following information must be recorded on the label:

- Sample identification number
- Date and time of sample collection
- Parameter(s) or analytical method(s) requested (if space permits)
- Preservatives used
- Place of Collection
- Name or initials of sampler

2.6 SAMPLE HANDLING

Samples are prepared, labeled, stored, and shipped in accordance with the procedures included in this document. Samples also are subject to the custody procedures included in this document.

The shipping container is sealed, so that it will be obvious if the seal has been tampered with or broken. The Chain-of-Custody documentation is placed on the inside of the container, so that it will be immediately apparent to the laboratory personnel receiving the container, but will not be damaged or lost during shipping.

Following sampling, the well cap will be locked and security sealed to assure its integrity for the next sampling. Record the new security seal in the Field Log Book. The Field Book Log will be reviewed for completeness before the sampler moves to another sample point.

All samples will be placed in shipping containers and transported to the dedicated sample refridgerator as soon as possible after sampling. In the event the sample refridgerator is inoperable or unavailable Ice packs or blue ice shall be used to ensure that samples are kept chilled until shipped to the laboratory.

Samples should be packed with sufficient packing material to minimize the potential for breakage during transport to the laboratory. Polyethylene overpack bags shall be used to contain the ice needed to keep the samples at 4 degrees C. As the samples are packed, all the required information shall be listed on the chain of custody form (Appendix 2). When all the samples have been packed, the shipping container will be sealed (See Section 3.2). The chain of custody shall be sealed in a zip lock plastic bag and placed inside the shipping container.

The samples will be analyzed per permit conditions.

Unless other instructions are given by the analytical laboratory, the sample containers will be completely filled. No air bubbles or headspace is allowed in samples collected for analysis for volatile organic compounds.

3. DOCUMENTATION OF FIELD ACTIVITIES

Identification and recordkeeping are as important as sound sampling techniques. This section addresses the documentation procedures required for field activities and transportation of the sample from the facility to the laboratory.

All information pertinent to field sampling must be documented, regardless of the type of sample. The Field Log Book should be a bound book, preferably with consecutively numbered pages. The following information must be documented and maintained in operational records.

- Sample location.
- Date.
- Depth to bottom of well (from surveyed measuring point), technique, and field meter used.
- Depth to water prior to purging (from surveyed measuring point), technique, and field meter used.
- Documentation of immiscible layer check, detection method, sample collected (if any), and field meter used.
- Time of purge, calculations for purge volume and actual volume purged, well yield, purged to dryness, any field changes in procedure made or deviations from the Sampling and Analysis Plan regarding purging, and purge pumping rate.
- Field measurements (pH, temperature, turbidity and specific conductance), method and field meter used.
- Purpose of sampling (i.e., RCRA, TSCA compliance).
- Field observations, includes general weather observations (air, temperature, wind direction, and strength), activity in sampling area, odor from the well, color and any other pertinent observations.
- Name of sample collector(s).
- Documentation of calibration of pH, and conductance meters, turbidity meter, well depth indicator (if separate from water level indicator), and immiscible layer meter used.

- The type of pump used for sampling will be entered in the log book at the beginning of the sampling event. If a sample is taken by equipment different from this pump, it shall be documented in the entry for that well.

Since sampling situations vary widely, no general rules are provided for the amount of information required. The best guideline is to record sufficient information so that anyone can reconstruct the sampling effort without reliance on the collector's memory. The Field Log Book(s) are filed chronologically when complete.

3.1 CHAIN OF CUSTODY RECORD

The Chain of Custody (COC) Record is the most important document in the entire process. When properly completed and signed, it is considered to be a suitable legal document in testimony regarding the validity of the sample. Each person who has the custody of the sample from the time it is collected until all analyses have been conducted should sign and date this document. Each signature acknowledges that the sample was secure from any outside forces (tampering) during the custody period. An example of a chain of custody form is included in Appendix B.

The COC Record also serves as official communication to the laboratory of the specific analyses required of each sample. After completing and signing the COC Record, the sample collector should file one copy and seal the original in the sample shipping container. When the samples are received at the laboratory, the individual taking possession of the samples should sign and date the COC form. The original COC Record will be returned to the facility with the analytical results.

3.1.1 Security Seals

Personnel from the delivery services employed to transport the samples to the laboratory are exempted from the Chain of Custody signatory requirements. As a protective measure, a security seal is affixed to the shipping container in such a way that the seal shall not come off and must be broken in order to access the container. The security seal is signed and dated by the sampling personnel. The integrity of the seal will be checked by the receiving laboratory's personnel before signing the Record. If the seal has been broken, the laboratory will inform the Environmental Manager or the Facility Manager.

3.2 SHIPMENTS

Groundwater monitoring samples should be forwarded to the analytical laboratory within 24 hours of sampling. If the sample cannot be shipped within 24 hours of sampling, or is to be held over night at the facility, it will be stored in the ground water laboratory refrigerator, along with the trip and field blanks, at about 4 degrees C until shipment.

Groundwater samples are shipped in containers maintaining temperatures at approximately 4^0C.

4. QUALITY ASSURANCE/QUALITY CONTROL

One equipment blank sample (distilled water) will be prepared for each sampling event. This sample will be obtained by collecting rinsate from the non-dedicated sampling equipment.

4.1 TRIP BLANKS

The independent laboratory shall provide trip blanks filled with deionized water. The blanks shall be transported to the sampling location and returned to the laboratory in a manner identical to the handling procedures used for the samples. The blank is not opened in the field. One trip blank shall be submitted to the laboratory each day that samples are taken, and analyzed at a minimum frequency of one per quarter. The trip blank shall be analyzed for volatile organics. The concentration levels of any contaminants found in the trip blank may not be used to correct the groundwater data. Comparison of trip blank contaminant levels to groundwater samples can form the basis for reassessing laboratory performance, discounting unreliable sample data, or deciding on well resampling requirements.

4.2 EQUIPMENT BLANKS

To ensure that any non-dedicated sampling devices have been properly cleaned between uses, the decontaminated device should be filled and or rinsed with deionized water and this water transferred to sample containers. The containers will be returned to the laboratory for the same analysis as the groundwater samples. If contaminants are found in the blanks, the source of contamination should be identified, and corrective action should be initiated, if appropriate. Equipment blanks will be submitted for analysis at the frequency of one per twenty samples for each type of non-dedicated sampling equipment and at a minimum frequency of once per quarter. Unless the equipment blank contains rinsate from all the above listed equipment, identification of which equipment rinsates were used should be included in the Field Log Book.

4.3 FIELD BLANKS

Field blanks are collected by pouring deionized water into labeled clean containers in the field. The blank is sent to the laboratory with the groundwater samples for analysis. Field blank samples are collected immediately after the well sample and at the well head with all equipment (air compressor and sample pump) operating. The intent is to fill the sample containers in the same manner and under the same environmental conditions as the ground water sample was collected. Field blanks shall be submitted at the minimum frequency of one per sampling event, not to exceed 20 wells. Field blanks will be analyzed for the most complete set of parameters for monitoring well samples collected.

4.4 LABORATORY QA/QC

USEN will only use a laboratory which exercises a proper QA/QC and data, management program, consistent or superior to SW-846 procedures. Upon receipt, the laboratory shall record the presence of headspace in VOA vials and the temperature of the sample.

4.5 REPORTING PROCEDURES

The Facility Manager or his desginee shall report data to NDEP on reporting sheets and/or electronically. The units of measure shall accompany each target analyte. The units of measure for a given target analyte shall be consistent throughout the report. The report shall include the value of the constituent determined by the laboratory, the date the sample was collected, the date the sample was received by the laboratory, the analytical method, and the detection limit. Data obtained from analysis of field and trip blanks shall also be submitted along with laboratory QA/QC data.

5. SAMPLING FREQUENCY

5.1.1 Detection Monitoring

The concentrations of the parameters listed in the permit will be determined for all detection monitoring wells during the active life and closure period of the facility quarterly.

The elevation of the groundwater surface and the total well depth must be determined at each monitoring well at least annually. Ground-water elevations are measured in wells prior to purging and sampling.

5.1.2 Compliance Monitoring

Compliance monitoring, if necessary, will be performed as specified in the permit. Compounds identified in Appendix IX Part 264 will be monitored at least every 2 years.

6. ANALYTICAL METHODS

Analytical methods are consistent with the intent and requirements of the latest edition of "Test Methods for Evaluating Solid Waste", U.S. EPA, SW-846. When an SW-846 method is not available or appropriate, alternative methods will be selected from sources such as "Standard Methods for the Examination of Water and Wastewater" and "Methods for Chemical Analysis of Water and Wastes", EPA 600/4-79-020 and submitted to NDEP as a permit modification.

Examples of specific methods are:

- Volatile Organic Compounds: SW-846 Method 8240/8260
- Organochloride Pesticides and PCBs: Method 8082
- Chlorinated Herbicides: Method 8150
- Semivolatile Organic Compounds: Method 8270

Examples of acceptable analytical methods are presented in Table 2.

7. MONITORING WELL AND EQUIPMENT INSPECTION

Monitoring wells and well monitoring equipment are inspected each time a sample is collected. The Facility Manager or designee will inspect for the following and record the results in the field log:

1. Inspect the protective well casings, locking cap and lock for cracks, damage, and any other signs of deterioration.
2. Inspect well pad for cracks or sign of deterioration.
3. Ensure that well identification number is legible.
4. Inspect pumping equipment for structural integrity and proper operation.

Any deficiencies noted will be brought to the attention of the Facility Manager or designee. Corrective actions will be taken, as expeditiously as possible, and will be noted in Field Log Book.

Table 2 - Sample Preparation and Analytical Methods

Parameter	Preparation Method	Analytical Method	Detection Limit
Volatile Organics	5030	8260	5 ug/L or PQL
Semi-volatile organics	3520	8270	PQL
Arsenic	3005,3010	7060	2 ug/L
Barium	3005,3010	6010	0.05 ug/L
Cadmium	3005,3010	6010, 7131	4 ug/L, 1 ug/L
Chloride		9250, 9251, 9252, 9553, 325.2	1 mg/L
Chromium	3005,3010	6010	0.05 mg/L
Fluoride		9200, 340.2	0.1 mg/L
Lead	3005,3010	9010, 7421	0.05 mg/L
Mercury	3005,3010	7470, 7471	0.004 mg/L
Nitrate		9200, 353.2, 353.1	0.05 mg/L
Sulfate		9036, 9038	1 mg/L
Sodium	3005,3010	7770, 6010	1 mg/L
Total Dissolved Solids		EPA 160.5, 160.1	1 mg/L
Selenium	3005,3010	6010, 7740	4 mg/L
Silver	3005,3010	6010	0.005 mg/L
Endrin	3510, 3520	8081, 8270	0.05 ug/L
Lindane	3510, 3520	8081, 8270	0.02 ug/L
Methoxyclor	3510, 3520	8081, 8270	0.2 ug/L
Toxaphene	3510, 3520	8081, 8270	0.5 ug/L
2,4-D	3510, 3520	8081, 8270	2ug/L
2,4,5-TP Silvex	3510, 3520	8081, 8270	2 ug/L
Radium		9315, 9320, SM704, SM705, 903, 904, 901.1M	Variable
Tritium		906.0	Variable
PCBs	3510, 3520	8082	0.5 ug/L
Cyanide		9010, 9012	0.005 mg/L

8. LEACHATE SAMPLING PROCEDURES

Leachate generated from the landfills are typically collected in 275 gallon plastic totes and always remain in the landfill area. Prior to sampling the totes will be moved to the outer edge of the landfill as to give the sampler better access to the totes. The method for extracting the leachate out of the totes is at the discretion of the sampler but several methods have been used in the past and are considered acceptable:

1. Use of a bottom feeding bailer with closure device
2. Disposable coliwasa
3. Dispenser valve at the bottom of the tote

Whatever method the sampler chooses to use to extract the leachate from the totes the removed leachate will be placed into a clean DI jug or container and then transferred into all the sampling containers. Once the leachate samples have been collected they will be managed in a similar fashion as the other groundwater samples as described in Sections 2.6 to 3.2, 4.4, and 4.5 and analyzed using the methods outlined in Table 2.

Lastly, when filling out the Chain of Custody (COC) for the leachate samples it is a good idea to indicate "High Concentrations" in the comments section of the COC as to give the laboratory notice. This is not required but a courtesy to the laboratory analzing the samples.

APPENDIX A

SAMPLING AND PRESERVATION PROCEDURES

FOR DETECTION MONITORING

Appendix A

SAMPLING AND PRESERVATION PROCEDURES

FOR DETECTION MONITORING

Parameter	Container	Holding Time	Preservative
Volatiles	2 x 40 ml, glass vial with Teflon septum – no head space	14 days	HCl, pH<2; Cool 4° C
Arochlors, Semivolatiles, Pesticides/Herbicides	1 x 1 L, glass amber with lid lined with fluorocarbon resin	7/14 days (prep) 40 days (analysis)	Cool, 4° C
Metals (except mercury)	1 x 500 ml, plastic polyethylene bottle with polypropylene cap	6 months	HNO_3, Ph < 2
Cyanide	1 x 1 L, plastic polyethylene bottle with polypropylene cap	14 days	NaOH, pH >12
Radiochemistry	2 x 1 L, plastic polyethylene bottle with polypropylene cap	6 months	HNO_3, pH < 2
Nitrate and Sodium	1 x 1 L, glass amber bottle with a Teflon lined lid	28 days	H_2SO_4, pH < 2
Chloride, Fluoride, Sulfate	1 x 1 L, plastic polyethylene bottle with polypropylene cap	28 days	None
Total Dissolved Solids	1 x 1 L, plastic polyethylene bottle with polypropylene cap	7 days	None
Mercury	1 x 500 ml, plastic polyethylene bottle with polypropylene cap	28 days	HNO_3, pH < 2

Appendix 2

Sample Chain of Custody

CHAIN-OF-CUSTODY

WWW.ANALYSYSINC.COM

AnalySys Inc.
3512 Montopolis Drive, Austin, TX 78744
Phone: (512) 385-5886 Fax: (512) 385-7411

2209 N.P.I.D., Ste K, Corpus Christi, TX 78408
Phone: (361) 289-6384 Fax: (361) 289-0875

Send Reports To:
Company Name ____________
Address ____________
City ________ State ____ Zip ______
ATTN: ____________
Phone ________ Fax ________

Bill to (if different):
Company Name ____________
Address ____________
City ________ State ____ Zip ______
ATTN: ____________
Phone ________ Fax ________

Rush Status (must be confirmed with lab mgr.): ____________
Project Name/PO#: ________ Sampler: ________

Analyses Requested (1)
Please attach explanatory information as required

Client Sample No. Description/Identification	Date Sampled	Time Sampled	No. of Containers	Soil	Water	Waste	Lab I.D. # (Lab only)									Comments

(1)Unless specifically requested otherwise on this Chain-of-custody and/or attached documentation, all analyses will be conducted using ASI's method of choice and all data will be reported to ASI's normal reporting limits (MDL/PQL). For GC/MS volatiles and extractables, unless specific analytical parameter lists are specified on this chain-of-custody or attached to this chain-of-custody, ASI will default to Priority Pollutants or ASI's HSL list at ASI's option. Specific compound lists must be supplied for all GC procedures.

Sample Relinquished By				Sample Received By			
Name	Affiliation	Date	Time	Name	Affiliation	Date	Time

[Tendering of above described samples to AnalySys, Inc. for analytical testing constitutes agreement by buyer/sampler to AnalySys, Inc.'s standard terms.]

Appendix 13 E

Statistical Analysis of Groundwater Monitoring Data

AquAeTer optimizing environmental resources | water, air, earth

7430 East Caley Avenue, Suite 310 ◦ Centennial, CO 80111 ◦ Phone (303) 771-9150 ◦ Fax (303) 771-8776

February 19, 2010 093196

US Ecology Nevada, Inc.
PO Box 578
Beatty, Nevada 89003

Attention: Mr. Scott Wisniewski

RE: Assistance with Statistical Analysis of Groundwater Monitoring Data
US Ecology Nevada, Inc., Beatty, Nevada

Dear Mr. Wisniewski:

AquAeTer, Inc. has completed the statistical analysis of groundwater monitoring data at the US Ecology Nevada, Inc. (USEN) facility located in Beatty, Nevada. The scope of monitoring data analysis is described in **AquAeTer's** proposal #093196P, as authorized by USEN on August 11, 2009.

BACKGROUND

AquAeTer assisted USEN with statistical analysis of monitoring data for background well MW-313 in 2003. At the time of that previous statistical analysis, the USEPA statistical program GRITS/STAT was used. The GRITS/STAT program, which no longer is supported by USEPA, was determined to be of limited value for long-term data management and was not used for the present data analysis. **AquAeTer** recommended and received your approval to integrate USEN's groundwater sampling database into the electronic data management and statistical analyses program DUMPStat®. **AquAeTer** has used DUMPStat® as a data management tool for other landfill facilities, where we have evaluated monitoring data by the methods offered by the program (e.g., intrawell or up-to-down-gradient) and in a manner that is compliant with regulatory requirements.

STATISTICAL ANALYSIS METHOD

DUMPStat® is a program for the statistical analysis of groundwater monitoring data using methods described in Statistical Methods for Groundwater Monitoring by Dr. Robert D. Gibbons. The program allows direct importation of laboratory analytical data in Laboratory Information Management System (LIMS) format. The program provides the capacity for complete analysis of wells and monitored constituents; allows selecting the appropriate statistical method to accomplish the desired data analyses while minimizing false positive and false negative rates. The DUMPStat® statistical procedures are consistent with USEPA Subtitle C and D regulations and guidance, and with ASTM D6312-98, "Standard Guide for Developing Appropriate Statistical Approaches for Ground-Water Detection Monitoring Programs."

DUMPStat® statistical methods include interwell (up-gradient to down-gradient) comparisons where up-gradient well data characterize the natural temporal and spatial variability that is observed in the down-gradient wells, as well as intrawell comparisons where the data history for individual wells is evaluated to identify evidence of potential impacts. The intrawell method is applicable at unimpacted wells with a sufficiently long historical database, usually at least eight measurements for each parameter. DUMPStat® uses Microsoft Access® as the database management software.

REGULATORY APPROVAL

AquAeTer notes that using DUMPStat® as the statistical analysis method for the Beatty facility will be a deviation from current RCRA Permit requirements that likely will require NDEP approval in order that the regulatory requirements are satisfied by the statistical analyses performed and the DUMPStat® reporting format.

Section 10.8.4 of the facility's RCRA Permit requires that USEN "determine whether there is a statistically significant increase over the Groundwater Protection Standards for each parameter identified in Table 4 each time groundwater quality is determined at the compliance point." Further, at 10.8.4.1, the Permit says that "a statistically significant increase is determined by comparing each groundwater monitoring result to the corresponding background limit." **AquAeTer** notes that the exceedence the Permit defines as a "statistically significant increase" actually is a non-statistical comparison of the observed groundwater quality at POC wells and the pre-determined background criterion listed in Permit Table 4. Although the background criterion might have been developed by a statistical method when the Permit was written, the Table 4 values do not consider temporal changes to background since that time and probably do not consider the spatial variability that would be represented by considering data from all up-gradient wells.

Organic constituents seldom result from natural causes, thus are appropriately considered to be potential facility-caused impacts that can be identified by comparison to criteria that are not site-specific, such as laboratory reporting limits or State or federal water quality standards (e.g., GWPS values). Many inorganic and indicator constituents potentially are naturally occurring and, as such, potential facility-caused impacts appropriately are identified using statistical methods to identify conditions that differ from natural occurrences. The DUMPStat® interwell method used by **AquAeTer** for the data comparison summarized in this letter is a statistical method that makes a site-specific data comparison for inorganic and indicator constituents. That is, the statistically determined constituent concentrations (i.e., control limits or prediction limits) derived for data from the three up-gradient wells are site-specific and event-specific values that probably will differ from the groundwater quality standards in Table 4 of the Permit.

DUMPStat® manages, reports, and displays the results of groundwater monitoring for organic constituents and will provide tabulated or graphical comparisons between observed concentrations in monitor wells and groundwater quality criteria. Though not a statistical data evaluation, the program manages these organic constituent data and identifies exceedences that can be simple detections or actual exceedences of water-quality criteria concentrations. Examples of tabular and graphical output for organics are attached.

SITE-SPECIFIC STATISTICAL DATA EVALUATION

The first task of the statistical analysis required **AquAeTer** to import USEN groundwater monitoring data from three up-gradient monitor wells and 15 down-gradient monitor wells (i.e., point of compliance, POC, wells). The data import covered all groundwater monitoring constituent data collected between 2002 and 2009, except for radiological analysis. Since monitor well MW-313 was designated the up-gradient well for previous statistical analysis, additional data for this well covering the time period from December 1988 to December 2001 also were imported. Data import also included leachate data and groundwater data for 600-series Supplemental Wells. The result of the data import process is the availability of a comprehensive electronic groundwater database for the USEN facility that covers sampling events for POC wells between 2002 and 2009, and historical groundwater data for several wells. Future groundwater analytical data can be added to the database, providing future users with access to the comprehensive data set.

In order to provide NDEP with a sample of the data evaluation generated by DUMPStat® and the proposed format of future groundwater data statistical analysis, **AquAeTer** performed the following statistical analyses.

- Up-to-down-gradient comparisons. Such comparisons were made for three up-gradient wells (MW-313, MW-318, and MW-319) and 15 down-gradient POC wells (MW-001, MW-002, MW-308, MW-309, MW-310, MW-311, MW-315A, MW-316, MW-317, MW-320, MW-322, MW-324, MW-325, MW-326, and MW-327).

- Changes in analytical methods. Considered whether inorganic and indicator constituent results done by different analytical methods can be grouped together (called 'aliasing' in DUMPStat®). Accomplished by grouping concentration data by various analytical methods as a single data set for each inorganic or indicator constituent. The initial conclusion is that inorganic and indicator data from the different analytical methods can be grouped to provide acceptable results.

- Reporting of statistical analyses. Analysis output consists of trend graphs of concentration versus time, up-gradient prediction limit, and the 2009 groundwater quality standard from USEN's RCRA Permit. In addition, summary statistics and prediction limit tables are generated. Example trend graphs for metals and indicators are attached.

AquAeTer ran statistic analyses for three groupings of inorganic and indicator constituents. The results of these DUMPStat® statistical analyses are as follow.

1. Water-quality constituents (including chloride, specific conductance, cyanide, fluoride, nitrate/nitrite-n, pH, sulfate, TOX, TOC) in groundwater.
   - When using the up-gradient groundwater data set from 2002 to 2009, DUMPStat® determined that there were only two exceedences in the down-gradient (POC) data set. These are for pH at well MW-310 and MW-315A.
   - After increasing the time period included in the up-gradient data set by adding up-gradient groundwater monitoring results from 1988 to 2009, DUMPStat® determined that there were no exceedences in down-gradient wells.
2. Metals constituents (Ag, As, Ba, Cd, Cr, Hg, Na, Pb, and Se) in groundwater.
   - Using background data from 2002 to 2009, DUMPStat® determined that there were no exceedences in the down-gradient (POC well) data set.
   - After including up-gradient data from 1988 through 2009, DUMPStat® again determined that there were no exceedences.
3. Radiological constituents (gross alpha, gross beta, radium-226, radium-228, tritium) in groundwater.
   - Using background data from 2002 to 2009, DUMPStat® found no exceedences; however, the statistical analysis of these data probably does not appropriately consider the uncertainty associated with reporting of radiological analyses.

An attached tabulation summarizes the results of up-gradient monitoring data evaluation by DUMPStat® as a comparison between the prediction limits determined by the program for up-gradient well data through 2009 with the groundwater protection standards contained in the RCRA Permit.

As discussed previously, the evaluation of the results of 2009 groundwater monitoring for organic constituents is a non-statistical comparison between the analytical results for POC wells and the groundwater protection standards listed in Table 10.5 of the RCRA Permit. For any other organic parameters for which groundwater samples are analyzed, the data evaluation process is based on laboratory reporting limits or practical quantitation limits (PQLs), where a reported concentration equal to or greater than the PQL is a "detection." Under RCRA Permit Section 10.8.4.1.1, such "detection" is subject to verification in the next scheduled sampling event. With regard to monitoring data for organic constituents, no statistical data evaluation is necessary, but DUMPStat® does manage and report the monitoring data in tabular and graphical form. Examples of both are attached.

CLOSING REMARKS

We recognize that this statistical method for groundwater data evaluation differs from that established in the current RCRA Permit, and that a permit modification probably will be required to change to using DUMPStat® or similar software for data analyses. Accordingly, the next step should include obtaining NDEP concurrence with the suggested statistical approach for analyses of groundwater monitoring data for inorganic and indicator constituents and the future use of DUMPStat® as an acceptable tool for identification of groundwater impact at the USEN Beatty facility. To begin a dialog with NDEP, **AquAeTer** suggests providing this letter or a similar summary to NDEP for review and comment.

We appreciate the opportunity to work with USEN on this project. If you should have questions or comments concerning the groundwater statistics performed or the use of DUMPStat®, please contact us by telephone at (303) 771-9150, by FAX at (303) 771-8776, or by electronic mail at cbolin@aquaeter.com.

Sincerely,
AquAeTer, Inc.

Chris A. Bolin
Project Manager

Stephen L. Wampler
Director of Engineering

Attachments: Comparison of Groundwater Criteria
Examples of DUMPStat® trend graphs for metals and indicator parameters
Examples of DUMPStat® monitoring data presentation for organics

COMPARISON OF GROUNDWATER CRITERIA

COMPARISON OF GROUNDWATER CRITERIA
USEN - BEATTY, NV

RCRA Permit Table 10.4 Constituent	Units	Permit GWQS	DUMPStat® 2009 Prediction Limit	USEPA MCL
Arsenic	ug/L	10	15.2	10
Barium	ug/L	100	240	2,000
Cadmium	ug/L	20	5.3	5
Chromium	ug/L	60	185	100
Lead	ug/L	50	29.7	15
Mercury	ug/L	2	2	2
Selenium	ug/L	40	33.9	50
Silver	ug/L	40	62.7	*100*
Cyanide	ug/L	20	10	200
Fluoride	ug/L	4,055	4,522	4,000
Sodium	ug/L	175,000	324,000	NA
Sulfate	ug/L	230,000	274,000	*250,000*
Chloride	ug/L	80,000	106,000	*250,000*
TOX	ug/L	10	7	NA
TOC	ug/L	2,100	7,460	NA
pH	s.u.	7 to 8.4	7 to 8.72	*6.5 to 8.5*
Specific Conductance	umhos	980 to 1240	1,398	NA
Nitrate-Nitrite as N	ug/L	1700	2,000	10,000

NOTES:

Groundwater Quality Standard (GQWS) from RCRA Permit, Revision 3, June 2009.

DUMPStat® Prediction Limits are based on up-gradient monitoring well data from 1988 to 2009.

MCL Italics indicates a Secondary MCL.

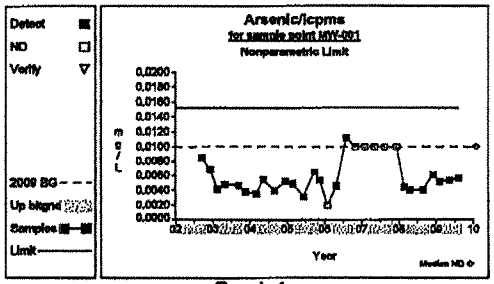
Fluoride GWQS value is 1.4 (Ln of concentration in mg/L) which converts to concentration = 4.055 mg/L = 4,055 ug/L

US Ecology Nevada, Inc.
Mr. Scott Wisniewski
February 19, 2010

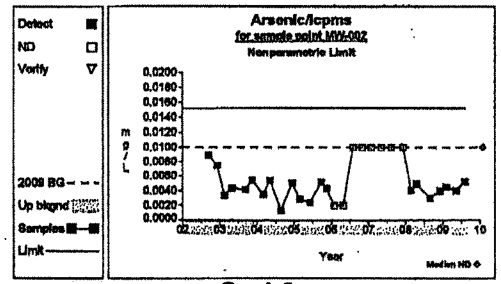
EXAMPLE OF DUMPSTAT® TREND GRAPHS
FOR METALS AND INDICATOR PARAMETERS

Beatty [mets_al] Analysis prepared on: 12/30/2009

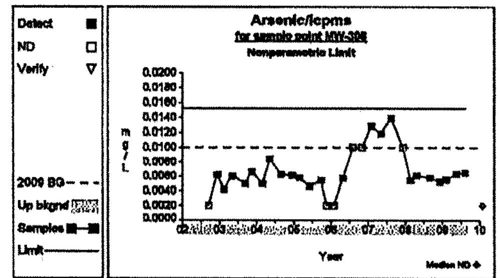
Up vs. Down Prediction Limits



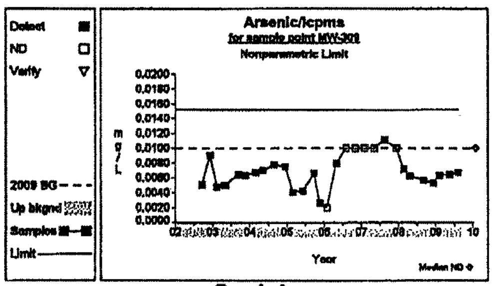
Graph 1



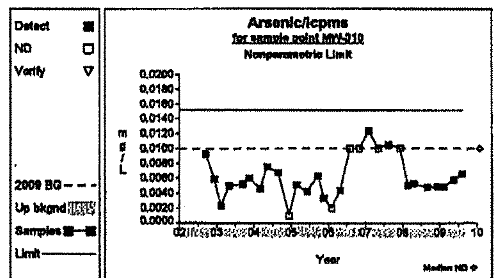
Graph 2



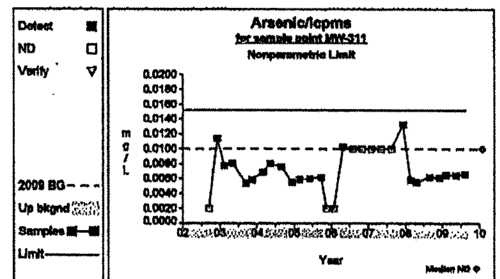
Graph 3



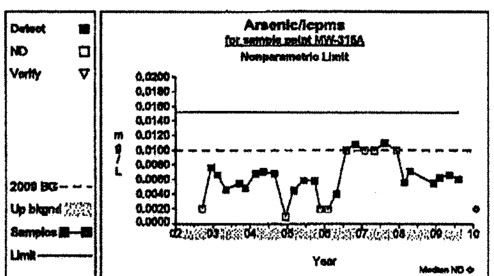
Graph 4



Graph 5



Graph 6



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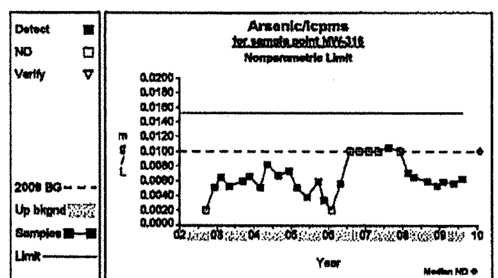
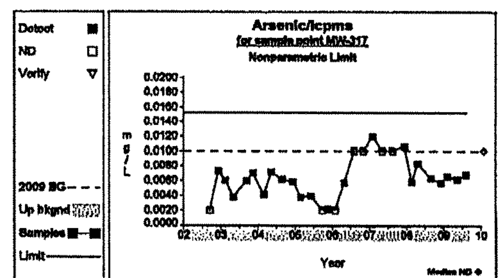


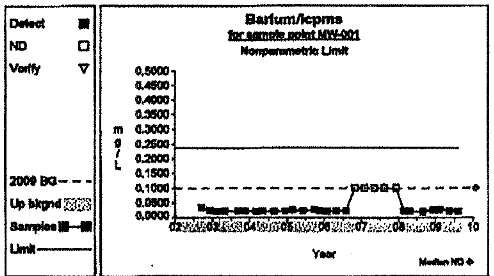
Graph 8



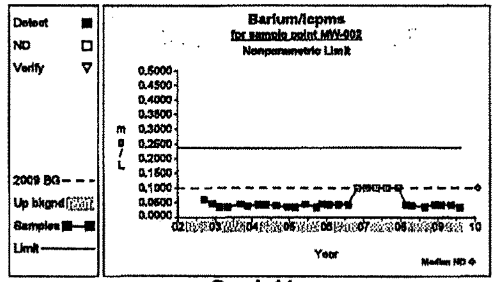
Graph 9

Prepared by: AquAeTer, Inc.

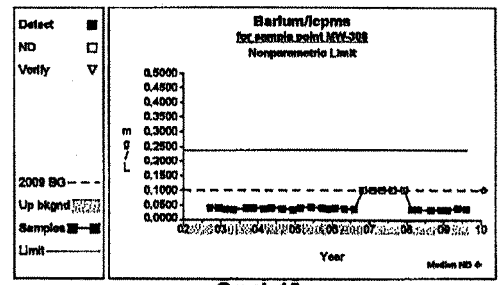
Up vs. Down Prediction Limits



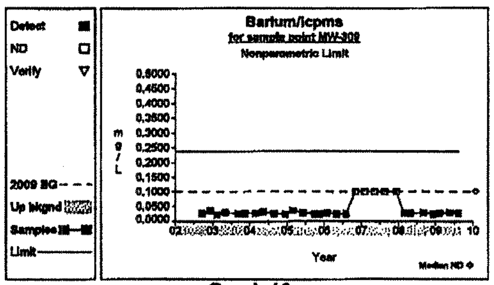
Graph 13



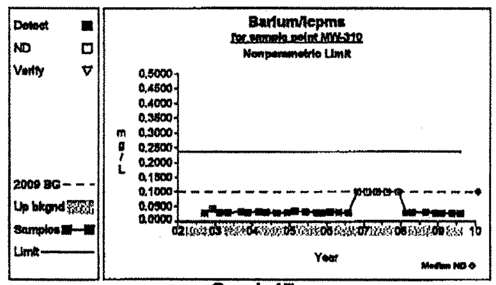
Graph 14



Graph 15



Graph 16



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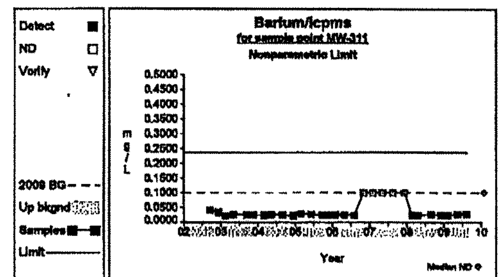
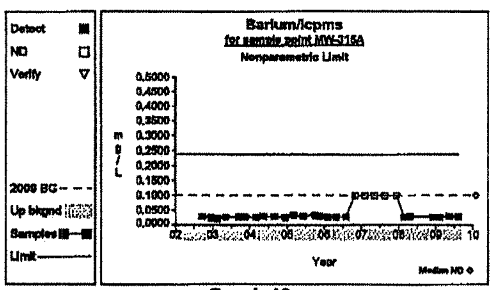
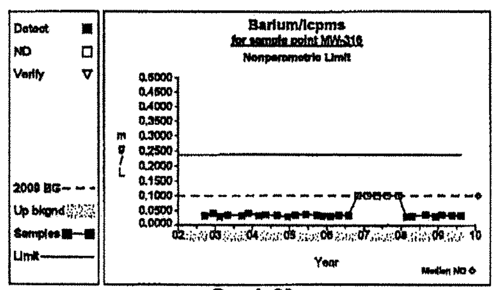


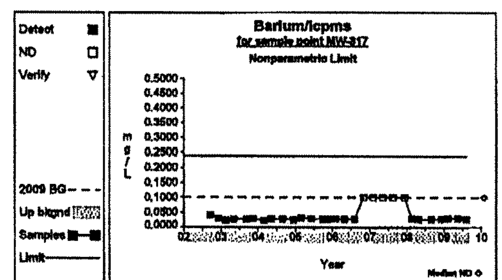
Graph 18



Graph 19

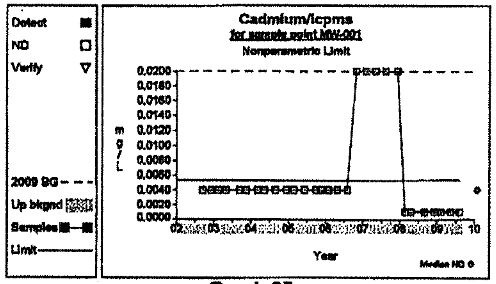


Graph 20

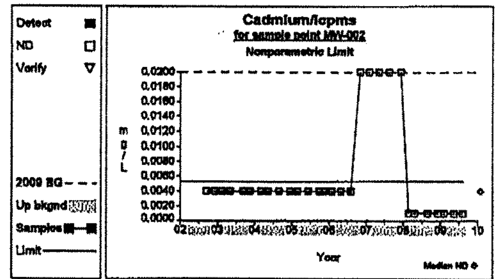


Graph 21

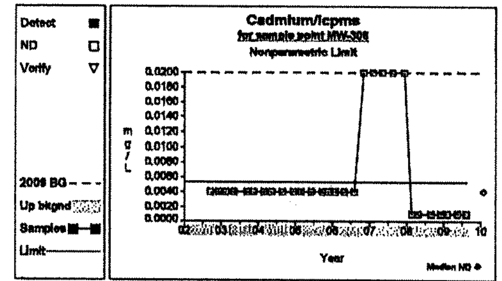
Up vs. Down Prediction Limits



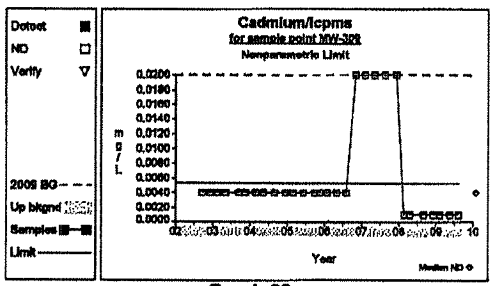
Graph 25



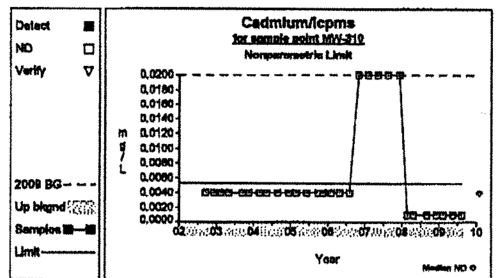
Graph 26



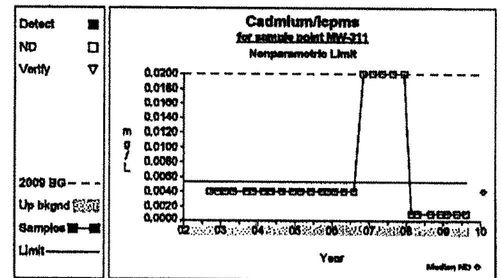
Graph 27



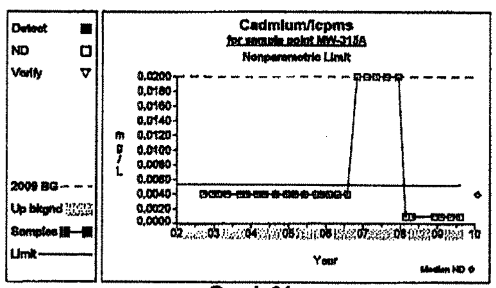
Graph 28



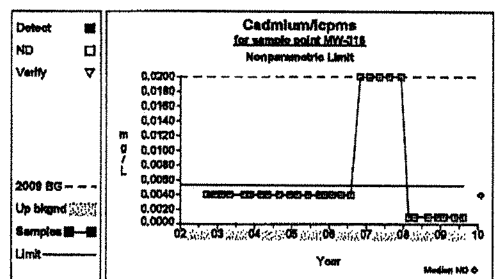
Graph 29



Graph 30



Graph 31



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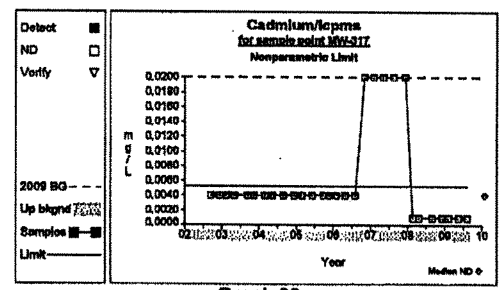
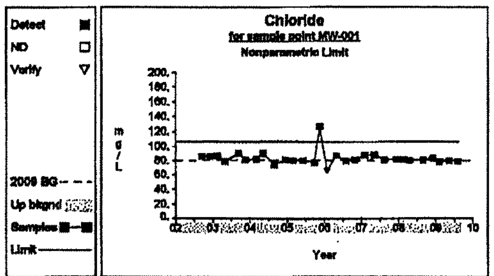
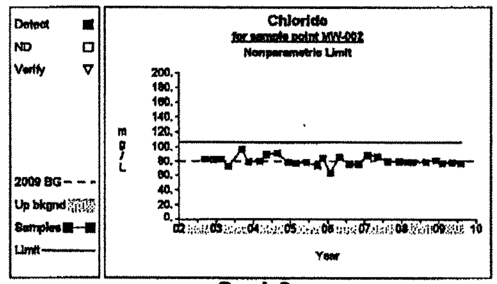


Graph 33

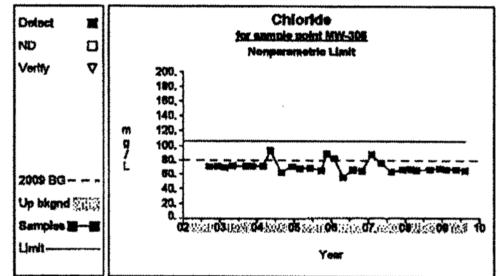
Up vs. Down Prediction Limits



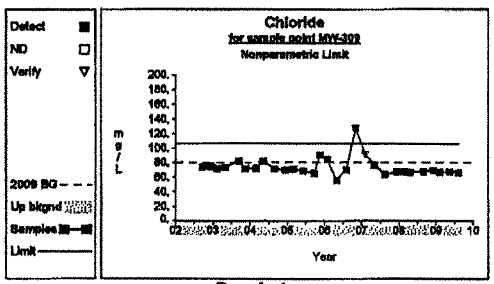
Graph 1



Graph 2



Graph 3



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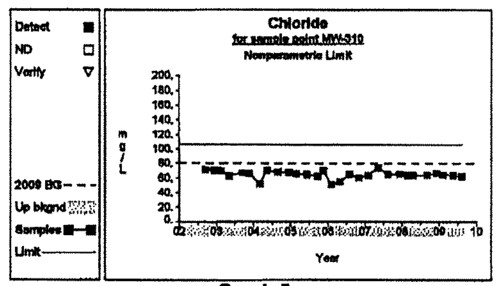

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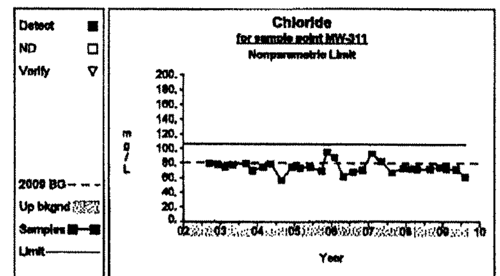

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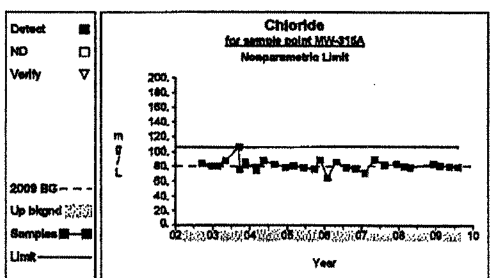

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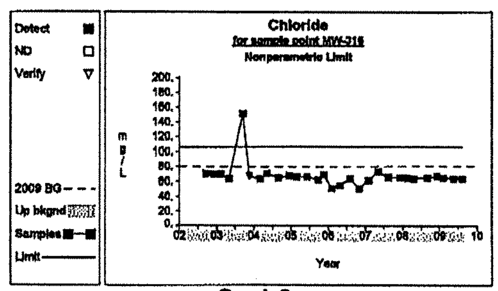

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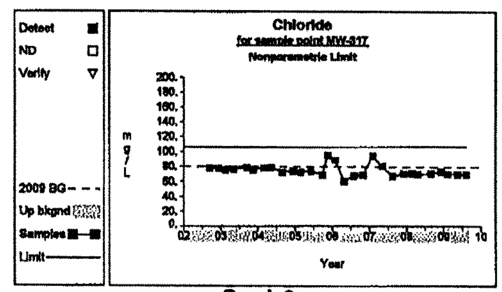

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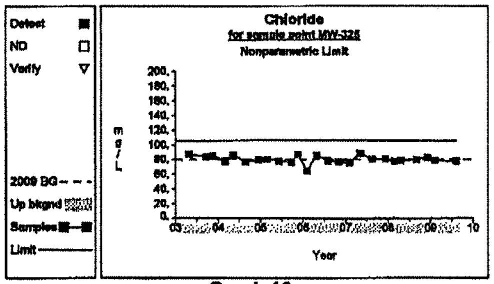
Up vs. Down Prediction Limits



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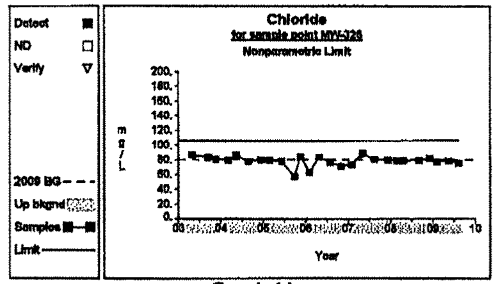

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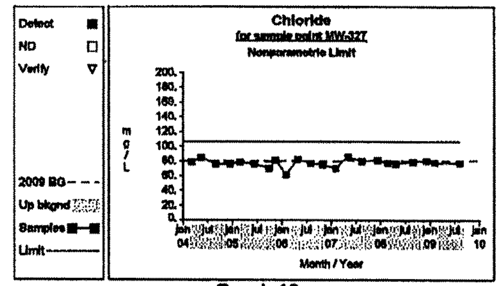

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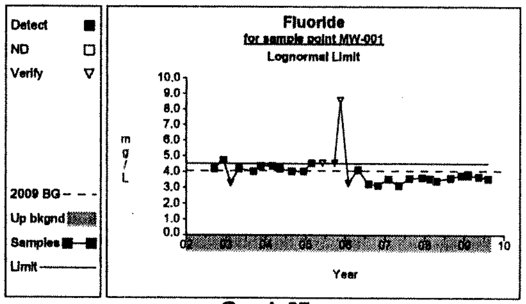
Up vs. Down Prediction Limits



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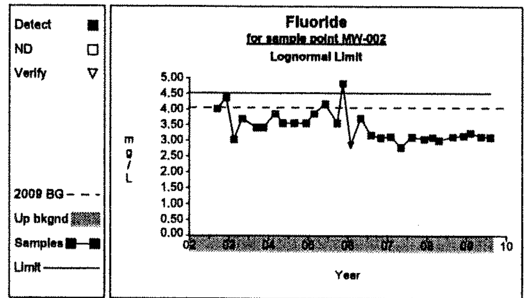

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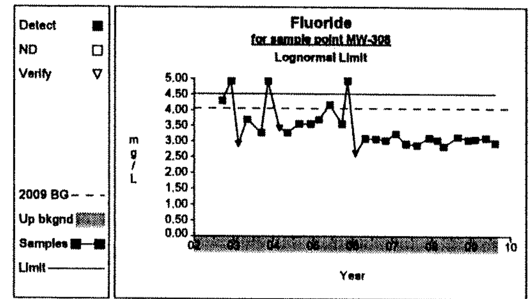

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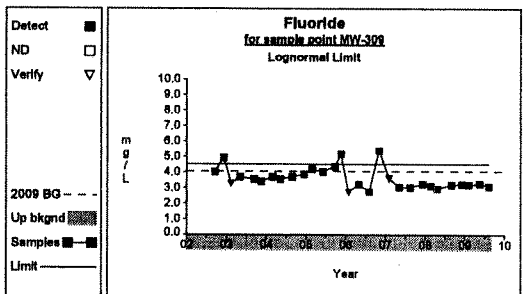

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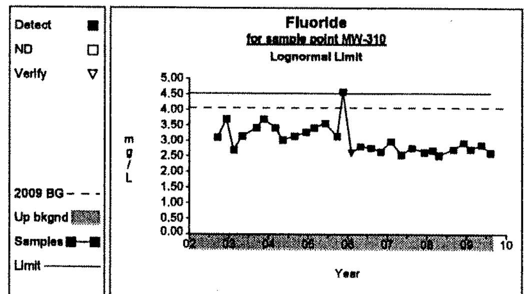

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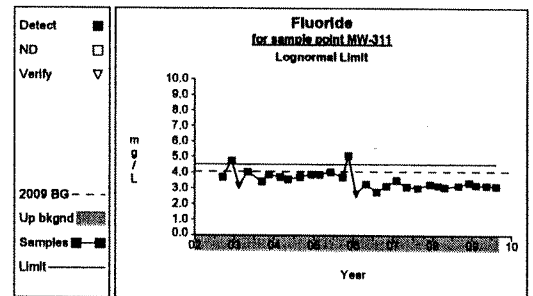

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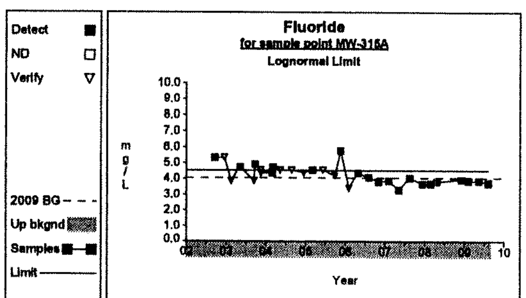

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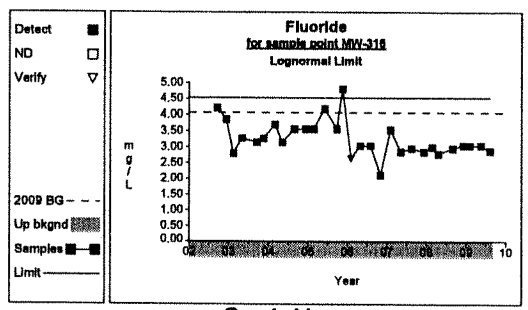

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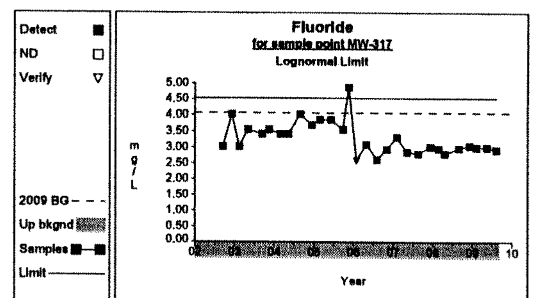

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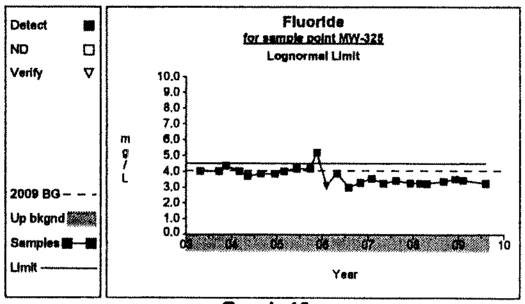

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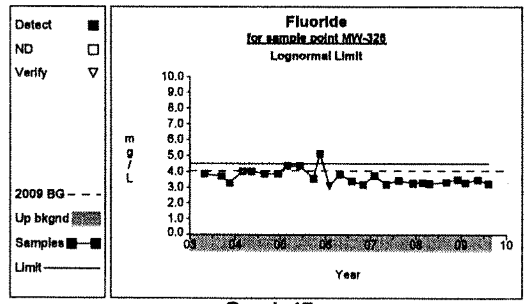

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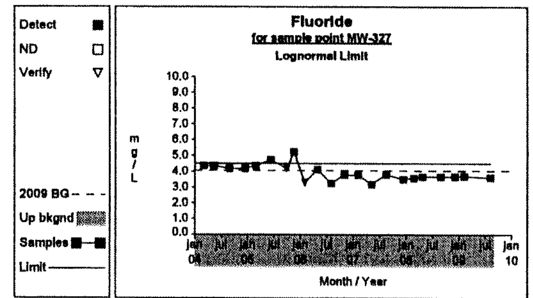

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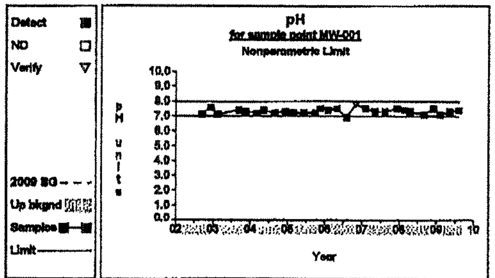

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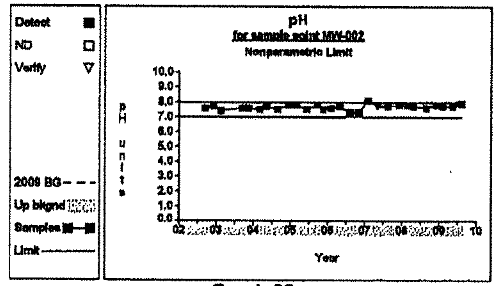

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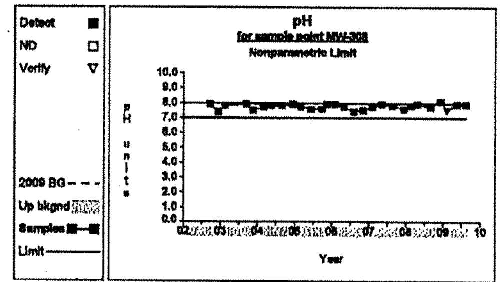

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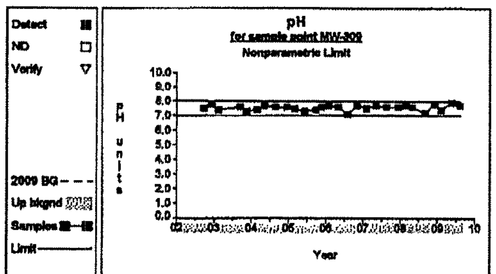

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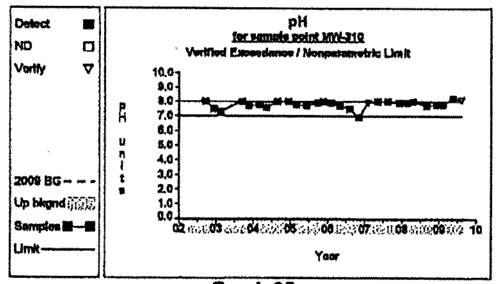

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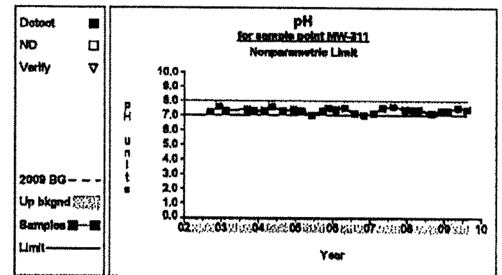

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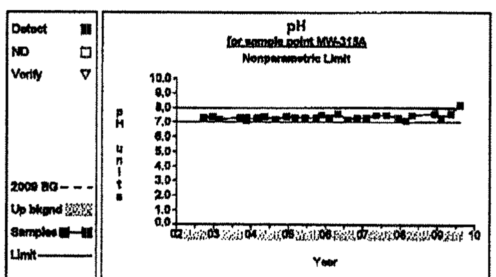

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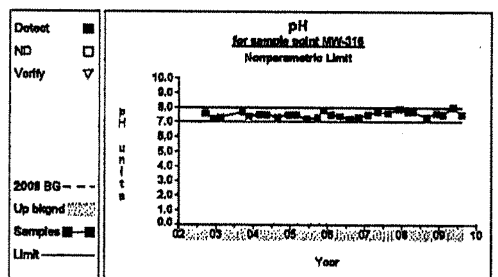

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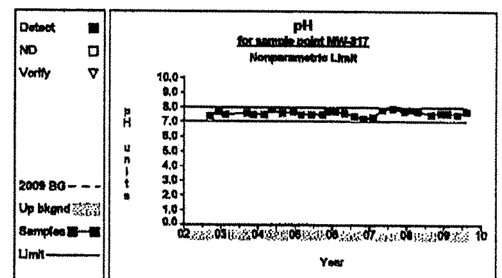

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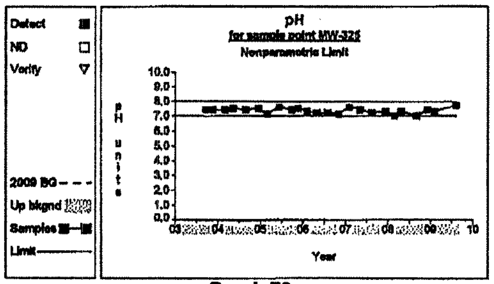

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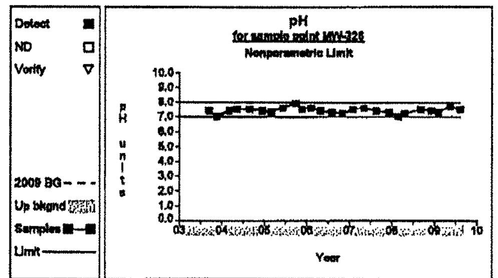

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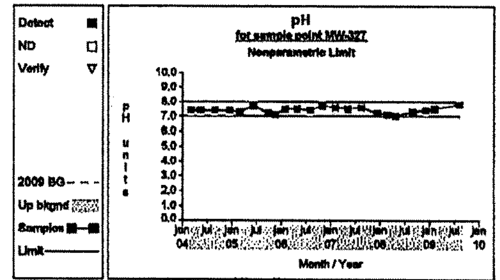

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US Ecology Nevada, Inc.
Mr. Scott Wisniewski
February 19, 2010

EXAMPLES OF DUMPSTAT® MONITORING DATA PRESENTATION FOR ORGANICS

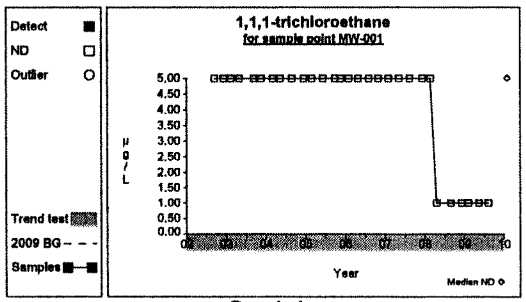
Table 1

Leachate Parameter Detections

Constituent	Units	Well	Date	Result	Limit
Acetone	μg/L	MW-310	9/02/2008	14.3000	10.0000
Tetrachloroethene	μg/L	MW-310	4/20/2008	1.9300	1.0000
Tetrachloroethene	μg/L	MW-310	9/02/2008	2.4900	1.0000
Tetrachloroethene	μg/L	MW-310	12/05/2008	1.9900	1.0000
Tetrachloroethene	μg/L	MW-310	2/07/2009	1.8700	1.0000
Tetrachloroethene	μg/L	MW-310	5/16/2009	2.3500	1.0000
Tetrachloroethene	μg/L	MW-310	8/08/2009	1.7700	1.0000
Acetone	μg/L	MW-313	8/27/2008	10.6000	10.0000
Acetone	μg/L	MW-315A	12/10/2007	889.0000	100.0000
Chloroform	μg/L	MW-315A	9/22/2003	6.4700	5.0000
Chloroform	μg/L	MW-315A	11/14/2003	78.1000	5.0000
Chloroform	μg/L	MW-315A	11/17/2003	10.7000	5.0000
Chloroform	μg/L	MW-315A	2/28/2004	8.5400	5.0000
Chloroform	μg/L	MW-315A	3/01/2005	14.0000	5.0000
Chloroform	μg/L	MW-315A	6/08/2005	7.9700	5.0000
Chloroform	μg/L	MW-315A	9/27/2005	21.1000	5.0000
Pcb, total	μg/L	MW-315A	4/28/2006	.6880	.5000
Acetone	μg/L	MW-318	4/25/2003	586.0000	500.0000
Acetone	μg/L	MW-325	4/25/2003	107.0000	100.0000
Acetone	μg/L	MW-326	4/28/2003	6540.0000	2500.0000
Lindane	μg/L	MW-326	4/19/2008	.0290	.0200
Pcb, total	μg/L	MW-326	9/03/2008	2.5500	.5000
Pcb, total	μg/L	MW-327	8/15/2007	.7430	.5000

Detections are shown for constituents selected in the VOC list and all selected wells
The Limit column refers to the laboratory reporting limit

Time Series



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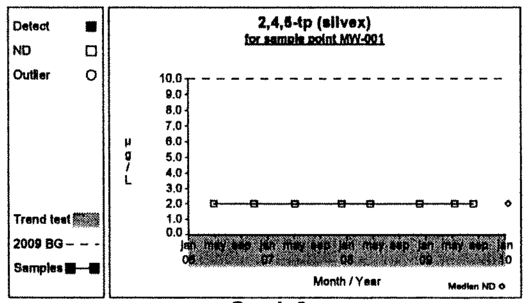

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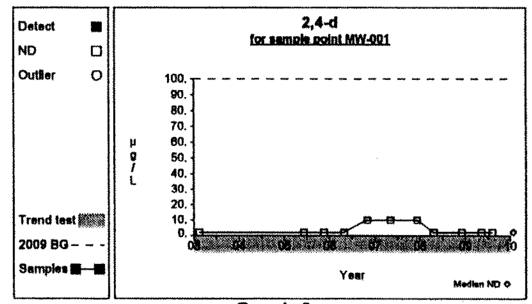

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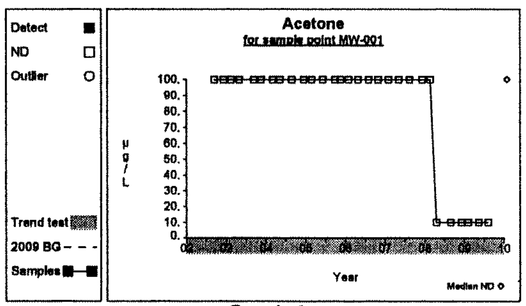

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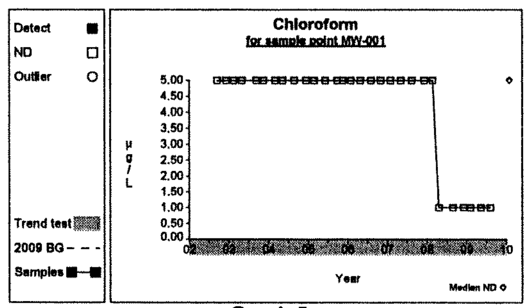

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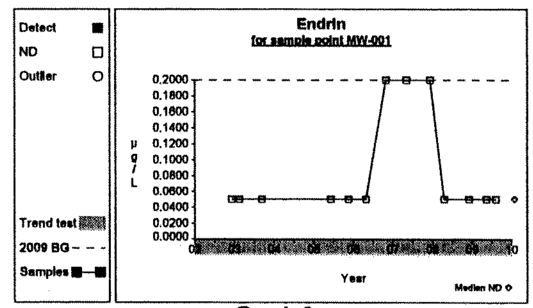

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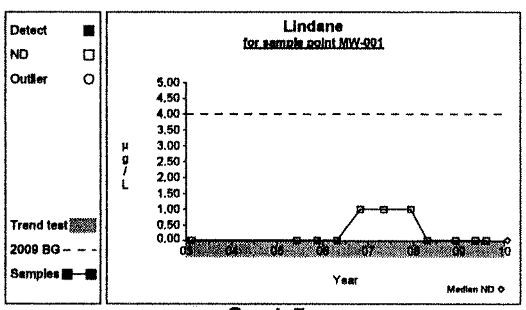

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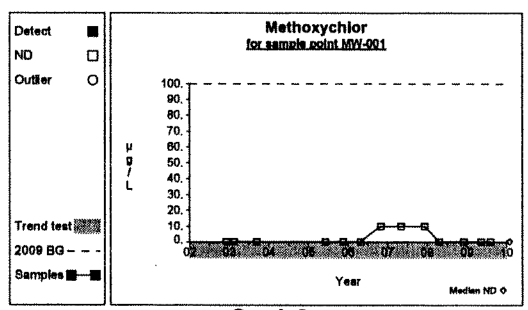

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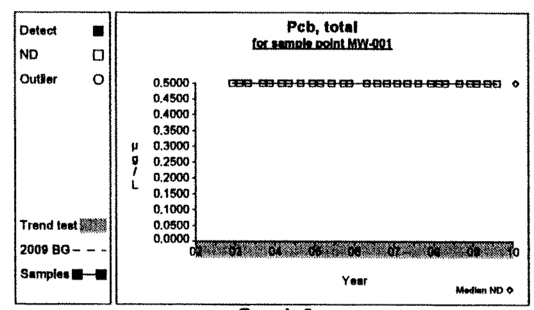

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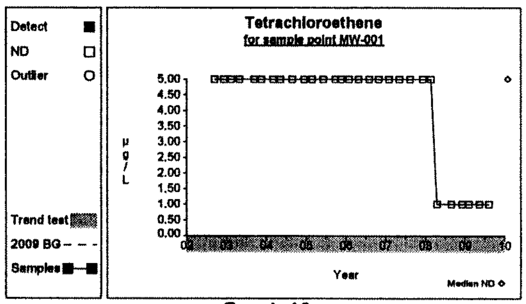

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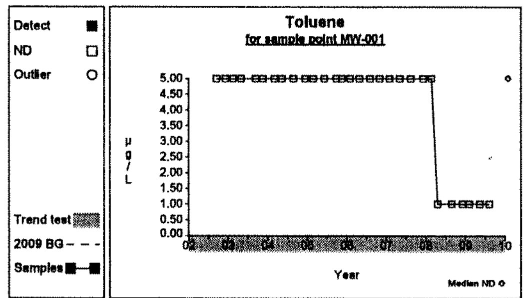

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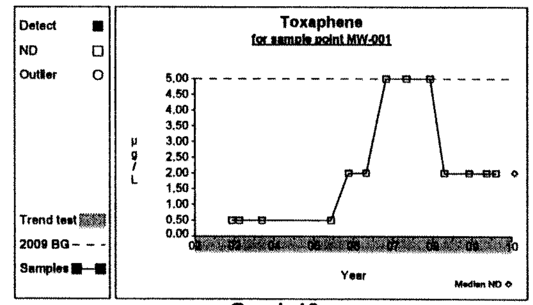


Graph 12

Appendix 13 F

Corrective Measures Study Work Plan

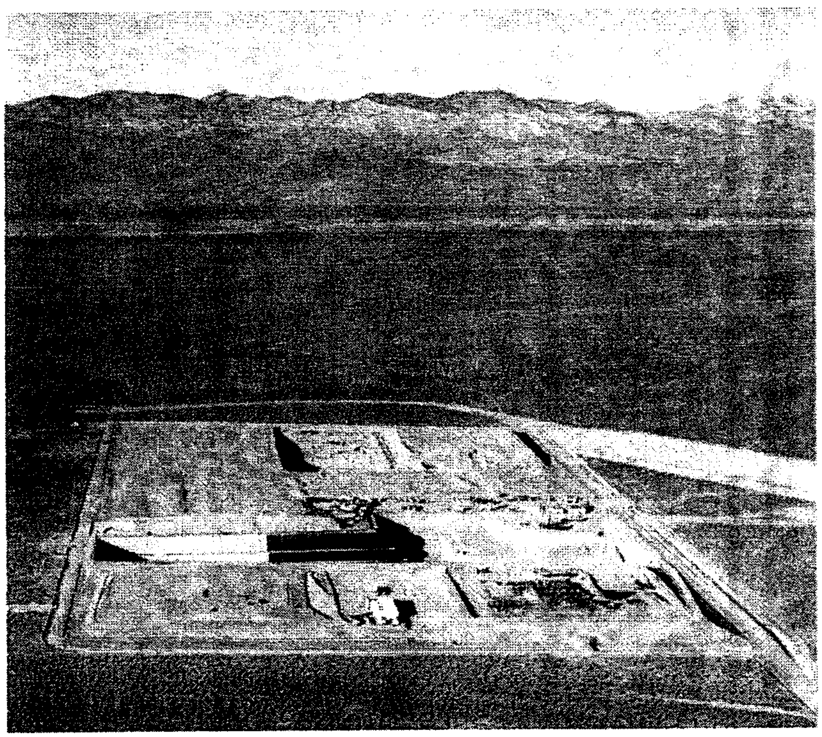
CORRECTIVE MEASURES STUDY WORKPLAN

for

US Ecology, Inc.'s

HAZARDOUS WASTE MANAGEMENT FACILITY

LOCATED NEAR BEATTY, NEVADA



SUBMITTED February 8, 1999

HW Permit NEV0011, Rev. 1, April 1997

CORRECTIVE MEASURES STUDY WORKPLAN
CHEMICAL WASTE DISPOSAL FACILITY

BEATTY, NEVADA

Prepared By

US Ecology, Inc.

Beatty, Nevada

with

AquAeTer, Inc.

Englewood, Colorado

February 8, 1999

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EXECUTIVE SUMMARY

US Ecology is implementing a Corrective Measures Study Workplan to address statistically significant contamination found in several groundwater monitoring wells. It has been determined that liquids disposed in the pre-RCRA trenches and Trench 10, have leached and volatilized in the surrounding areas of the Vadose Zone. The conceptual site model for the potential release pathways, presented in the Current Conditions Report, determined that this soil gas vapor was the most likely transport mechanism for the groundwater contamination. However, the Current Conditions Report concluded that neither the Vadose Zone nor groundwater are an immediate hazard to human health or the environment.

The Corrective Measures Study Workplan will be implemented in accordance with the requirements contained in Section XIV.F.3 of HW Permit NEV HW0011, Revision 1, January 1998 (Permit) for the active US Ecology Hazardous Waste Management Facility located about 11 miles south of Beatty, Nevada, in Nye County. The preparation of this CMS Workplan, its implementation, as well as the subsequent report, is part of the corrective action process required by US Ecology's Permit. The goal of RCRA corrective action is to identify and evaluate alternatives for the correction action necessary to mitigate and/or remediate any releases of hazardous waste or hazardous constituents identified at the facility that potentially pose a threat to human health and the environment. US Ecology believes that this CMS Workplan will accomplish this objective.

The CMS Workplan presents the scope of work required to implement a pilot Soil Vapor Extraction system (SVE), as well as identify and evaluate additional potential remedial alternatives for the releases that have been identified at the facility. The major field work presented in the CMS Workplan is the pilot SVE. SVE is a remediation process utilizing the volatile properties of contaminants, allowing for mass transfer across the non-aqueous phase liquid (NAPL), solid, liquid, and gas interfaces. The process relies on diffusion and advection as the primary transport processes.

The vertical extent of groundwater containing organic compounds is limited to the Upper Water-Bearing Zone. The on-site pilot SVE system will utilize an extraction well, air vent network (e.g., inlet wells), mechanical vacuum equipment, and vapor effluent monitoring. SVE is widely applied to coarse-grained unsaturated soils contaminated with a variety of organic compounds. This technology description appears to be well suited to the US Ecology's Beatty, Nevada facility. The field pilot testing results will be evaluated to determine the effectiveness of this technology in remediating the statistically significant contamination in the groundwater at the facility.

1. PURPOSE OF CORRECTIVE MEASURES STUDY

US Ecology has prepared this Corrective Measures Study (CMS) Workplan in accordance with the requirements contained in Section XIV.F.3 of HW Permit NEV HW0011, Revision 1, January 1998 (Permit) for the active US Ecology Hazardous Waste Management Facility (HWMF) located about 11 miles south of Beatty, Nevada, in Nye County. The preparation of this CMS Workplan, and conducting and reporting the CMS, are part of the corrective action process required by the Permit.

These two CMS steps, the CMS Workplan and the actual CMS, will be completed in accordance with pertinent administrative and technical requirements contained in the December 15, 1998 "Report for RCRA Facility Investigation" that was approved by the Nevada Department of Environmental Protection (NDEP) on January 11, 1999.

1.1 FACILITY BACKGROUND

The US Ecology Facility near Beatty Nevada was opened and permitted to receive solid, low-level radiological waste in 1962. The last trench to receive radioactive wastes was closed in 1992. On December, 30, 1997, the Nevada Department of Health (NDH) accepted custodial care for the Low-Level Radioactive Waste Disposal Facility (LLRWDF) under terms of the 1977 lease, conditions of a 1993 settlement agreement, and provision of the Nevada Administrative Code (NAC). Effective December 30, 1997, US Ecology was no longer the leasee, licensee, or operator of the LLRWDF.

The Facility began receiving liquid and solid chemical waste in 1971. However, after 1979, liquid wastes were no longer accepted for disposal. The Facility submitted a RCRA Part B permit to USEPA Region 9 in 1983, and received the RCRA Permit in 1988.

The HWMF manages the disposal of hazardous waste using a trench system. Pre-RCRA Trenches 1 through 9 were unlined trenches that are closed with a soil cover, and no longer used. Trench 10 is a hybrid trench: unlined, but with a soil cover that incorporates a synthetic component. After waste reached the ground level, berms were constructed, and additional waste placed above grade. Trench 10 is closed with an impermeable flexible membrane liner cover, protected by a soil cover. Trench 11 was constructed in accordance with RCRA regulations, and is lined and has a leachate collection system. Trench 11 is the only operational trench at the Facility at this time. A site map is included as Figure 1.1.

1.1.1 Groundwater Contamination

The detection of contamination in the groundwater beneath the Facility is based on recurrent detections of a few compounds at low concentrations, isolated detections of other compounds, and intermittent detections of compounds that also appear in equipment blanks.

The vertical extent of groundwater containing organic compounds is limited to the Upper Water-Bearing Zone. No confirmed organic constituents have been detected in the Lower Water-Bearing Zone.

1.1.2 Soil Contamination

There are no known current soil contamination releases from the site. The detections of organic constituents in the soil have been isolated. Soil samples were collected during the excavation of Trench 11 in 1988. These samples were collected at depths between 21 and 48 feet. The greatest detections were observed at 33 feet below grade surface (bgs). These samples showed detections of methylene chloride, chloroform, and tetrachloroethene.

1.1.3 Soil Gas Contamination

The two Vadose Zone monitoring wells located along the southern boundary provide depth-discrete samples. The results of sampling in 1996 from the groundwater monitoring well casings (which screen across the Vadose Zone / groundwater interface) indicate elevated levels of organic compounds in the well casing air.

The horizontal distribution of the organic constituents in the soil gas (vapor) concentrations, based on vapor samples and analyses, suggests a strong influence of the well construction on the vadose sample results, especially when compared to the results from other nearby wells. The extent maps indicate greatest vapor concentrations along the south boundary of the Trenches 1 through 9 area and along the west side of Trench 11. Vapor readings in three distant wells provide information about what essentially can be considered background locations.

Vapor readings along the east and southeast side of the Facility are relatively low and only slightly elevated when compared to the background wells. Vapor concentrations in the south and southwest portions of the facility are elevated, but decrease with distance from the trenches. Along the southern extent, the depth-discrete samples have the highest recorded vapor concentrations. The extent is not clearly bounded along the south and southwest sides of the chemical disposal area. There are no sampling locations between the northern boundary of the Trench 10 area and the Facility upgradient well. The vapor extent is assumed to be between these points.

Trench 10 is covered with an impermeable cap to reduce infiltration into the waste. An impermeable surface cover also reduces natural venting; vapors may eventually spread beyond the limits of a surface cover. However, sampling data from wells along the east side of the Facility and photoionization detection (PID) monitoring of ambient air do not indicate elevated concentrations of organic constituents.

1.2 PURPOSE OF CORRECTIVE MEASURES STUDY

The goal of RCRA corrective action is to identify and evaluate alternatives for the correction action necessary to mitigate, and/or remediate, any releases of hazardous waste or hazardous constituents identified at the facility that potentially pose a threat to human health and the environment. The CMS will identify and evaluate potential remedial alternatives for the releases that have been identified at the site. The on-going corrective measures activities at the facility are regulated under a RCRA Hazardous Waste Permit NEV HW0011 (Permit). The Permit specifies that US Ecology conduct corrective actions at the Beatty facility. These corrective actions are intended to evaluate the nature and extent of the releases of hazardous waste or constituents; to evaluate facility characteristics; and to identify, develop, and implement an appropriate corrective measure or measures to protect human health and the environment. The following are the main components of the required corrective action process:

- Interim/Stabilization Measures,
- RCRA Facility Investigation,
- Corrective Measures Study, and
- Corrective Measures Implementation.

Measures to stabilize affected areas, reducing the potential for migration of impacts to unaffected areas, have been implemented and are continuing. US Ecology finalized the RFI and Interim Measures in 1998 and submitted the Final RFI Report to NDEP on December 15, 1998 (approved January 11, 1999).

The CMS Workplan presents the scope of work required to identify and evaluate potential remedial alternatives for the releases that have been identified at the facility. US Ecology will implement a site-specific strategy to focus the selection and identification of corrective measures. Exposure pathway evaluation, future facility use, and technical limitations will be considered as site-specific characteristics regarding the identification and selection of corrective measures.

1.2.1 Exposure Pathway

An exposure pathway analysis links the sources, locations, and types of environmental releases with population locations and activity patterns to determine significant pathways of human exposure. An exposure pathway is complete if there is (1) a source or chemical release from a source, (2) an exposure point where contact can occur, and (3) an exposure route by which the release can migrate to the exposure point. Therefore, to be effective in the protection of human health, corrective measures must mitigate the exposure pathway by controlling either the release source, the exposure point, or exposure route.

Identification and selection of corrective measures will focus on their effectiveness in mitigating exposure pathways. The RFI Report (US Ecology, 1998) identified groundwater and soil gas as potential exposure pathways. Soil is included in this CMS Workplan as a medium which may contain groundwater or soil gas.

1.2.2 Future Facility Use

The Beatty facility is permitted as a HWMF. A LLRWDF operated adjacent to the HWMF until 1992; maintenance of the LLRWDF has since transferred to the State of Nevada. Future use for the Facility will remain as HWMF.

1.2.3 Technical Limitations

The Facility is underlain by a thick Vadose Zone that serves to isolate the facility from human health and environmental impacts. Moisture travel times through the Vadose Zone are long. In addition, the site is remote and the nearest potential receptors are 13 miles away. US Ecology will consider these factors in the evaluation of corrective measures. US Ecology believes that a practicable combination of corrective measures will be identified in the CMS that is protective of human health and the environment.

1.3 CMS REQUIREMENTS AND GUIDANCE

The requirements for this CMS Workplan are contained in the HW Permit (Section XIV). The requirements closely follow EPA's guidance for the CMS process contained in the EPA guidance document entitled "RCRA Corrective Action Plan (Final)" dated May 1994. The requirements for the CMS Workplan are as follow:

HW Permit Requirements (Attachment D, NEV HW0011)	Section of CMS Workplan
1. Statement of purpose	1
2. Description of objectives including proposed cleanup standards	2
3. Description of measures to be studied	3
4. Description of evaluation approach	4
5. Description of any proposed pilot or laboratory demonstration studies	5
6. CMS Report outline	6
7. Project management information, including organization	7
8. Schedule for CMS and CMS Report	8
9. References	9

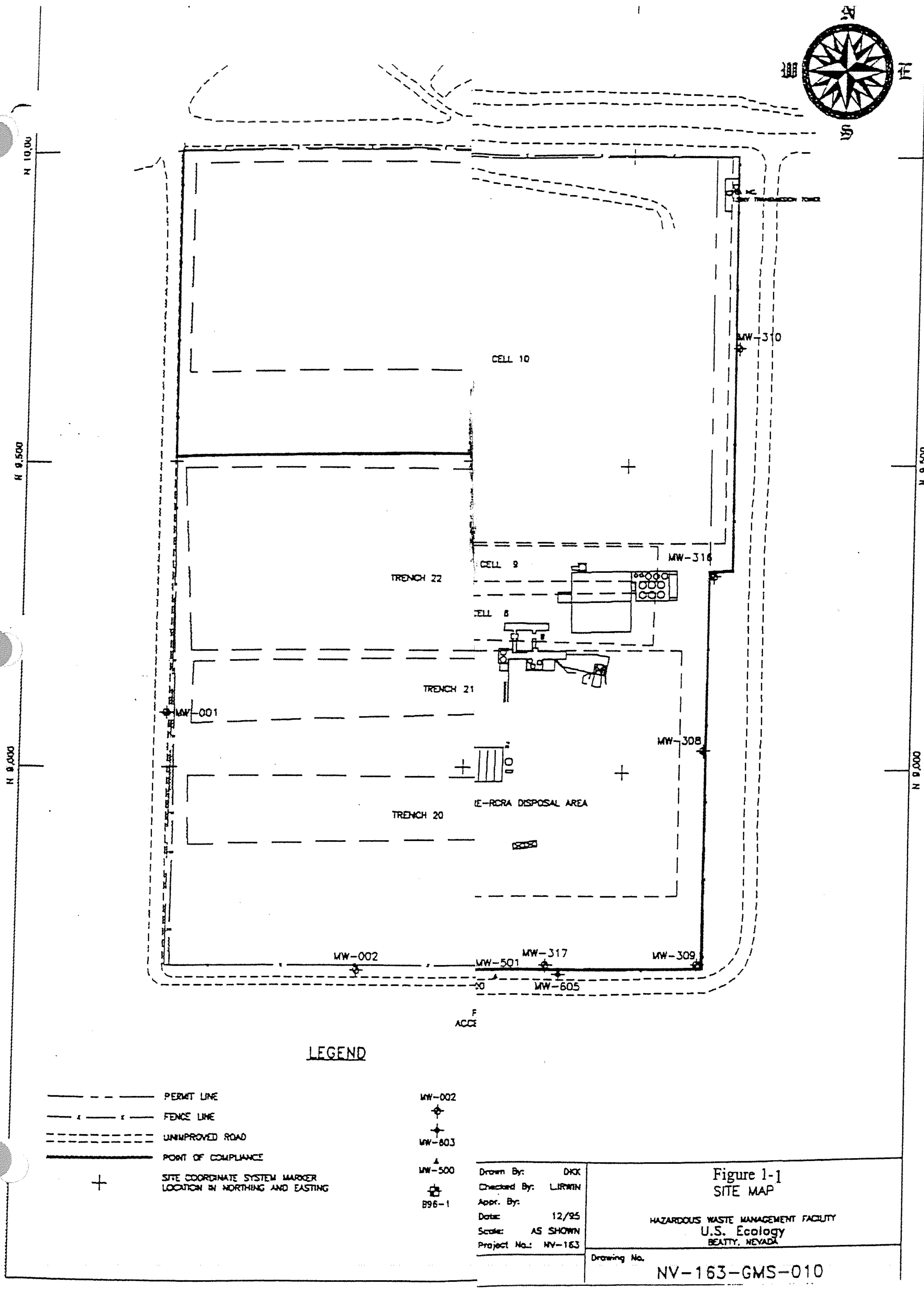

Figure 1-1
SITE MAP

2. CORRECTIVE MEASURES OBJECTIVES

The goal of RCRA corrective action is to identify and evaluate alternatives for the correction action necessary to mitigate, and/or remediate, any releases of hazardous waste or hazardous constituents identified at the facility that potentially pose a threat to human health and the environment. Therefore, the screening, development, and evaluation of corrective measures is the main focus of the CMS process. The objective of screening and evaluation of corrective measures will be to:

- Provide a systematic, comparative corrective measure evaluation that meets the requirements of the CMS in accordance with the facility RCRA Permit and USEPA guidance;
- Develop corrective measures appropriate for site remediation to conditions consistent with likely future land uses based on initial screening, and further evaluation considering four general standards and five decision factors;
- Develop recommendations for continuing and, as appropriate, modifying the corrective measures at the facility;
- Identify the preferred approach for implementing continued corrective measures; and
- Develop protocol to implement a pilot study of a recommended remedial alternative, and evaluate the study's effectiveness.

2.1 SCREENING OBJECTIVES

The CMS will be conducted using three screening steps for potentially effective corrective measures. These steps, initial screening, evaluation against general standards, and evaluation against decision factors, are summarized below.

1. **Initial Screening.** The results of the screening process are presented in Section 3 of this CMS workplan. Corrective measures are evaluated based on their applicability to the physical and chemical conditions at the facility and their effectiveness in preparing the facility for permanent closure. For this initial screening, the level of technology development, performance record, general effectiveness regarding risk reduction, and inherent construction, operation, and maintenance problems are considered. Measures that are unreliable, perform poorly, or have not been fully demonstrated are eliminated from further consideration, as described in Section 3.

2. **General Standards Evaluation.** Individual and combined corrective measures retained after the initial screening step will be evaluated against four general standards. These are: 1) be protective of human health and the environment; 2) be able to attain media cleanup standards where technologically possible; 3) have the ability to control the sources of

releases so as to reduce or eliminate, to the extent practical, further releases that may pose a threat to human health and the environment; and 4) comply with federal and State regulations. Corrective measures satisfying the four general standards will be included in the Corrective Measures Report. These measures will be subjected to the final evaluation step, as described in Section 4.

3. **Decision Factors Evaluation.** Retained individual and combined corrective measures will be evaluated against five decision factors. These are 1) long-term reliability and effectiveness; 2) reduction of waste toxicity, mobility or volume; 3) short-term effectiveness; 4) implementability; and 5) cost. In this evaluation, each remedial alternative will be given a weighted numerical ranking for each criterion. The ranking will be based on the potential of an alternative to satisfy the criterion. The recommendation of individual or combined remedial alternatives to be implemented, based on the combination of rankings for these five criteria, will be included in the Corrective Measures Report, as described in Section 4.

US Ecology will implement a site-specific strategy to focus these three evaluation steps by considering migration pathway, future facility use, and technical limitations as the primary site-specific characteristics regarding the identification and selection of corrective measures. US Ecology anticipates that a comprehensive corrective measures program will be developed through this process. This program probably will be a combination of several different measures addressing contaminants in different areas.

3. IDENTIFICATION OF REMEDIES TO BE EVALUATED

The RFI Report (US Ecology, 1998) identifies constituent sources and delineates impacts to soil, soil gas, and groundwater that potentially are related to the facility. In addition, the RFI Report identifies constituent migration pathways and potential receptors. Collectively, sufficient information was gathered during the RFI to support the CMS. Specifically, for those measures passing the initial screening step, the CMS will utilize RFI data to evaluate the effectiveness of corrective measures regarding the mitigation of exposure pathways in soil gas (unsaturated zone) and groundwater (saturated zone). Corrective measures for these exposure pathways are addressed by this CMS Workplan.

3.1 GROUNDWATER REMEDIES

The purpose of groundwater remediation is to mitigate human and environmental exposure to impacted groundwater. Specifically, the groundwater remedy will contain or restore impacted groundwater to eliminate any hazard to human health or the environment, and to prevent migration of the contaminants.

3.1.1 Results of Initial Screening of Groundwater Remedies

Table 3.1 summarizes US Ecology's initial screening of groundwater remedies. This initial screening eliminates several remedial alternatives from further consideration. These specific remedies are not applicable to the site conditions or the objectives for remedial measures. These remedies are eliminated from further consideration based on reasoning presented in Table 3.1. Several remedial alternatives to contain affected groundwater, including horizontal barriers and immobilization, are eliminated as are some approaches to in-situ chemical and physical treatment. The basis for measure elimination is the likelihood that these methods are infeasible or ineffective.

3.1.2 Groundwater Remedies Retained for Further Evaluation

Remedial alternatives which can be reasonably expected to apply to site conditions will address the groundwater exposure pathway. This exposure pathway consists of impacted groundwater and soil in the saturated zone media. The RFI Report identifies dissolved constituent impacts in the saturated zone.

The groundwater corrective measures that can be used to attain these objectives are divided into four categories: monitored natural attenuation, containment, treatment, and recovery. The CMS will consider potentially effective groundwater corrective measures in these categories and provide a description and evaluation for each measure retained as a result of the initial screening evaluation.

3.1.2.1 Monitored Natural Attenuation

The facility's isolated location, distance to point of exposure, and the limited use of groundwater makes monitored natural attenuation a viable consideration.

3.1.2.2 Containment

Containment utilizes natural or engineered barriers to reduce or eliminate migration of contaminants to uncontaminated media. Containment may involve leaving contaminated materials in-place for full or partial remediation in conjunction with other processes. Containment barrier technologies do not pass initial screening evaluation because of the depth to groundwater at the Beatty Facility (about 300 feet) and the impracticability of constructing such barriers at these depths. However, the use of pumping wells to form a hydraulic containment is retained from the initial screening.

3.1.2.3 Treatment

Treatment of groundwater can be conducted in-situ or ex-situ. In-situ treatment is done in place and is an alternative to the removal and subsequent treatment of contaminated groundwater. In-situ methods can require fewer surface facilities and reduce the likelihood of human exposure to the contaminant. However, in-situ treatment is not applicable to groundwater at this location and does not pass initial screening.

Ex-situ treatment requires the removal and subsequent treatment of groundwater. Ex-situ treatment technologies passing the initial screening evaluation include biological, chemical, and physical treatment.

3.1.2.4 Removal (Recovery)

Pumping systems for recovery is one of the processes often used for aquifer remediation. Groundwater pumping techniques involve the active manipulation and management of groundwater in order to partially or fully remove a plume. Because of the depth to groundwater, wells would be necessary to remove groundwater. Removal technologies that pass the initial screening evaluation include extraction by pumping.

3.2 SOIL GAS REMEDIES

The purpose of the soil gas remedy is to mitigate human and environmental exposure to impacted soil gas and the possibility of continued migration of contaminants. Specifically, the Vadose Zone remedy will contain or remove impacted soil gas to eliminate any hazard to human health or the environment, and to prevent migration of the contaminants.

3.2.1 Results of Initial Screening of Soil Gas Remedies

Table 3.1 summarizes the initial screening of soil gas remedies. Initial screening eliminates several remedial alternatives from further consideration. These specific remedies are not applicable to the site conditions or the objectives for remedial measures. These remedies are eliminated from further consideration based on reasoning presented in Table 3.1. Remedial alternatives for soil gas, including containment and immobilization, and in-situ treatment were eliminated. The basis for elimination is the likelihood that the measure would be infeasible or ineffective.

3.2.2 Soil Gas Remedies Retained for Further Evaluation

Remedial alternatives which can be reasonably expected to apply to site conditions will address the soil gas exposure pathway. This exposure pathway consists of the Vadose Zone impacted by waste constituents. Soil gas remediation measures are divided into four categories: monitored natural attenuation, containment, treatment, and removal. The CMS will consider potentially effective soil gas corrective measures and provide a detailed description and evaluation for each measure retained as a result of the initial screening evaluation.

3.2.2.1 Monitored Natural Attenuation

The monitored natural attenuation measure for soil gas is retained with the assumption that risks associated with the observed concentrations of contaminants are acceptable, that the source has been delineated, and that natural degradation can continue to reduce chemical concentrations. If no action is taken for soil gas, monitored natural attenuation corrective measures will be implemented.

3.2.2.2 Containment

Containment is not a viable remedial alternative for soil gas. The technology for immobilizing soil gas is unknown. Methods for soil gas containment may include use of barriers such as caps, walls, or in-situ grouting. The thickness of the Vadose Zone (about 300 feet) precludes construction of barriers.

3.2.2.3 Treatment

Treatment of the soil gas can be conducted in-situ or ex-situ. In-situ treatment technology, in which impacted soil gas is treated in-place, utilizing chemical or biological agents, or physical manipulations, to degrade, remove, or immobilize contaminants, is unknown. Only ex-situ physical treatment technologies passed the initial screening evaluation. Ex-situ physical soil gas treatment technologies that are viable include carbon adsorption and thermal destruction.

3.2.2.4 Removal

The removal of soil gas from the Vadose Zone is a viable alternative. The soil gas may be pumped from the Vadose Zone using active (soil vapor extraction) or passive (barometric pumping) methods, or a combination.

3.3 SOIL REMEDIES

The purpose of the soil remedy is to mitigate human and environmental exposure to impacted soil. Specifically, the soil remedy will contain or restore impacted soil to eliminate any hazard to human health or the environment, and to prevent migration of the contaminants from soil to other media. The impacted soil at the Facility consists of the Vadose Zone beneath the trenches and where volatile organic compounds have migrated with the soil gas.

3.3.1 Results of Initial Screening of Soil Remedies

Table 3.1 summarizes the initial screening of soil remedies. Initial screening eliminated several remedial alternatives from further consideration. These specific remedies are not applicable to the site conditions or to the objectives for remedial measures. These remedies are eliminated from further consideration based on reasoning presented in Table 3.1. Remedial alternatives for soil, including containment by barriers or immobilization, in-situ treatment by chemical methods, and ex-situ treatment by biological, chemical, and physical treatment methods, were eliminated from further consideration. The basis for elimination was the likelihood that the measure would be infeasible or ineffective.

3.3.2 Soil Remedies Retained for Further Evaluation

Remedial alternatives which can be reasonably expected to apply to site conditions will address the soil exposure pathway. This exposure pathway consists of soil in the unsaturated zone. Soil remediation measures are divided into four categories: monitored natural attenuation, containment, treatment, and removal measures. The CMS will consider potentially effective soil corrective measures and provide a detailed description and evaluation for each measure retained as a result of the initial screening evaluation.

3.3.2.1 Monitored Natural Attenuation

The monitored natural attenuation measure for soil is considered with the assumption that risks associated with the observed concentrations of contaminants are acceptable, that the source potential from both the unsaturated and saturated zones has been delineated, and that natural degradation can continue to reduce chemical concentrations. If no additional action is taken for soil, monitored natural attenuation corrective measures will be implemented. Current systems constructed during past closure of units, such as soil covers and caps, will remain in-place.

3.3.2.2 Containment

Containment utilizes natural or engineered barriers to reduce or eliminate migration of contaminants to uncontaminated media. Containment may involve leaving contaminated materials in-place for full or partial remediation in conjunction with other processes. Contaminants at the Facility already are contained in disposal trenches, and additional containment will not lead to soil objectives. No containment technologies passed the initial screening evaluation.

3.3.2.3 Treatment

Treatment of soil can be conducted in-situ or ex-situ. In-situ treatment is an alternative to soil excavation and removal. In-situ treatment, in which impacted soils are treated in-place, utilizes chemical or biological agents, or physical manipulations, to degrade, remove, or immobilize contaminants. In-situ biological and physical treatment methods can be effective for the constituent types and soil types present at the site.

Ex-situ treatment involves the excavation and on-site or off-site treatment or disposal of the contaminated soil. Once the soil has been excavated, it can be physically altered or treated to detoxify, immobilize, or reduce the concentration of the contaminants, or be transferred to another location for disposal. Ex-situ treatment technologies such as biological treatment (land treatment and slurry treatment), chemical treatment (soil washing), and physical treatment (incineration and thermal desorption) did not pass the initial screening evaluation. The presence of immovable surface structures, including RCRA-permitted waste disposal trenches, eliminated removal (a precursor of ex-situ treatment) as a viable option.

3.3.2.4 Removal

Soil excavation and removal for site remediation did not pass the initial screening evaluation. The presence of immovable surface structures, including RCRA-permitted waste disposal trenches, eliminated removal as a viable option.

TABLE 3.1
INITIAL SCREENING EVALUATION OF CORRECTIVE MEASURES

REMEDIAL ALTERNATIVE	Level of Technology Development	Performance Record at Similar Sites	Effectiveness in Risk Reduction at Similar Sites	Construction, Operation, and Maintenance Problems	APPLICABILITY TO PHYSICAL & CHEMICAL CONDITIONS AT FACILITY	LIKELY EFFECTIVENESS IN ACHIEVING CLEANUP OBJECTIVES	RETAIN FOR FURTHER CORRECTIVE MEASURES STUDY
A. MONITORED NATURAL ATTENUATION							
GROUNDWATER	High	Good	Good	Low	Natural attenuation already is occurring. Natural degradation will continue to reduce contaminant concentrations in groundwater.	Natural attenuation can be effective in achieving objectives, especially when realistic receptor locations are considered. Long-term groundwater effectiveness is directly related to soil and soil gas effectiveness	YES
SOIL GAS	High	Good	Good	Low	Natural attenuation already is occurring. Natural degradation will continue to reduce contaminant concentrations in soil gas.	Natural attenuation can be effective in achieving objectives. Long-term soil gas effectiveness is directly related to soil effectiveness.	YES
SOIL	High	Good	Good	Low	Natural attenuation already is occurring. In-place soil covers are effective measures to separate contaminant from the surface environment and limit infiltration. Natural degradation will continue to reduce contaminant concentrations in soil.	Natural attenuation can be effective in achieving objectives, especially because the depth of contaminants prevents contact with human or environmental receptors.	YES
B. CONTAINMENT (physical measures to reduce or eliminate migration of contaminants to uncontaminated areas or media)							
GROUNDWATER							
horizontal barriers	High	Unknown	No	High	Horizontal barriers, including disposal cell covers and other than natural features (thick, dry, low permeability geologic materials), exist above groundwater. Additional horizontal barriers would be of no benefit in this instance.	This is not an effective measure.	No
vertical barrier walls (low permeability barrier, e.g. slurry wall, sheet piling)	High	Unknown	Unknown	Very High	Up- or down-gradient flow cutoffs or diversions of groundwater to minimize ground-water movement typically are not effective below about 70 feet deep. They are not economically or technically feasible at site depths that would exceed 250 feet.	This is not an effective measure.	No
pumping controls (extraction wells)	High	Fair	Fair	Moderate	Removal or containment of a contaminant plume is possible; however, to be effective favorable (e.g. high permeability) hydrogeologic conditions are necessary.	Complete or partial plume containment might be achievable using extraction wells.	YES
pumping and injection controls (extraction/injection wells)	High	Fair	Fair	Moderate	Removal or containment of a contaminant plume is possible; however, to be effective favorable (e.g. high permeability) hydrogeologic conditions are necessary.	Using water injection to control groundwater flow is desirable only under favorable and well-characterized groundwater conditions. At this site, the likelihood that injection might cause spreading, rather than containment, of the plume makes this an undesirable measure.	No

TABLE 3.1
INITIAL SCREENING EVALUATION OF CORRECTIVE MEASURES

REMEDIAL ALTERNATIVE	Level of Technology Development	Performance Record at Similar Sites	Effectiveness in Risk Reduction at Similar Sites	Construction, Operation, and Maintenance Problems	APPLICABILITY TO PHYSICAL & CHEMICAL CONDITIONS AT FACILITY	LIKELY EFFECTIVENESS IN ACHIEVING CLEANUP OBJECTIVES	RETAIN FOR FURTHER CORRECTIVE MEASURES STUDY
immobilization (grouting)	Low	Unknown	Poor	High	There are no practical methods to immobilize groundwater on a large scale. Grouting to reduce aquifer permeability is very expensive and seldom is used in unconsolidated sediments. Success likely would be limited when the aquifer is deep and permeability is low, as at this site.	Success in containing the plume is not likely.	No
SOIL GAS							
horizontal barriers (liners and covers)	Moderate	Unknown	Unknown	High	Liners and covers, using soil or man-made materials, can separate soil gas from the surface environment. Such liners and covers are in-place over portions of the facility.	Existing liners and covers reduce soil gas discharge to the surface environmental, but the potential for soil gas migration to unlined or uncovered areas is significant. Use of additional horizontal liners and covers will not lead to achieving soil gas objectives.	No
vertical barriers	Low	Unknown	Unknown	High	Vertical barriers typically are not effective below about 70 feet deep. They are not economically or technically feasible at site Vadose Zone depths that would exceed 100 feet.	This is not an effective measure.	No
immobilization	Unknown	Unknown	Unknown	Unknown	No soil gas immobilization methods potentially applicable to this site are known.	This is not an effective measure.	No
SOIL							
horizontal barriers (liners and covers)	High	Good	Fair	Low	Liners and covers, using soil or man-made materials, can separate soil from the surface environment and can limit infiltration of precipitation. Such liners and covers are in-place over portions of the facility.	Use of additional liners and covers above contaminated Vadose Zone soil will not lead to achieving soil objectives.	No
vertical barriers	High	Good	Fair	High	Vertical barriers typically are not effective below about 70 feet deep. They are not economically or technically feasible at site Vadose Zone depths that would exceed 100 feet.	This is not an effective measure.	No

TABLE 3.1
INITIAL SCREENING EVALUATION OF CORRECTIVE MEASURES

REMEDIAL ALTERNATIVE	Level of Technology Development	Performance Record at Similar Sites	Effectiveness in Risk Reduction at Similar Sites	Construction, Operation, and Maintenance Problems	APPLICABILITY TO PHYSICAL & CHEMICAL CONDITIONS AT FACILITY	LIKELY EFFECTIVENESS IN ACHIEVING CLEANUP OBJECTIVES	RETAIN FOR FURTHER CORRECTIVE MEASURES STUDY
immobilization	Low	Unknown	Unknown	Unknown	Includes many high-cost physical and chemical methods to immobilize contaminants in soil, such as high-temperature vitrification, ground freezing, and chemical treatment. Site applicability limited by high cost of unproved techniques and low soil permeability.	This is not an effective measure.	No
C. TREATMENT (biological, chemical, or physical methods to degrade, remove, attenuate, or immobilize contaminants)							
IN-SITU MEASURES (implemented without medium removal)							
GROUNDWATER							
in-situ biological treatment	Moderate	Fair	Fair	High	In-situ biological processes can be effective for these contaminants; however, low contaminant concentrations in groundwater limit measure usefulness, and low permeability limits likely effectiveness. The applicability of such methods at the site is unknown, and would have to be determined through costly testing. Technical and economic feasibility is questionable.	Not applicable	No
in-situ chemical treatment	Low	Unknown	Unknown	Unknown	There are chemical methods that can be used for in-situ treatment of volatile constituents in groundwater. The applicability of such methods at the site is unknown, and would have to be determined through costly testing. Technical and economic feasibility is questionable.	Not applicable.	No
in-situ physical treatment	Moderate	Unknown	Unknown	Unknown	The applicability of in-situ physical treatment measures for volatile constituents in deep site groundwater, such as by air sparging, would have to be determined through costly testing. Technical and economic feasibility is questionable.	Not applicable.	No
SOIL GAS							
in-situ biological treatment	Unknown	Unknown	Unknown	Unknown	There is no known in-situ biological treatment process applicable to soil gas.	Not applicable	No
in-situ chemical treatment	Unknown	Unknown	Unknown	Unknown	There is no known in-situ chemical treatment process applicable to soil gas.	Not applicable.	No
in-situ physical treatment	Unknown	Unknown	Unknown	Unknown	There is no known in-situ physical treatment process applicable to soil gas.	Not applicable.	No

TABLE 3.1
INITIAL SCREENING EVALUATION OF CORRECTIVE MEASURES

REMEDIAL ALTERNATIVE	Level of Technology Development	Performance Record at Similar Sites	Effectiveness in Risk Reduction at Similar Sites	Construction, Operation, and Maintenance Problems	APPLICABILITY TO PHYSICAL & CHEMICAL CONDITIONS AT FACILITY	LIKELY EFFECTIVENESS IN ACHIEVING CLEANUP OBJECTIVES	RETAIN FOR FURTHER CORRECTIVE MEASURES STUDY
SOIL							
in-situ biological treatment	Moderate	Fair	Fair	Moderate	In-situ biological processes can be effective for these contaminants; however, low permeabilities and high clay contents of soils could reduce effectiveness.	Biological treatment could be effective for volatile constituents in site soil. However, soil depth, thickness, and permeability could limit effectiveness.	YES
in-situ chemical treatment	Low	Unknown	Unknown	Unknown	There are no practical chemical methods that can be used for in-situ treatment of volatile constituents in soil.	Not applicable.	No
in-situ physical treatment	High	Good	Good	High	In-situ physical processes can be effective for these contaminants; however, low permeabilities and high clay contents of soils could reduce effectiveness.	Soil vapor extraction could be effective for volatile constituents in site soil. However, soil depth, thickness, and permeability could limit effectiveness.	YES
EX-SITU MEASURES (Implemented after medium is removed)							
GROUNDWATER: All ex-situ treatment measures require groundwater removal before treatment occurs; thus, the method must be used in combination with a removal measure.							
ex-situ biological treatment	High	Good	Good	High	Biological treatment for site constituents in recovered groundwater has been proven to be effective at other sites.	Biological treatment can be effective in treatment of contaminated groundwater.	YES
ex-situ chemical treatment	High	Good	Good	High	Chemical treatment for site constituents in recovered groundwater has been proven to be effective at other sites.	Chemical treatment can be effective in treatment of contaminated groundwater.	YES
ex-situ physical treatment	High	Good	Good	High	Physical treatment for site constituents in recovered groundwater has been proven to be effective at other sites.	Physical treatment can be effective in treatment of contaminated groundwater.	YES

TABLE 3.1
INITIAL SCREENING EVALUATION OF CORRECTIVE MEASURES

REMEDIAL ALTERNATIVE	Level of Technology Development	Performance Record at Similar Sites	Effectiveness in Risk Reduction at Similar Sites	Construction, Operation, and Maintenance Problems	APPLICABILITY TO PHYSICAL & CHEMICAL CONDITIONS AT FACILITY	LIKELY EFFECTIVENESS IN ACHIEVING CLEANUP OBJECTIVES	RETAIN FOR FURTHER CORRECTIVE MEASURES STUDY
SOIL GAS							
ex-situ biological treatment	Unknown	Unknown	Unknown	Unknown	There are no known practical methods for ex-situ biological treatment of soil gas.	Not applicable	No
ex-situ chemical treatment	Unknown	Unknown	Unknown	Unknown	There are no known practical methods for ex-situ chemical treatment of soil gas.	Not applicable	No
ex-situ physical treatment	High	Good	Good	Moderate	There are practical methods for ex-situ physical treatment of soil gas, including carbon adsorption and thermal destruction.	Ex-situ physical treatment methods can be effective in reducing contaminant concentrations in recovered soil gas.	YES
SOIL: All ex-situ treatment measures require soil removal before on-site or off-site treatment occurs; thus, the method must be used in combination with a removal measure.							
ex-situ biological treatment	High	Good	Good	Moderate	Biological treatment for site constituents in soil has been proven to be effective at other sites. However, removal of contaminated soil for ex-situ treatment is technically and economically infeasible.	Biological treatment can be effective in treatment of contaminated soil; but, soil removal is not feasible.	No
ex-situ chemical treatment	Moderate	Fair	Unknown	Very High	Chemical treatment for site constituents in soil has been proven to be effective at other sites. However, removal of contaminated soil for ex-situ treatment is technically and economically infeasible.	Chemical treatment can be effective in treatment of contaminated soil; but, soil removal is not feasible.	No
ex-situ physical treatment (including incineration)	High	Good	Good	High	Physical treatment for site constituents in soil has been proven to be effective at other sites. However, removal of contaminated soil for ex-situ treatment is technically and economically infeasible.	Physical treatment can be effective in treatment of contaminated soil; but, soil removal is not feasible.	No

TABLE 3.1
INITIAL SCREENING EVALUATION OF CORRECTIVE MEASURES

REMEDIAL ALTERNATIVE	Level of Technology Development	Performance Record at Similar Sites	Effectiveness in Risk Reduction at Similar Sites	Construction, Operation, and Maintenance Problems	APPLICABILITY TO PHYSICAL & CHEMICAL CONDITIONS AT FACILITY	LIKELY EFFECTIVENESS IN ACHIEVING CLEANUP OBJECTIVES	RETAIN FOR FURTHER CORRECTIVE MEASURES STUDY
D. REMOVAL (measures that remove the impacted medium are used in combination with disposal or a treatment measure)							
GROUND WATER							
Recovery of impacted groundwater by pumping	High	Good	Good	High	Removal of contaminant plume by pumping is possible.	Pumping to remove contaminated groundwater can be effective in achieving cleanup objectives.	YES
SOIL GAS							
Soil gas removal by air pumping	High	Good	Good	Moderate	Removal of soil gas by air pumping (e.g. soil vapor extraction, SVE) is possible.	Pumping to remove contaminated soil gas can be effective in achieving cleanup objectives.	YES
SOIL							
soil excavation for disposal or treatment	High	Unknown	Unknown	Very High	Contaminated soil removal is not applicable at this site because of the extreme depth of such soil (potentially more than 100 feet) and the presence of immovable surface obstructions.	Not applicable.	No

REFERENCES:

1. USEPA Handbook, Remedial Action at Waste Disposal Sites (Revised), October 1985
2. USEPA Innovative Treatment Technologies: Annual Status Report (Sixth Edition), September 1994
3. USEPA Technology Profiles Seventh Edition, November 1994

4. GENERAL APPROACH TO FURTHER REMEDY EVALUATION

The general approach to further remedy evaluation consists of implementing a systematic, comparative corrective measure evaluation with a site-specific strategy. The systematic corrective measures evaluation will meet the requirements of the CMS in accordance with the facility RCRA Permit and USEPA guidance.

The CMS will be continued using two additional steps for evaluating potentially effective corrective measures. These steps, evaluation against general standards and evaluation against decision factors, are discussed below and presented in Figure 4.1 (flow chart).

4.1.1 Evaluation Against General Standards

The next step, after initial screening, in the selection of the corrective measures will be based upon evaluation against the general standards listed below. Each remedial measure will be evaluated against these standards. Measures not satisfying these standards, independently or when combined with other alternatives, will be eliminated from further consideration. Satisfaction of these general standards will advance the remedial measure for further consideration against the decision factors discussed in Section 4.1.2.

The four general standards for corrective measure evaluation are the following:

- be protective of human health and the environment,
- be able to attain media cleanup standards where this is technologically possible,
- have the ability to control the sources of releases so as to reduce or eliminate, to the extent practical, further releases that could pose a threat to human health and the environment, and
- comply with applicable requirements for waste management.

A table will be included in the CMS Report that demonstrates the evaluation of remedial alternatives against general standards.

4.1.2 Remedy Selection Decision Factors

Evaluation of potentially effective corrective measures also will be based on decision factors which satisfy an appropriate combination of technical objectives and management controls for addressing environmental releases at the facility. These decision factors are the following.

Long-Term Reliability and Effectiveness - usually based on the measure's effectiveness demonstrated at other facilities, and assessment of the useful life of hardware components.

Reduction in the Toxicity, Mobility, or Volume of Wastes - measures that can reduce these factors are considered preferable to those that do not.

Short-Term Effectiveness - usually based on an assessment of any increased risk to human health (including remediation workers) or the environment that could be associated with implementing a measure.

Implementability - usually an assessment of administrative feasibility (permits, access, and public acceptance) and technical feasibility or "constructibility."

Cost - estimates of initial capital cost and on-going operating costs are important considerations when several measures are capable of achieving corrective action objectives.

A table will be included in the CMS Report that demonstrates the evaluation of remedial alternatives based on decision factors.

4.2 REMEDY EVALUATION APPROACH

The remedy evaluation approach also will include the selection of the media action levels, and the selection of a preferred measure. These items are discussed below.

4.2.1 Media Action Level Identification

The RFI conducted in 1998 identified impacts to groundwater, soil, and soil gas in the Vadose Zone that potentially could be related to the facility. No such impacts to air, surface water or surface water sediments were identified. The CMS will develop media action levels for groundwater, soil, and soil gas to evaluate the necessity for and effectiveness of corrective measures.

The development of action levels to be used to determine the need for and adequacy of corrective measures will consider realistic human and environmental exposure scenarios. US Ecology envisions developing and applying action levels that are compatible with likely future land uses at this facility.

4.2.1.1 Groundwater Action Levels

The RCRA Permit directs US Ecology to maintain and implement a groundwater corrective action program and establishes groundwater protection standards for waste constituents. The constituent maximum concentration limits specified in the RCRA Permit are proposed as the groundwater protection standard (GWPS) for the SWMUs. These limits are listed in Table 4.1. US Ecology proposes these limits as the initial action levels under the CMS.

4.2.1.2 Soil Action Levels

Action levels for soil are not established by the RCRA Permit. Therefore, no soil action levels are established.

4.2.1.3 Soil Gas Action Levels

Action levels for soil gas have not been established by the RCRA Permit. Therefore, no soil action levels are established. The CMS will propose that corrective action at the Facility results in releases to the atmosphere that are below regulatory limits for air quality permitting.

4.2.2 Selection of Preferred Measure

The CMS will identify the preferred corrective measures. Measures evaluated in this manner will be ranked on the basis of the relative importance of each decision factor and the degree to which the decision factor is satisfied. The resultant ranking will be used to identify the preferred measure or combination of measures.

The CMS also will present a schedule of corrective action implementation, with consideration given to the corrective actions previously implemented at the facility. Based on the results of Table 3.1, Initial Screening Evaluation of Corrective Measures, a pilot test study of the remedial alternative for soil gas is proposed to be implemented. The pilot test will be a soil vapor extraction (SVE) system. The implementation and operational objectives of the pilot test study are presented in Section 5 of the CMS Workplan. The schedule for implementation and monitoring of the pilot test study is presented in Section 8. The results of the pilot test study are expected to provide supporting information for the selection of the preferred measure. These results will be included in the CMS Report.

TABLE 4.1
RECOMMENDED GROUNDWATER PROTECTION STANDARDS

Table XI-3 Metals[1]

Common name	CAS RN	Chemical abstracts service index name[4]	Analytical Methods[5]	Background (BKG) (ug/l)	Groundwater Protection Standard (GPS) (ug/L)	Reference BKG/GPS
Arsenic		Arsenic	6010 7060	15.6	50	BKG/MCL
Barium		Barium	6010	49.5	1000	BKGMCL
Cadmium		Cadmium	6010 7131	5	5	PQL/MCL
Chromium		Chromium	6010	100	100	PQL/PQL
Lead		Lead	6010 7421	15	15[2]	PQL/PQL
Sodium		Sodium	6010	290,000	NA	BKG
Selenium		Selenium	6010 7740	50	50[1]	PQL/PQL
Silver		Silver	6010	70	70[2]	PQL/PQL
Mercury		Mercury	7470 7471	2	2	PQL/PQL

1 The metals analyses are from non-filtered samples.

Table XI-4 PCB's and Pesticides

Common name	CAS RN	Chemical abstracts service index name[4]	Analytical Methods[5]	Background (ug/l)	GPS (µg/L)	Reference BKG/GPS
Aldrin	309-00-2	1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-(1alpha,4alpha,4abeta,5alpha,8alpha,8abeta)-	8080 8081	0.05	0.05	PQL/ PQL
Endrin	72-20-8	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,-7,7a-octahydro-, (1aalpha, 2beta,2abeta,3alpha,6alpha, 6abeta,7beta,7aalpha)-	8080 8081	0.1	2	PQL/ MCL
Methoxychlor	72-43-5	Benzene, 1,1'-(2,2,2,trichloroethylidene)bis [4-methoxy-	8080 8081	2	40	PQL/ MCL
Polychlorinated biphenyls; PCBs	1336-36-3	1,1'-Biphenyl, chloro derivatives	8080 8081		0.5	MCL
Aroclor-1016	12674-11-2		8080 8081	50		PQL
Aroclor-1221	11104-28-2		8080 8081	50		PQL
Aroclor-1232	11141-16-5		8080 8081	50		PQL
Aroclor-1242	53469-21-9		8080 8081	50		PQL
Aroclor-1248	12672-29-6		8080 8081	50		PQL
Aroclor-1254	11097-69-1		8080 8081	50		PQL
Aroclor-1260	11096-82-5		8080 8081	50		PQL
2,4,5-T, 2,4,5-Tri-chlorophenoxyacetic acid	93-76-5	Acetic acid, (2,4,5-trichlorophenoxy)-	8150	2	2	PQL/ PQL
Silvex; 2,4,5-TP	93-72-1	Propanoic acid, 2-(2,4,5-trichlorophenoxy)-	8150	2	50	PQL/MCL

Table XI-4 PCB's and Pesticides

Common name	CAS RN	Chemical abstracts service index name[4]	Analytical Methods[5]	Background (ug/l)	GPS (ug/L)	Reference BKG/GPS
Toxaphene	8001-35-2	Toxaphene	8080 8081	2	3	PQL/MCL

Table XI-5 Volatiles

Common name	CAS RN	Chemical abstracts service index name[4]	Analytical Methods[5]	Background (ug/l)	Groundwater Protection Standard (ug/L)	Reference
1,2-Dichloroethane; Ethylene dichloride	107-06-2	Ethane, 1,2-dichloro-	8240/ 8260	5	5	PQL/MCL
1,1,2-Trichloroethane	79-00-5	Ethane, 1,1,2-trichloro-	8240/ 8260	5	5	PQL/MCL
1,1,1-Tri-chloroethane; Methylchlor-oform	71-55-6	Ethane, 1,1,1-trichloro-	8240/ 8260	5	200	PQL/MCL
1,1-Dichloroethane	75-34-3	Ethane, 1,1-dichloro-	8240/ 8260	5	5	PQL/PQL
1,1-Dichloroethylene; Vinylidene chloride	75-35-4	Ethene, 1,1-dichloro-	8240/ 8260	5	7	PQL/MCL
1,2-Dichloropropane	78-87-5	Propane, 1,2-dichloro-	8240/ 8260	5	5	PQL/MCL
1,1,2,2-Tetrachloro-ethane	79-34-5	Ethane, 1,1,2,2-tetrachloro-	8240/ 8260	5	5	PQL/PQL
2-Hexanone	591-78-6	2-Hexanone	8240/ 8260	50	50	PQL/PQL
4-Methyl-2-pentanone; Methyl isobutyl ketone	108-10-1	2-Pentanone, 4-methyl-	8240/ 8260	50	50	PQL/PQL
Acetone	67-64-1	2-Propanone	8240/ 8260	100	100	PQL/PQL
Benzene	71-43-2	Benzene	8240/ 8260	5	5	PQL/MCL
Bromodichloromethane	75-27-4	Methane, bromodichloro-	8240/ 8260	5	5	PQL/PQL
Bromoform; Tribromomethane	75-25-2	Methane, tribromo-	8240/ 8260	5	5	PQL/PQL
Carbon disulfide	75-15-0	Carbon disulfide	8240/ 8260	5	5	PQL/PQL
Carbon tetrachloride	56-23-5	Methane, tetrachloro-	8240/ 8260	5	5	PQL/MCL
Chlorobenzene	108-90-7	Benzene, chloro-	8240/ 8260	5	100	PQL/MCL

Table XI-5 Volatiles

Common name	CAS RN	Chemical abstracts service index name[4]	Analytical Methods[5]	Background (ug/l)	Groundwater Protection Standard (ug/L)	Reference
Chloroethane; Ethyl chloride	75-00-3	Ethane, chloro-	8240/ 8260	10	10	PQL/PQL
Chloroform	67-66-3	Methane, trichloro-	8240/ 8260	5	5	PQL/PQL
cis-1,3-Dichloropro-pene	10061-01-5	1-Propene, 1,3-dichloro-, (Z)-	8240/ 8260	5	5	PQL/PQL
Dibromochlorome-thane; Chlorodibro-momethane	124-48-1	Methane, dibromochloro-	8240/ 8260	5	5	PQL/PQL
Ethylbenzene	100-41-4	Benzene, ethyl-	8240/ 8260	5	700	PQL/MCL
Methyl chloride; Chloromethane	74-87-3	Methane, chloro-	8240/ 8260	10	10	PQL/PQL
Methyl bromide; Bromomethane	74-83-9	Methane, bromo-	8240/ 8260	10	10	PQL/PQL
Methyl ethyl ketone; MEK	78-93-3	2-Butanone	8240/ 8260	100	100	PQL/PQL
Methylene chloride; Dichloromethane	75-09-2	Methane, dichloro-	8240/ 8260	5	5	PQL/MCL
Styrene	100-42-5	Benzene, ethenyl-	8240/ 8260	5	100	PQL/MCL
Tetrachloroethylene; Perchloroethylene; Tetrachloroethene	127-18-4	Ethene, tetrachloro-	8240/ 8260	5	5	PQL/MCL
Toluene	108-88-3	Benzene, methyl-	8240/ 8260	5	1000	PQL/MCL
trans-1,2-Dichloroe-thylene	156-60-5	Ethene, 1,2-dichloro-, (E)-	8240/ 8260	5	100	PQL/MCL
trans-1,3-Dichloropro-pene	10061-02-6	1-Propene, 1,3-dichloro-, (E)-	8240/ 8260	5	5	PQL/PQL
Trichloroethylene; Trichloroethene	79-01-6	Ethene, trichloro-	8240/ 8260	5	5	PQL/MCL
Trichlorofluoromethane	75-69-4	Methane, trichlorofluoro-	8240/ 8260	5	5	PQL/PQL
Vinyl acetate	108-05-4	Acetic acid, ethenyl ester	8240/ 8260	5	5	PQL/PQL
Vinyl chloride	75-01-4	Ethene, chloro-	8240/ 8260	5	2	PQL/MCL
Xylene (total)	1330-20-7	Benzene, dimethyl-	8240/ 8260	5	10,000	PQL/MCL

Table XI-6 Semi-Volatiles

Common name	CAS RN	Chemical abstracts service index name[4]	Analytical Methods[5]	Background (ug/l)	GPS (ug/L)	Reference
1,2,4-Trichlorobenzene	120-82-1	Benzene, 1,2,4-trichloro-	8270	10	70	PQL/MCL
2,4,6-Trichlorophenol	88-06-2	Phenol, 2,4,6-trichloro-	8270	10	10	PQL/PQL
2,4,5-Trichlorophenol	95-95-4	Phenol, 2,4,5-trichloro-	8270	10	10	PQL/PQL
2,4-Dimethylphenol	105-67-9	Phenol, 2,4-dimethyl-	8270	10	10	PQL/PQL
2,4-Dichlorophenol	120-83-2	Phenol, 2,4-dichloro-	8270	10	10	PQL/PQL
2,4-Dinitrotoluene	121-14-2	Benzene, 1-methyl-2,4-dinitro-	8270	10	10	PQL/PQL
2,6-Dinitrotoluene	606-20-2	Benzene, 2-methyl-1,3-dinitro-	8270	10	10	PQL/PQL
2-Chloronaphthalene	91-58-7	Naphthalene, 2-chloro-	8270	10	10	PQL/PQL
2-Chlorophenol	95-57-8	Phenol, 2-chloro-	8270	10	10	PQL/PQL
2-Methylnaphthalene	91-57-6	Naphthalene, 2-methyl-	8270	10	10	PQL/PQL
3,3'-Dichlorobenzidine	91-94-1	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dichloro-	8270	20	20	PQL/PQL
4-Bromophenyl phenyl ether	101-55-3	Benzene, 1-bromo-4-phenoxy-	8270	10	10	PQL/PQL
4-Chlorophenyl phenyl ether	7005-72-3	Benzene, 1-chloro-4-phenoxy-	8270	10	10	PQL/PQL
Acenaphthene	83-32-9	Acenaphthylene, 1,2-dihydro-	8270	10	10	PQL/PQL
Acenaphthylene	208-96-8	Acenaphthylene	8270	10	10	PQL/PQL
Anthracene	120-12-7	Anthracene	8270	10	10	PQL/PQL
Benzo[a]anthracene; Benzanthracene	56-55-3	Benz[a]anthracene	8270	10	10	PQL/PQL
Benzo[a]pyrene	50-32-8	Benzo[a]pyrene	8270	10	0.2	PQL/MCL
Benzo[b]fluoranthene	205-99-2	Benz[e]acephenanthrylene	8270	10	10	PQL/PQL
Benzo[ghi]perylene	191-24-2	Benzo[ghi]perylene	8270	10	10	PQL/PQL
Benzo[k]fluoranthene	207-08-9	Benzo[k]fluoranthene	8270	10	10	PQL/PQL
Bis(2-chloro-1-methylethyl) ether; 2,2'-Dichlorodiiso-propyl ether	108-60-1	Propane, 2,2'-oxybis[1-chloro-	8270	10	10	PQL/PQL
Bis(2-chloroethoxy)-methane	111-91-1	Ethane, 1,1'-[methylenebis(oxy)]bis[2-chloro-	8270	10	10	PQL/PQL

Table XI-6 Semi-Volatiles

Common name	CAS RN	Chemical abstracts service index name[4]	Analytical Methods[5]	Background (ug/l)	GPS (µg/L)	Reference
Bis(2-chlor-oethyl)ether	111-44-4	Ethane, 1,1'-oxybis[2-chloro-	8270	10	10	PQL/PQL
Bis(2-ethylhexyl) phthalate	117-81-7	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl)ester	8270	10	. 6	PQL/MCL
Butyl benzyl phthalate; Benzyl butyl phthalate	85-68-7	1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester	8270	10	10	PQL/PQL
Chrysene	218-01-9	Chrysene	8270	10	10	PQL/PQL
Di-n-butyl phthalate	84-74-2	1,2-Benzenedicarboxylic acid, dibutyl ester	8270	10	10	PQL/PQL
Di-n-octyl phthalate	117-84-0	1,2-Benzenedicarboxylic acid, dioctyl ester	8270	10	10	PQL/PQL
Dibenzofuran	132-64-9	Dibenzofuran	8270	10	10	PQL/PQL
Dibenz[a,h]-anthracene	53-70-3	Dibenz[a,h]anthracene	8270	10	10	PQL/PQL
Diethyl phthalate	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester	8270	10	10	PQL/PQL
Dimethyl phthalate	131-11-3	1,2-Benzenedicarboxylic acid, dimethyl ester	8270	10	10	PQL/PQL
Fluoranthene	206-44-0	Fluoranthene	8270	10	10	PQL/PQL
Fluorene	86-73-7	9H-Fluorene	8270	10	10	PQL/PQL
Hexachlorobenzene	118-74-1	Benzene, hexachloro-	8270	10	1	PQL/MCL
Hexachloro-butadiene	87-68-3	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-	8270	10	10	PQL/PQL
Hexachloroethane	67-72-1	Ethane, hexachloro-	8270	10	10	PQL/PQL
Indeno(1,2,-3-cd)pyrene	193-39-5	Indeno[1,2,3-cd]pyrene	8270	10	10	PQL/PQL
Isophorone	78-59-1	2-Cyclohexen-1-one, 3,5,5-trimethyl-	8270	10	10	PQL/.PQL
m-Cresol	108-39-4	Phenol, 3-methyl-	8270	10	10	PQL/PQL
m-Dichlorobenzene	541-73-1	Benzene, 1,3-dichloro-	8270	10	600	PQL/MCL
Naphthalene	91-20-3	Naphthalene	8270	10	10	PQL/PQL
Nitrobenzene	98-95-3	Benzene, nitro-	8270	10	10	PQL/PQL
o-Cresol	95-48-7	Phenol, 2-methyl-	8270	10	10	PQL/PQL
o-Dichlorobenzene	95-50-1	Benzene, 1,2-dichloro-	8270	10	600	PQL/MCL
o-Nitrophenol	88-75-5	Phenol, 2-nitro-	8270	10	10	PQL/PQL
p-Cresol	106-44-5	Phenol, 4-methyl-	8270	10	10	PQL/PQL

Table XI-6 Semi-Volatiles

Common name	CAS RN	Chemical abstracts service index name[4]	Analytical Methods[5]	Background (ug/l)	GPS (ug/L)	Reference
p-Dichlorobenzene	106-46-7	Benzene, 1,4-dichloro-	8270	10	75	PQL/MCL
p-Nitroaniline	100-01-6	Benzenamine, 4-nitro-	8270	50	50	PQL/PQL
Phenanthrene	85-01-8	Phenanthrene	8270	10	10	PQL/PQL
Phenol	108-95-2	Phenol	8270	10	10	PQL/PQL
Di-n-propylnitrosamine	621-64-7		8270	10	10	PQL/PQL
Pyrene	129-00-0		8270	10	10	PQL/PQL

Table XI-7
Water Quality Parameters

Common name	CAS RN	Chemical abstracts service index name[4]	Analytical methods[5]	Background (ug/l)	GPS (µg/L)	Reference
Sulfate		Sulfate	9030	250,000	250,000	BKG/BKG
Cyanide		Cyanide	9010, 9012	10	0.2	PQL/MCL
pH		pH	9040	≥6.47 ≤8.38	≥6.47 ≤8.38	BKG/BKG
Specific Conductance		SCCN	9050	1320 µMHOS		
Groundwater Elevation				NA[11]	NA	
Chloride			9250, 9251, 9252, 9553, 325.3[6]	81,600	81,600	BKG/BKG
Fluoride			340.2[5]	4,600	4,600	BKG/BKG
Nitrate-Nitrite as N			9200, 353.2[6], 353.3[6]	1,200	1,200	BKG/BKG
Gross Alpha			9310, 900.0[7]	21.86pCi/l	21.86pCi/l	BKG/BKG
Gross Beta			9310, 900.0[7]	48.23pCi/l	48.23pCi/l	BKG.BKG
Radium 226			9315, SM704[8], 903[7]	TBD[9]	5pCi/l (combination of Radium 226 and 228)	MCL
Radium 228			9320, SM705[7], 904[8]	TBD[9]	See above	MCL
Tritium			SM7500	TBD[9]	20,000pCi/l	MCL
Total Organic Carbon		TOC	9060, 415.2[6]	2,600	2,600	BKG/BKG
Turbidity				NA	NA	
Temperature				NA	NA	
Total Dissolved Solids		TDS	EPA 160.1	TBD[9]	TBD[9]	

FOOTNOTE: [1]MCL
FOOTNOTE: [2]MCL OF METHOD 6010
FOOTNOTE: [3]MCL OF METHOD 7470
FOOTNOTE: [4]CAS index names are those used in the 9th Cumulative index.
FOOTNOTE: [5]Analytical Methods refer to analytical procedure numbers used in EPA Report SW-846 "Test Methods for Evaluating Solid Waste", third edition, November 1986 or more recent updates.
FOOTNOTE:[6] Methods for Chemical Analysis of Water and Wastewater. EPA 1983
FOOTNOTE:[7] Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA 600/4-80-32, USEPA, August, 1980
FOOTNOTE:[8] Selected Analytical Methods Approved and Cited by the USEPA, Supplement to the 15th Edition of Standard Methods for the Examination of Water and Wastewater, American Public Health Association, American Water Works Association, Water Pollution Control Federation, 1981
FOOTNOTE: [9] TBD stands for To Be Determined

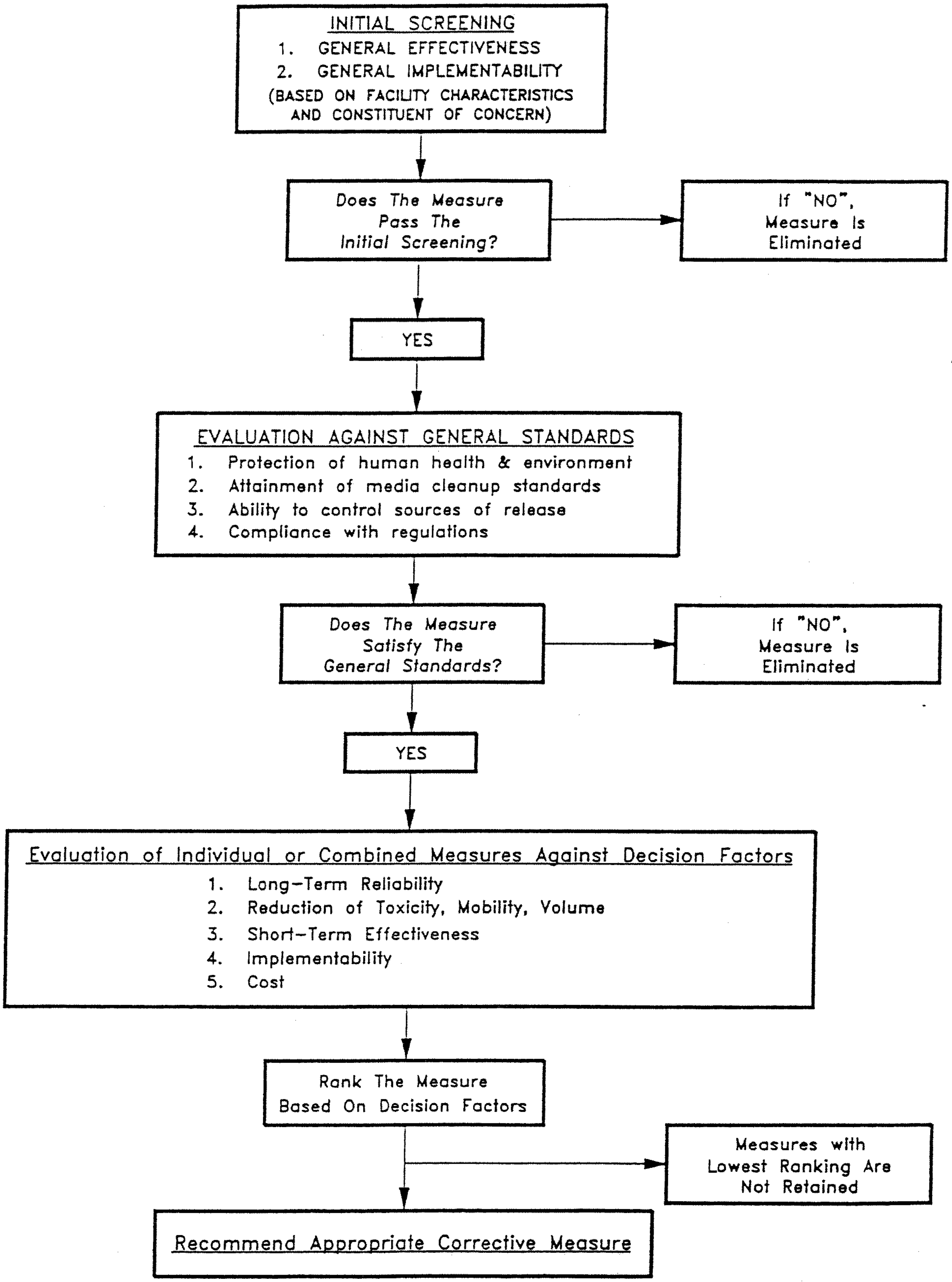

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Figure 4.1

FLOW CHART FOR CORRECTIVE MEASURES STUDY

5. CMS TASKS AND PILOT STUDIES

The following activities comprise the CMS tasks to be performed. The field pilot test will be performed to determine the effectiveness of this technology in remediating the statistically significant contamination in the groundwater at the facility. The remaining activities are included to enhance monitoring and data gathering during the study.

5.1 ADDITIONAL VADOSE ZONE SAMPLING

Two additional Vadose Zone sampling events (summer and winter) will be performed. Vadose Zone sampling will include the 500-series wells, the 300-series wells, the two piezometers B96-01 and B96-02, and wells MW-001 and MW-002. Continuation of the sampling will be evaluated based on SVE operational effectiveness.

The procedure for this task is included in Appendix 1.

5.2 DOWNHOLE TELEVIEWER

Physical investigation of all monitoring wells at the HWMF will be performed. A downhole televiewer will be used in all HWMF monitoring wells to evaluate if they are potential conduits contributing to vertical migration. Based on the results of that examination, some wells could require additional evaluation or repair or abandonment.

The procedure for this task is included in Appendix 1.

5.3 SOIL VAPOR EXTRACTION

Soil vapor extraction (SVE) is a remediation process utilizing the volatile properties of contaminants, allowing for mass transfer across the non-aqueous phase liquid (NAPL), solid, liquid, and gas interfaces. The process relies on diffusion and advection as the primary transport processes when placed under a vacuum.

An SVE system typical utilizes an extraction well network, air vents (or inlet wells), vapor/liquid separator, vacuum blower, vapor treatment/release, and liquid wastewater treatment/release. SVE is widely applied to coarser-grained (e.g., sands, silty sands, etc.) unsaturated soils contaminated with a variety of organic compounds. A schematic of the SVE system is included in Figure 5.1.

5.3.1 Site Characterization Data Requirements

Based on the data and the interpretations presented in the CCR, Section 5, there is sufficient knowledge of the extent of contamination in the subsurface for development of alternative remedial approaches and to begin the CMS. No additional site characterization is necessary to proceed with the SVE pilot study.

5.3.2 Key Factors Affecting Application

Key factors influencing the application of SVE can be broken into contaminant properties and specific site characteristics.

5.3.2.1 Contaminant Properties

1. Volatile organics are the target COCs.
2. Minimum vapor pressure greater than 0.5 mm Hg (desirable to have vapor pressure greater than 10 mm Hg).

5.3.2.2 Contaminated Media Characteristics

1. Suitable sites include permeable unsaturated porous media.
2. Hydraulic conductivity greater than 0.001 cm/sec and greater than 10 percent air-filled voids, or air permeability greater than 10^{-8} cm^2.

SVE operations and performance can be enhanced and/or facilitated by manipulation methods including subsurface fracturing and heating. In addition, hot fluids can be injected (e.g., heated air or steam) rather than ambient air.

5.3.2.3 Fate and Transport

The key chemical properties affecting the relevant behavior of the contaminants of concern that make them amenable to SVE include:

1. Volatility (boiling point, vapor pressure)
2. Relative polarity (solubility)
3. Sorption affinity (solubility and chemical structure/activity)
4. Diffusivity (molecular weight)
5. Density and viscosity

The principal governing relationships include Henry's Law for dilute aqueous solutions and Raoult's Law for NAPL to vapor phase.

5.3.3 Proposed Design

5.3.3.1 Operational Unit

The SVE system at the US Ecology facility will be used to extract the contaminant vapor in the unsaturated or Vadose Zone and to a lesser degree VOC contamination in the groundwater. The proposed design is to install, operate and sample a pilot SVE well (SVE-1) in the Vadose Zone near the location of former well MW-307. The SVE well will be located between Trenches 9 and 10, in an effort to maximize the removal of waste constituents from the Vadose Zone. The proposed location of SVE-1 was chosen after a review of facility history. This review included groundwater monitoring data, MW-307 boring logs and the US Ecology Monitoring Well 307 Evaluation Report (4-15-87), and Geraghty and Miller report titled Abandonment of Five Groundwater Monitoring Wells at US Ecology, Beatty Nevada. Facility (7-20-90). Vadose well 104 was also located near MW-307.

The SVE well construction will be installed with standard water well drilling equipment with a nominal borehole diameter of 18 inches. It will be installed to a depth of about 100 feet. Centered in the 18-inch diameter well will be a 4-inch diameter riser/screen. The 4-inch diameter PVC well will be equipped with a 50-feet long slotted screen starting at the elevation of the bottom of Trench 10 (elevation 2727) approximately 50 feet below ground surface. The annulus around the screen will be a coarse gravel filter pack. A five-feet thick dry granular or pellet bentonite seal will be placed above the filter pack. The annulus above the bentonite seal will be grouted to the surface. The grout will be a neat cement mixed with 3 to 5% bentonite prior to placement. A pad will be constructed at the surface. The mechanical portion of SVE-1 will be placed upon the well pad, as illustrated in Figure 5.3. The final depth of the well will be based on the lithologic conditions and the observed presence of contamination. The SVE well will not be screened through low permeability zones. The SVE well installation procedure is included in Appendix 1.

The SVE mechanical setup will include a 20 standard cubic feet per minute (scfm) vacuum pump connected to the SVE well head. The piping will have pressure and flow gauges as well as sampling connections. The equipment housing will be located on the SVE well pad. Power is available from the nearby PCB building.

The SVE remediation component will use existing wells for air influent at locations along the south, east and west sides of the HWMF, with monitoring points surrounding the site. A schematic is included as Figure 5.2.

The concentration of waste constituents extracted by the SVE system will be monitored to demonstrate extraction rates. The concentration of waste constituents also will be monitored to determine compliance with air quality regulations or the need for effluent treatment to be protective of human health and the environment. Other associated data will be collected from the SVE system in order to optimize the system's operating flow and effective radius of influence. Data will be gathered at the monitoring wells to determine influent air flow and pressure changes. SVE effluent and well influent rates will be measured to identify operational effects and limitations. If the pilot testing of the SVE demonstrates that off-gas treatment is required, the system will be field-fitted with the appropriate equipment.

The objective is to screen a 50-feet interval below the lowest point in Trench 10. If noticeable contamination is encountered in the soil materials, drilling may either be stopped and the borehole relocated, or proceed, but not beyond the extent of the contaminated soil depth.

5.3.3.2 System Operation, Maintenance and Evaluations

After installation of the system is complete, system startup activities will be performed to determine that all mechanical and electrical components are operating properly. A complete as-built description of the system will be provided in the CMS report.

The facility monitoring system will undergo a pre-operational (base line) groundwater and soil vapor sampling several weeks prior to the SVE system operations. The procedure for soil vapor sampling is included in Appendix 1. Normal environmental monitoring will be evaluated to assess the performance of the SVE system remedial effectiveness on groundwater. SVE system monitoring will include laboratory and field measurements of Vadose Zone soil gas and SVE effluent air monitoring. VOCs are the main COC. However, the normal quarterly groundwater monitoring also will be monitoring for the additional constituents required by the permit.

After it has been determined that each aspect of the SVE system is operating properly, monitoring of the system's performance will be documented. The documentation will include:

- field and laboratory sampling of the SVE performance parameters;
- maintenance of system component;
- trouble shooting system; and
- field data on the influent wells flow rate and pressure drop.

5.3.3.3 Schedule

Field work will commence within two weeks of receipt of NDEP approval of the CMS Workplan. The installation of the SVE pilot system is expected to be completed within six weeks of receipt of NDEP approval of the CMS Workplan. It is anticipated that the pilot SVE system will run for at least one year. This will allow data to be gathered under varied conditions (operational and environmental). The pilot SVE system may be modified during the pilot test period to examine operational protocol. Additionally, depending on the results from the pilot test period, the pilot SVE system may be incorporated into the selected remedy.

5.4 SOIL VAPOR EXTRACTION (SVE) SYSTEM MONITORING

The intent of the SVE monitoring and sampling is to gather information that will be used to determine the performance of SVE-1. The following monitoring, inspections and sampling plan describes the process that will be used to obtain the data needed to make this assessment.

- Daily inspections will consist of those elements found in Field Data Soil Vapor Extraction System Daily Inspection, Appendix 3. The performance of the daily inspection shall be in accordance with the following.

- Weekly inspections shall consist of those elements contained in Field Data Soil Vapor Extraction Weekly Assessment, Appendix 3.

- Monthly VOC samples shall be taken at the discharge of SVE-1 exhaust and analyzed in accordance with USEPA TO-14 Method.

- Quarterly Groundwater Monitoring

  For the purposes of this CMS, no special sampling is required. Normal facility quarterly groundwater monitoring data shall be used in assessing SVE performance and affect on groundwater.

  If contaminants are detected using routine facility sampling protocol, those wells will be subjected to the effect of purge time on organic constituent concentrations observed in groundwater due to vadose contaminants.

  The procedure for this task is included in Appendix 2.

5.4.1 Soil Vapor Extraction Well (SVE-1)

The reduction in vapor concentration in the Vadose Zone or groundwater contamination beneath the Facility will be used as an empirical evaluation to describe the effectiveness of the pilot SVE system. Several operational scenarios for both extraction and influent rate and location management are expected to be evaluated. These operational scenarios will be based on field and laboratory monitoring data to determine the optimum operation of the SVE system. Each tested operational scenario will be discussed in the CMS Report with an evaluation and recommendation for future consideration.

Discharge of extracted vapors will be monitored to determine compliance with State air discharge standards. If the pilot field testing of the SVE demonstrates that off-gas treatment is required, the system will be field-fitted with the appropriate equipment. The information from the SVE effluent air monitoring will be evaluated with Vadose Zone sampling data to determine the effectiveness of the pilot system.

5.4.2 Geoprobe Wells

Geoprobe or small diameter sampling points will be installed to be used as monitoring locations in the pilot SVE study. The initial locations for shallow monitoring points are indicated in Figure 5.4. It is likely that the installation of the monitoring points may be performed in phases, in response to monitoring requirements determined by the pilot SVE system. For example, to determine the radius of influence of the SVE system, it may be necessary to install monitoring locations at distances that identify the boundary between those areas that are influenced, and those that are not influenced by the SVE system. Different operational parameters may affect the distances at which the monitoring points are useful.

Data that may be gathered during monitoring would include depth of installation, distance to SVE well, air flow into or out of the monitoring point, and concentration of waste constituents in the Vadose Zone.

The procedure for this task is included in Appendix 1. Data quality assurance procedures also are included in Appendix 1.

5.4.3 Assessment of SVE-1 System

The assessment of performance and viability of SVE-1 will be a dynamic process as data are obtained. The information gathered during the daily, weekly, and monthly sampling and quarterly groundwater monitoring will be used to fine-tune the system to optimize system performance. This process will include range of influence and environmental conditions that enhance or reduce the effectiveness of the system. VOC extraction rates will be tracked and trends will be developed to assess these influences. The configuration of those monitoring wells incorporated into the SVE system may be changed as information is obtained. If contaminants (VOC) are detected during groundwater monitoring in wells previously non-detect, those wells will be incorporated into the system. The decision matrix for this process is found as Figure 5.5.

5.5 EVALUATION OF VAPOR BARRIER

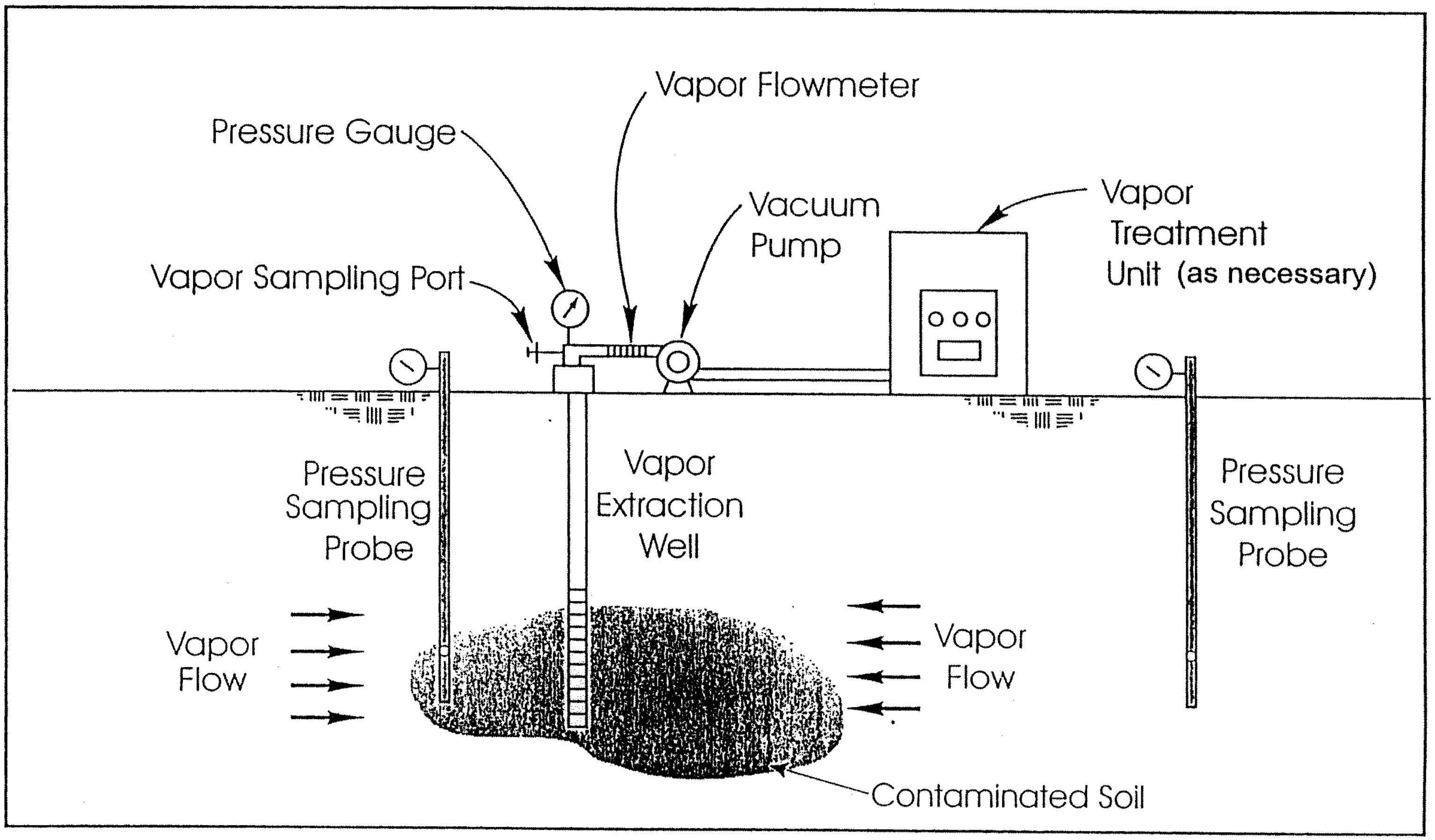
Existing monitoring wells will be incorporated into pilot SVE system as boundary wells. The groundwater monitoring wells are located near the site boundary. Currently, it is envisioned that caps with one-way valves allowing downward movement of ambient air in response to SVE pumping will serve to create a boundary system around the HWMF. Because the monitoring wells are screened partially in the groundwater and partially in the Vadose Zone, the SVE system should allow deep recharge of ambient air.

Data that may be gathered during monitoring would include distance to SVE well, air flow into the well, and concentration of waste constituents in the groundwater.

5.6 CONTINUE MODIFIED SAMPLING PROTOCOL

The sampling protocol experiment will be continued in the potentially damaged wells (MW-312 and MW-315), to examine the effect of purge volume on organic constituent concentrations observed in groundwater.

The procedure for this task is included in Appendix 1.



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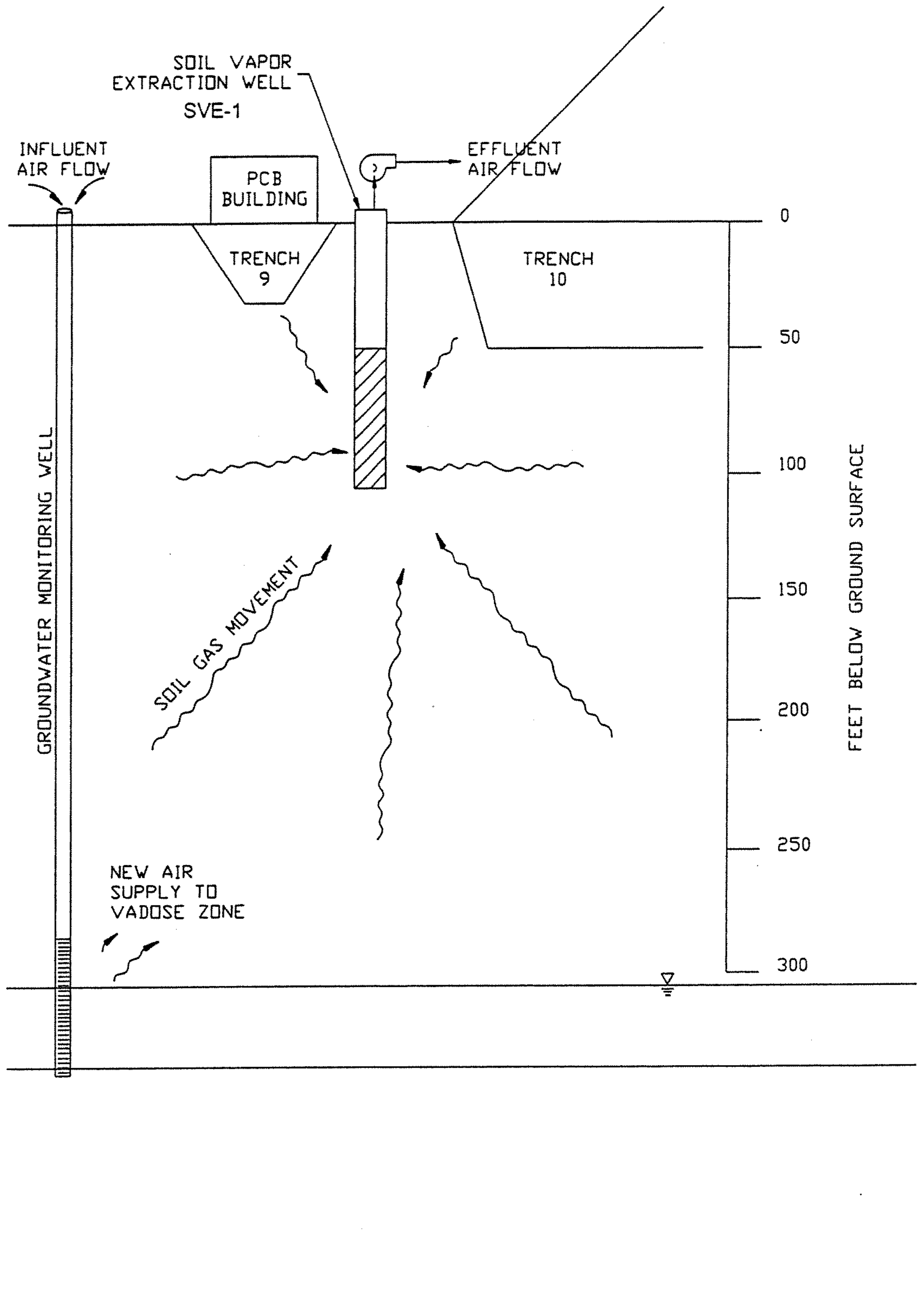
Englewood, Colorado

from: Nyer, E.K. et al., 1996, In Situ Treatment Technology

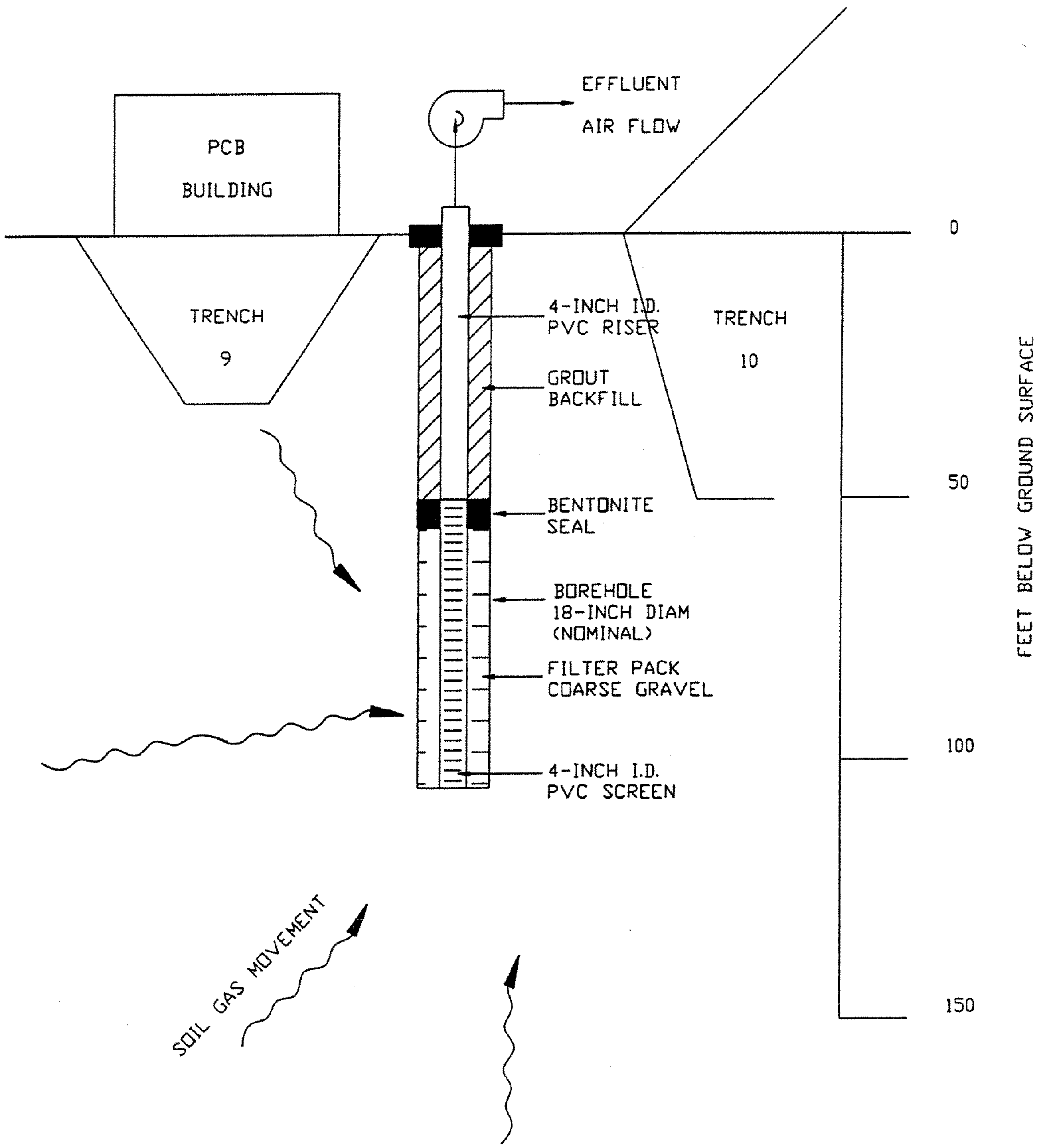
Figure 5.1
Typical Soil Vapor Extraction System



NOT TO SCALE

ENGLEWOOD, COLORADO AquAeTer

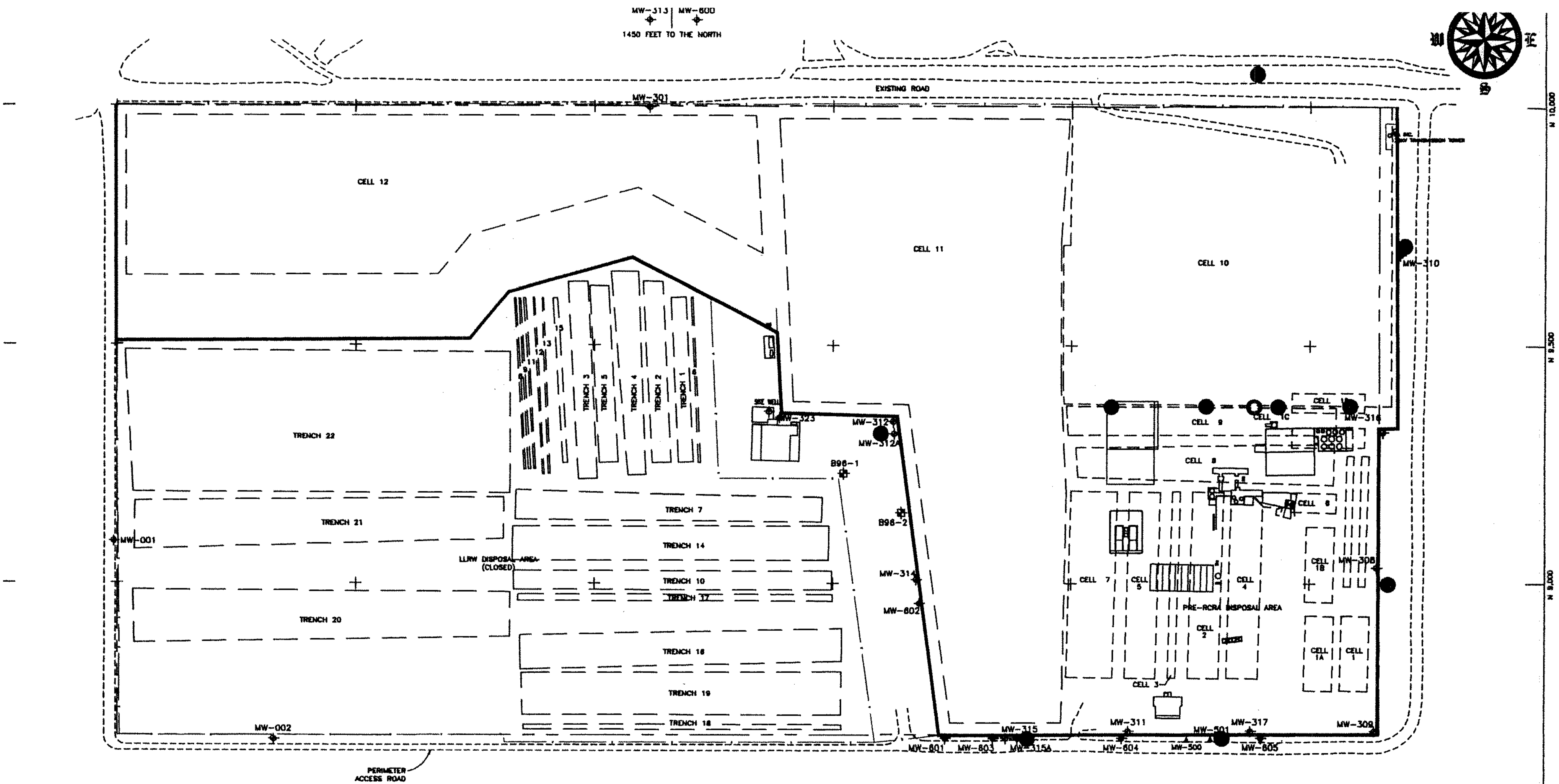
FIGURE 5.2
SCHEMATIC OF
SOIL VAPOR EXTRACTION SYSTEM
U.S. ECOLOGY
BEATTY, NEVADA



NOT TO SCALE

ENGLEWOOD, COLORADO AquAeTer

FIGURE 5.3
SCHEMATIC OF SOIL VAPOR
EXTRACTION WELL
U.S. ECOLOGY
BEATTY, NEVADA



LEGEND

- PERMIT LINE
- FENCE LINE
- UNIMPROVED ROAD
- POINT OF COMPLIANCE
- SITE COORDINATE SYSTEM MARKER LOCATION IN NORTHING AND EASTING
- MW-002 DETECTION MONITOR WELL LOCATION AND NUMBER
- MW-603 SUPPLEMENTAL MONITOR WELL LOCATION AND NUMBER
- MW-500 VALDOSE ZONE MONITOR WELL LOCATION AND NUMBER
- B98-1 CORRECTIVE ACTION BORING LOCATION AND NUMBER
- GEOPROBE MONITORING LOCATION
- SOIL VAPOR EXTRACTION WELL

SCALE 100 50 0 100 FEET

Rev	Drawn	Check	Appr	Date	Description

REVISIONS

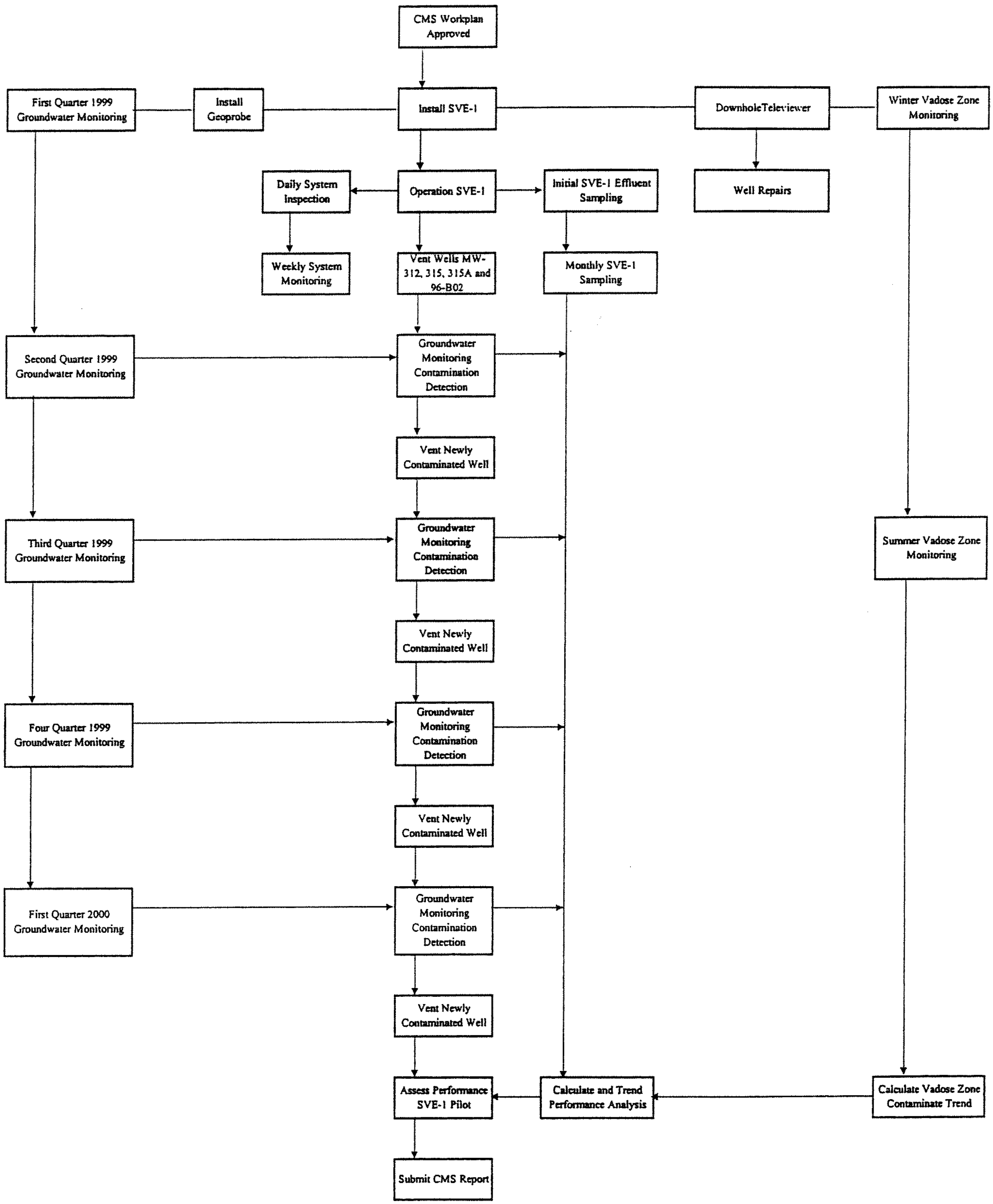
SOIL VAPOR EXTRACTION SYSTEM LOCATIONS

HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology
BEATTY, NEVADA

Drawing No.

Figure 5.4

Figure 5.5
CMS Workplan Flow Chart



6. REPORT FORMAT

The following is the anticipated outline for the CMS Report.

EXECUTIVE SUMMARY

1. INTRODUCTION/PURPOSE
   - Facility Description and History
   - Facility Environmental Setting

2. DESCRIPTION OF CURRENT CONDITIONS
   - Potential Sources of Contamination
   - Migration Pathways
     - Groundwater Pathway
     - Soil Pathway
     - Soil Gas Pathway
   - Summary of Impacted Areas
   - Voluntary Corrective Measures
     - SWMU Closure
     - Interim Corrective Actions

3. CORRECTIVE ACTION OBJECTIVES
   - Groundwater Standards

4. IDENTIFICATION AND SCREENING OF CORRECTIVE MEASURE TECHNOLOGIES APPROACH
   - Groundwater Corrective Measures
   - Soil Corrective Measures
   - Soil Gas Corrective Measures

5. CORRECTIVE MEASURE ALTERNATIVE DEVELOPMENT
   - Groundwater Corrective Measures
   - Soil Corrective Measures
   - Soil Gas Corrective Measures

7. CMS PROJECT MANAGEMENT

7.1 PROJECT PERSONNEL

The project team that will perform the CMS will include qualified US Ecology personnel. Key members of the US Ecology project team have been involved in previous investigations of the HWMF.

The remainder of the project team will consist of contractor personnel, hydrogeologic consultants and analytical laboratory personnel, and other support services. Subcontractors will be identified promptly after this CMS Workplan has been approved by NDEP.

The field data acquisition team, including professional and support personnel, will be experienced in the specific technical activities to which they will be assigned. Personnel will be experienced in pertinent field data collection activities described in this CMS Workplan. Laboratory personnel will be experienced in USEPA-approved procedures for conducting the assigned analyses.

CMS team members will have completed safety training required for their specific work assignment in accordance with Occupational Health and Safety Administration (OSHA) requirements and US Ecology standard operating practices.

7.2 CMS MANAGEMENT

7.2.1 Corrective Action Project Coordinator

The US Ecology Corrective Action Project Coordinator (CAPC) for the CMS implementation will be Mr. Zaki Naser. Mr. Naser is US Ecology's, Beatty, NV, HWMF General Manager.

7.2.2 Health and Safety Officer

Health and safety issues during the CMS will be administered by the Health and Safety Officer. The Health and Safety Officer will be a US Ecology employee. The CAPC will identify the Health and Safety Officer. The Health and Safety Officer will be responsible for monitoring compliance with the Health and Safety Plan. The Health and Safety Officer will identify health and safety issues or non-compliance with the Health and Safety Plan, and will initiate, recommend or provide solutions or corrective actions. The Health and Safety Officer will verify implementation of correction actions.

7.2.3 QA Officer

CMS quality assurance (QA) will be administered by the CMS Quality Assurance Officer (QAO). The CAPC will determine which organization will provide the QAO.

The QAO will be responsible for reviewing project records for the adequacy of compliance with this CMS Workplan. The QAO will identify quality problems or non-compliance with the Workplan, and will initiate, recommend, or provide solutions or corrective actions to correct deficiencies. The QAO will document implementation of corrective action.

In a quality assurance position, this person will not be directly responsible for performing or directing CMS data collection or reporting. However, this person can work under the general direction of the Corrective Action Project Coordinator.

7.3 CMS ORGANIZATION

Figure 7.1 illustrates the organization planned for the CMS and shows the relationship between US Ecology and contractor personnel.

7.3.1 US Ecology Personnel

The CAPC, Mr. Naser of US Ecology, will be assisted by US Ecology and contractor environmental specialists and scientists. Ms. Lori Taguchi of US Ecology, and other US Ecology personnel, will assist Mr. Naser with the CMS Workplan implementation.

7.3.2 Contractor Personnel

A hydrogeology consultant, drilling contractor, surveying contractor, and chemical laboratory will be required. Contractors in other areas might be required as the CMS proceeds. Contractors involved in on-site activities will be required to provide documentation of acceptable training.

7.3.2.1 Hydrogeology Consultant

The hydrogeology consultant will be knowledgeable of the tasks to be fulfilled as part of this CMS Workplan, and familiar with the necessary approach to successful completion.

7.3.2.2 Drilling Firm

The drilling firm will be selected on the basis of state certification and commitment to providing timely and cost-effective drilling and well installation services in accordance with the procedures included in this RFI Workplan. The quality of available equipment and the OSHA training and experience of field personnel also will be considered.

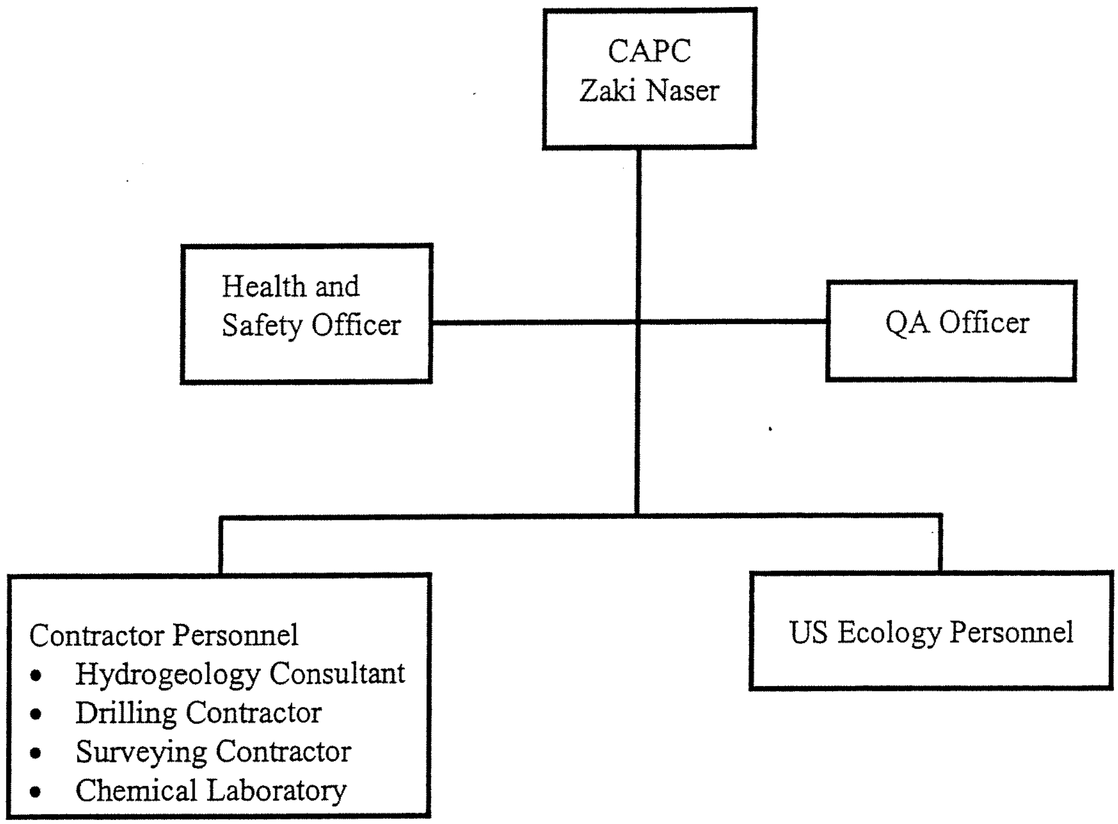
7.3.2.3 Land Surveyor

The land surveyor retained to conduct surveys for the RFI will be selected on the basis of availability of Nevada-licensed personnel, proximity to the HWMF, and commitment to providing timely and cost-effective surveying in accordance with the specific requirements of this RFI Workplan.

7.3.2.4 Chemical Laboratory

The laboratory retained to conduct chemical analyses of samples will be selected on the basis of commitment to providing timely and cost-effective testing service in accordance with a documented and operative QA/QC program.

Figure 7.1
CMS Organization



8. CMS SCHEDULE

The RCRA Permit contains the schedule requirement for the CMS. The CMS Workplan must be submitted to the agency within 60 days after US Ecology receives notification that the CMS is required. US Ecology received this notification on January 11, 1999, and has been informed that the CMS Workplan must be submitted to the NDEP by February 8, 1999.

US Ecology presents the following schedule for the submittal and projected approval date for the CMS Workplan, and the projected time for the start of field work.

Item	Date
RFI Report Approved	1/11
CMS Workplan Due (4 weeks)	2/08
CMS Workplan Approved (2 weeks)	2/22 projected
CMS Workplan Field Work Start (2 weeks)	3/08 projected

US Ecology has developed a detailed sequence schedule to aid in the identification of critical path items. As part of this sequence, US Ecology has developed an "early start" and "late start" schedule, with corresponding "early finish" and "late finish" dates. The early schedule is dependent on several items including:

- availability of contractors,
- availability of mechanical equipment for SVE,
- favorable weather, and
- no unforeseen subsurface conditions or difficulties.

The late schedule includes the possibilities for delays related to these above mentioned items that are outside of US Ecology's control.

CMS Tasks	Early Start	Late Start	Early Finish	Late Finish
• All Groundwater Sampling w/ Special Sampling (Task 6)	1/18	1/18	2/19	2/19
• Pull Well Internals (pumps and piping)	1/25	1/25	2/19	2/19
• Vadose Zone Sampling of All Site Wells (Winter Event) (Task 1)	2/22	3/1	2/26	3/5
• Down-Hole Televiewer (Task 2)	2/23	3/2	3/9	3/9

• SVE Pilot System Start-up (Task 3)				
Contract paper work	~1/18	2/22	3/9	3/9
Mobilize/on site (complete within 7 days of CMS Workplan Approval)			3/1	3/8
Order and Assemble Mechanical Equipment	2/22	2/22	3/5	3/8
Install Well and Equipment Setup/Preoperation Testing/Sealing Wells	3/1	3/8	3/12	3/26
Operational Start-up (Task 5)	3/5	3/26		
• Vadose Zone Monitoring Point Geoprobe (Task 4)				
Contract paper work	1/18	2/22	1/29	3/5
Mobilize/on site (complete within 7 days of CMS WP Approval)			3/1	3/8
Install	3/1	3/8	3/8	3/19
Sample	3/8	3/22	3/12	3/26
• Vadose Sampling of All Site Wells (Summer Event) (Task 1)	8/23	8/23	8/27	8/27

Sampling

Sampling	Daily	Weekly	Month	Quarterly	Semi-Annually
SVE					
Air Flow & Pressure	x				
SVE-1 (Summa canisters)			x		
Well Vapor					
All wells & Geoprobe (Summa canisters)					x
GW Sampling				x	
Air Flow, PID, LEL (all wells in system, and geoprobe)		x			
SVE Physical inspection (physical conditions, mechanical conditions, measured values, date/time/weather)	x				

Reporting

Item	Frequency	Content
CMS Progress Reporting	15 days following the end of the bimonthly period (starting 60 days following approval of the CMS Workplan)	Description of significant activities and work completed Summary of system effectiveness. Compare with prediction. Summary of findings, SVE effluent data, monitoring well data Contact with agency/public Any problems and solutions Personnel changes Projected work
CMS Report	90 days after completion of pilot test	Introduction/Purpose DOCC Corrective Action Objectives Identification and Screening of Corrective Measures Technologies Corrective Measures Alternative Development Evaluation of Corrective Measure Alternatives Recommendation and Justification of Corrective Measure Alternative Summary of Recommended Corrective Measure Alternative
Revised CMS Report	30 days following receipt of NDEP review comments	Incorporate review comments

9. BIBLIOGRAPHY

AquAeTer, Inc., 1998. Final Report, Pathways Evaluation, RCRA Disposal Facility, Beatty, Nevada, prepared for US Ecology.

Camp, Dresser & McKee, 1995. 1994 Vadose Zone Sampling Summary Report.

Camp, Dresser, and McKee, 1996, US Ecology, Beatty Facility Interim Measures Plan, Phase I and II.

Clebsch, A., Jr., 1962. Geology and Hydrology of a Proposed Site for Burial of Solid Radioactive Waste Southeast of Beatty, Nye County.

EMCON, 1973. Evaluation of the Potential for Waste Migration and Contingency Plan for Waste Containment, Industrial-Nuclear Waste Disposal Site, Beatty, Nevada.

EMCON, 1973. Geologic Investigation to Determine Extent of Phosphoric Liquor Migration and Installation of Monitoring Wells, Beatty, Nevada.

EMCON, 1994. Corrective Measures Study, PCB Draining and Flushing Area, US Ecology Landfill, Beatty, Nevada

Geraghty and Miller, Inc., 1990. Abandonment of Five Groundwater Monitoring Wells at the US Ecology, Inc., Beatty, Nevada Facility Chemical Site.

Geraghty and Miller, Inc., 1991. Drilling and Installation of Six Monitoring Wells at the US Ecology, Inc., Beatty, Nevada Facility Chemical Site.

Geraghty and Miller, Inc., 1991. Drilling, Sampling, and Installation of Two Monitoring Wells at the US Ecology, Inc., Beatty, Nevada Facility Rad Site.

Grant, J. L. & Associates, 1989 and 1993. The Beatty Source Term and Evaluation of the US Ecology Dose Model and Pathways Analysis, Beatty, Nevada Low Level Radioactive Waste Disposal Site, prepared for US Ecology.

Grant, J. L. & Associates, 1990. Beatty, Nevada Aquifer Test Review, prepared for US Ecology.

Johnson, P.C., Stanley, C.C., Kemblowski, M.W., Byers, D.L., and Colthart, J.D., 1990, A practical approach to the design, operation, and monitoring of in-situ soil-venting systems., Ground Water Monitoring & Remediation.

Law Engineering and Testing Company, 1981, Geohydrological Studies, Beatty, Nevada Disposal Facility.

Mark Group, 1989. Exploratory boring and monitoring well installation program, US Ecology RCRA Facility, Beatty, Nevada, 2 Volumes, prepared for US Ecology.

Nevada Division of Environmental Protection, 1998, Beatty, Nevada Hazardous Waste Management Facility Permit, HW Permit NEV HW0011, Rev 1., April 1997.

Nichols, W. D., and Akers, J. P., 1985. Water-Level Declines in the Amargosa Valley Area, Nye Co., Nevada 1962-84. U.S. Geological Survey Water Resources Investigation Report 85-4273.

Nichols, W.D., 1986, Geohydrology of the Unsaturated Zone at the Burial Site for Low-Level Radioactive Waste Near Beatty, Nye County, Nevada. US Geological Survey, Open-File Report 85-198.

Nyer, E.K., Fam, S., Kidd, D.F., Johns, F.J., Palmer, P.L., Boettcher, G., Crossman, T.L., and Suthersan, S.S., 1996, In Situ Treatment Technology, Lewis Publishers.

Settlement Agreement, 1993. Court approved agreement between the State of Nevada and US Ecology on terms for the LLRWDF closure and stabilization and lease renewal.

US Ecology, Inc., 1986. Beatty, NV, Letter dated 11/18/86 concerning the LLRWDF as a SWMU.

US Ecology, Inc., 1987. Monitoring Well 307 Evaluation.

US Ecology, 1989. RCRA Facility Investigation Plan, US Ecology, Beatty, Nevada Facility, Permit # NEV HW002.

US Ecology, 1989. Site Stabilization and Closure Plan for Low-Level Radioactive Waste Management Facility, US Ecology, Beatty, Nevada, Radioactive Materials License State of Nevada, No. 13-11-0043-02.

US Ecology, 1990. RCRA Facility Investigation Workplan, US Ecology, Beatty, Nevada Facility, Permit # NEV HW002.

US Ecology, 1992. RCRA Facility Investigation Report, US Ecology, Beatty, Nevada Facility, Permit # NEV HW002.

US Ecology, 1995. Corrective Action Plan, Beatty, Nevada Facility Permit # NEV-HW002.

US Ecology, 1998. Current Conditions Report for US Ecology's Hazardous Waste Management Facility, Located near Beatty, Nevada, HW Permit NEV HW0011.

US Ecology, 1998. RFI Workplan, Revision 1, November 20, 1998.

US Ecology, 1998. RFI Report, Revision 1, December 15, 1998.

U.S. EPA, 1986. Groundwater Task Force Report, Beatty, Nevada Facility.

Appendix 13 G

Justification for Elimination of Monitoring Requirements for the 600-series Wells

AquAeTer optimizing environmental resources | water, air, earth
7430 East Caley Avenue, Suite 310 ◦ Centennial, CO 80111 ◦ Phone (303) 771-9150 ◦ Fax (303) 771-8776

August 25, 2010

093205

US Ecology Nevada, Inc.
P.O. Box 578
Beatty, Nevada 89003

Attention: Mr. Scott Wisniewski

**RE: Justification for Elimination of Monitoring Requirements at 600-series Wells
US Ecology Nevada, Inc., Beatty, Nevada**

Dear Mr. Wisniewski:

AquAeTer, Inc. has completed a review of groundwater conditions at the US Ecology Nevada, Inc. (USEN) facility located in Beatty, Nevada in support of justification for elimination of monitoring and reporting for 600-series monitoring wells. The scope of this review of monitoring well data and water bearing zone characteristics was initially proposed in **AquAeTer's** proposal #093205P, as authorized by USEN on October 6, 2009 and refined in recent telephone conversations between you and Mr. Chris Bolin.

BACKGROUND

Natural subsurface materials at the USEN facility include about 300 feet of unsaturated strata above groundwater (the Vadose Zone) that consist of primarily of interbedded sandy gravels and gravelly sands, with some layers of fine-grained materials (i.e., silt and clay). Typically, individual layers of fine-grained in the Vadose Zone are not continuous beneath the entire Facility area, but the sequence of discontinuous fine-grained sediment layers in the Vadose Zone impedes downward movement of infiltrating water or contaminants. Further, downward movement of infiltrating water is significantly impeded by the extremely low moisture content of Vadoze Zone sediments. Research conducted at the Amargosa Desert Research Site (ADRS), located adjacent to the Facility, indicates that the dominant direction of moisture movement within the Vadose Zone is upward[1].

Groundwater occurs below the Vadose Zone in two zones. The Upper Water-Bearing Zone occurs between about 326 and 340 feet deep, and the Lower Water-Bearing Zone occurs at about 350 feet deep. A continuous fine-grained stratum separates the Upper Water-Bearing Zone and

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1 Stonestrom, D.A., Abraham, J.D., Andraski, B.J., Baker, R.J., Mayers, C.J., Michel, R.L., Prudic, D.E., Striegl, R.G., and Walvoord, M.A., 2004, Monitoring Radionuclide Contamination in the Unsaturated Zone--Lessons Learned at the Amargosa Desert Research Site, Nye County, Nevada: Proceedings, Workshop on Long-Term Performance Monitoring of Metals and Radionuclides in the Subsurface, Reston, VA, April 20-22.

Lower Water-Bearing Zone. The Upper Water-Bearing Zone is considered to be semi-confined to confined and is monitored by the 300-series groundwater monitoring wells. The Lower Water-Bearing Zone is confined and is composed of thin interbedded sand and gravel layers. It occurs at depths of about 350 feet and greater below the ground surface, and is monitored by the 600-series monitoring wells.

AquAeTer assisted USEN with groundwater monitoring reporting in the past and recently assisted USEN with statistical analyses of groundwater data. Recently, we were made aware of Facility RCRA Permit modifications being done as part of your Permit renewal. Also, we understand that a notice of deficiency (NOD) was issued by the State for failure to address sampling at 600-series wells in the Permit renewal.

It is **AquAeTer**'s understanding that the current RCRA Permit (NVT330010000) specifies wells to be sampled, parameters to be analyzed, and schedule for sampling. The 600-series wells include MW-600, 601, 603, 604, and 605. The wells are identified in the Permit as supplemental lower aquifer monitoring wells. Samples from the supplemental wells are analyzed for constituents included in Tables 10.4, 10.5, and 10.6 (in accordance with Section 10.7.1.1). 600-series well monitoring is scheduled to occur once every five quarters.

USEN has monitored both the 300-series and 600-series wells as a condition of the RCRA Permit. Recent updates to the Permit include a re-evaluation of the applicability of sampling the 600-series wells. Based on **AquAeTer**'s review of data collected from the 600-series wells and assessment of the water bearing zone characteristics we provide the following justification for their elimination from the groundwater monitoring plan.

WELL PAIRS

The USEN groundwater monitoring system includes wells located in the Upper Water-Bearing Zone and Lower Water-Bearing Zone. Wells in close proximity to each other, but screened in separate water bearing zones are considered to be "well pairs" in this justification, for the purpose of comparing their hydrologic and chemical properties. Well pairs include the following:

1. MW-313/MW-600
2. MW-327/MW-601
3. MW-315A/MW-603
4. MW-311/MW-604
5. MW-317/MW-605

INDICATOR PARAMETER AND METALS CONSTITUENT CONCENTRATION COMPARISONS

AquAeTer has imported USEN groundwater data into the statistical database program, DUMPStat™. The database program allows the query or inorganic and indicator parameters in 300 and 600-series wells including:

1. Water-quality constituents (including chloride, specific conductance, cyanide, fluoride, nitrate/nitrite-n, pH, sulfate, TOX, TOC); and

2. Metals (Ag, As, Ba, Cd, Cr, Hg, Na, Pb, and Se).

DUMPStat™ query outputs consist of trend graphs of concentration versus time, and up-gradient prediction limits. The trend graphs are used to compare indicator parameter and metals concentrations at respective well pairs and to determine if variances in concentrations support a justification that these are separate groundwater bearing zones. The graphical displays included in Attachment 1 summarize the results for 300-series and 600-series wells. Representative parameter concentrations are summarized in Table 1. Comparison of constituent concentration at 300-series wells and their respective 600-series well pair confirms the similarity of water quality and metals concentrations. Although some variations exist, they appear to be minimal and indicate the waters likely are of similar origin and that the water-bearing strata are of similar composition and chemical makeup. Given the similarity of the geologic origins of the water-bearing strata, this physical and chemical similarity is expected. However, the similarity of the indicators of basic water quality should not be considered to be evidence that the two zones are not hydraulically separated beneath the Facility. The two zones, though possibly interconnected at an up-gradient (off-site) location, are hydraulically separated beneath the Facility. Other data and interpretations supportive of this separation are presented below.

CROSS SECTIONS

AquAeTer reviewed cross-sections and monitor well installation logs to evaluate subsurface media. The pertinent cross-sections are included as Attachment 2. The two water-bearing zones are shown to be separated by a confining layer that is made up of several feet of low to high plasticity silts and clays. The hydraulic conductivity of the fine-grained confining layer, though not confirmed by site-specific testing, is likely to be several orders of magnitude lower than that of the coarser-grained materials comprising the matrix of the two water-bearing zones. Based on our evaluation, it appears to be unlikely that the two zones are hydraulically connected beneath the USEN Facility and contaminant impacts to the Upper Water-Bearing Zone are unlikely to impact the Lower Water-Bearing Zone within the area monitored by 300 and 600-series wells. .

GROUNDWATER ELEVATIONS

Historic groundwater elevation data was examined to determine if variability exists between the 300 and 600-series well pairs. As shown on Figure 1 and included in Attachment 3, variations do exist at the well pairs. All well pairs except MW-327/MW-601 show approximately 20 feet of vertical difference with the 300 series wells being the upper potentiometric surface.

MW-327 is about 200 feet from MW-601. Based on the February 2009 potentiometric map, the groundwater elevation in the Upper Water-Bearing Zone, at a location equivalent to MW-601, is approximately 2452 ft msl or approximately 8 feet higher than the Lower Water-Bearing Zone The actual and theoretical differences in groundwater elevation for this well pair are shown on Figure 1.

The variations in groundwater elevation data provide an additional line of evidence that the two zones are not hydraulically connected.

WATER-BEARING ZONE CHARACTERISTICS

Historic groundwater flow directions have minor variations as illustrated on potentiometric maps included in Attachment 3. The Upper Water-Bearing Zone has a localized flow direction that varies across the site, a hydraulic conductivity of 61 feet per day and a hydraulic gradient of approximately 0.03 to 0.04 feet per foot. The Lower Water-Bearing Zone has a localized flow direction towards the south-southwest, a hydraulic conductivity of 2 feet per day and a hydraulic gradient of approximately 0.01 feet per foot. The differences, particularly the differences in groundwater flow direction, are indications of hydraulic separation. More closely comparable flow directions and rates would be expected if the two zones were hydraulically connected.

The facility water production well is located in close proximity to MW-313 and MW-600 and is completed in the Lower Water-Bearing Zone. The hydrograph of this well pair (included on Figure 1) shows significant fluctuations in groundwater levels in MW-600, believed to be the result of pumping from the facility production well. These same fluctuations are not observed in MW-313, evidence that the two zones are not hydraulically connected.

DETECTIONS OF VOCS

Volatile organics are not naturally occurring constituents of water-bearing zones and, where present, indicate impact that is attributable to the history of waste disposal at the Facility. Within the USEN monitoring system, some 300-series wells have been impacted by VOCs in the past. Those detections have occurred at wells located in close proximity to the disposal cells and are generally thought to be the result of the presence of soil gas containing volatile constituents in the Vadose Zone and migration of soil gas within the vadose zone and diffusion into the groundwater of the Upper Water-Bearing Zone. Further, it is believed that vertical migration of soil gas (and VOCs) in the Vadose Zone might be associated with monitor well borings, allowing gas to move vertically along preferential pathways associated with the borings. Where gas contacts groundwater (or interstitial water) in the vadose zone, VOCs can partition from the gas into the water. The low concentration detections of some VOCs in USEN wells offer confirmation of the influence of vadose zone gas on groundwater.

Gas-related VOC movement is limited by the presence of groundwater. That is, the groundwater surface provides a distinct lower boundary to gas movement. Thus, the migration mechanism that is suspected of being the primary cause for VOC impact to the upper zone cannot affect the lower zone.

VOC impacts are not observed in the Lower Water-Bearing Zone. The absence of such impacts in the lower zone is an indication of the effectiveness of the fine-grained stratum separating the upper and lower zones, and the absence of hydraulic connectivity between the zones.

CONCLUSIONS

The Upper and Lower Water-Bearing Zones located at the USEN facility have distinctive characteristics that support the conclusion that the two zones are not hydraulically connected. The geologic makeup of the two zones are similar and they exhibit similar historic water quality (indicator parameters and metals) suggesting that the water within each zone originated from a similar source, such as the surrounding zones of higher elevation. However, at the USEN Facility they are separate units.

Consideration of historic groundwater levels indicates the head pressures are different at the paired wells. Connected water-bearing zones would be expected to have the similar head pressures at similar locations. In addition, the characteristics of the water-bearing zones are different, including different groundwater flow directions, different hydraulic conductivities, and variations in potentiometric gradient. Finally, VOCs have been detected in the Upper Water-Bearing Zone, but not in the Lower Water-Bearing Zone.

Based on the findings of this assessment, it is concluded that the Upper and Lower Water-Bearing Zones are separated by a less permeable (lower hydraulic conductivity) stratum that is continuous beneath the Facility. With the intervening stratum limiting hydraulic connection between the water-bearing zones, the potential for vertical contaminant migration from the upper to lower zones is unlikely. The absence of impact and the poor hydraulic connectivity between the zones provides justification for the conclusion that monitoring of the 600-series wells is unnecessary. **AquAeTer** recommends that the 600-series wells be eliminated from the requirement for groundwater monitoring through the RCRA Permit modification process.

CLOSING REMARKS

We recognize that this groundwater monitoring recommendation differs from the requirements established in the current RCRA Permit, and that a Permit modification probably will be required to make the requested change. Accordingly, the next step should include obtaining NDEP concurrence with the suggested approach for monitoring of groundwater impact at the USEN Beatty facility. To begin a dialog with NDEP, **AquAeTer** suggests providing this letter or a similar summary to NDEP for review and comment.

We appreciate the opportunity to work with USEN on this project. If you should have questions or comments concerning this justification, please contact us by telephone at (303) 771-9150, by FAX at (303) 771-8776, or by electronic mail at cbolin@aquaeter.com.

Sincerely,
AquAeTer, Inc.

Chris A. Bolin
Project Manager

Stephen L. Wampler
Director of Engineering

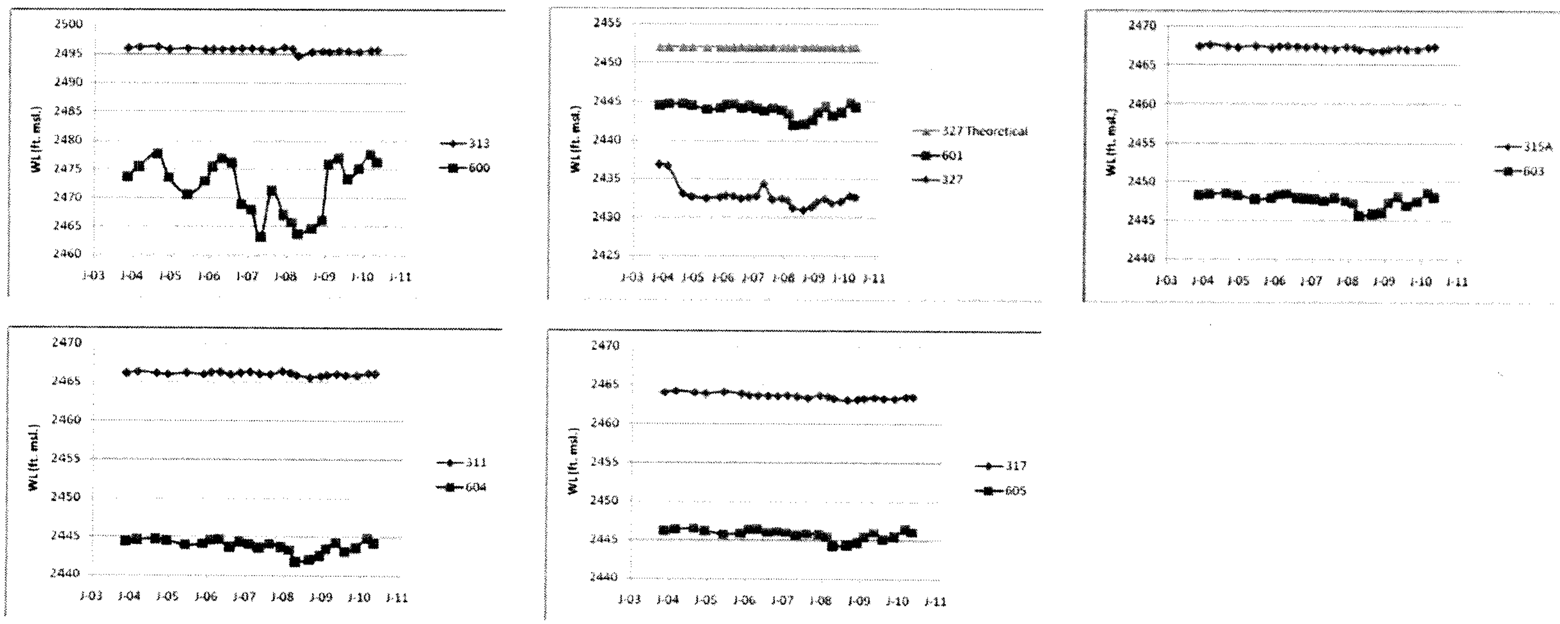
Attachments: as stated

Table 1 Summary of Indicator Parameter and Metals Constituent Concentration Comparisons

Parameter	Well Pair									
	MW-313/MW-600		MW-327/MW-601		MW-315A/MW-603		MW-311/MW-604		MW-317/MW-605	
	MW-313	MW-600	MW-327	MW-601	MW-315A	MW-603	MW-311	MW-604	MW-317	MW-605
Water Quality										
Chloride	75	75	80	80	80	80	75	80	75	75
Specific Conductance	1100	1000	1100	1050	1100	1000	1100	1000	1050	1000
Cyanide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoride	3.5	3.5	3.5	3.0	4.0	3.0	3.0	3.0	3.0	3.0
Nitrate/Nitrite	0.25	0.2	0.2 t 0.4	0.2	0.2 to 0.6	0.2	0.3 to 0.8	0.2	0.1 to 0.7	0.2
pH	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Sulfate	200	160	175	190	190	175	175	175	190	175
TOX	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TOC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metals										
Arsenic	0.005 to 0.010	0.0150 to 0.020	0.001	0.01	0.007	0.01	0.006	0.01	0.007	0.01
Barium	0.025	0.02	0.025	0.02	0.025	0.03	0.025	0.02	0.025	0.04
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	0.020	0.020	0.030	0.040	0.020	0.010	0.025	0.020	0.020	0.020
Lead	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	175	175	175	175	175	175	160	175	150	175

US Ecology Nevada, Inc.
Mr. Scott Wisniewski
August 25, 2010

Figure 1 Groundwater Elevation Data (Presentation by Well Pairs)



Note: MW-327 is about 200 feet from MW-601. Based on the February 2009 potentiometric map, the groundwater elevation in the Upper Water-Bearing Zone, at a location equivalent to MW-601, is approximately 2452 ft msl or approximately 8 feet higher than the Lower Water-Bearing Zone (as shown on the above figure as "327 Theoretical").

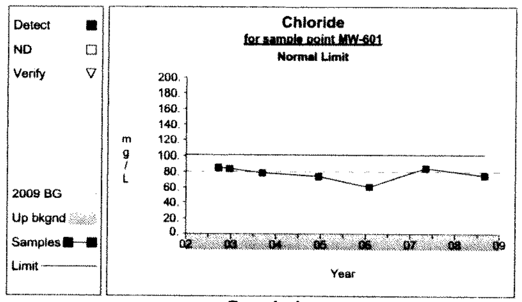
ATTACHMENT 1

WATER QUALITY AND METALS CONCENTRATION TREND GRAPHS FOR 300 AND 600 SERIES WELLS

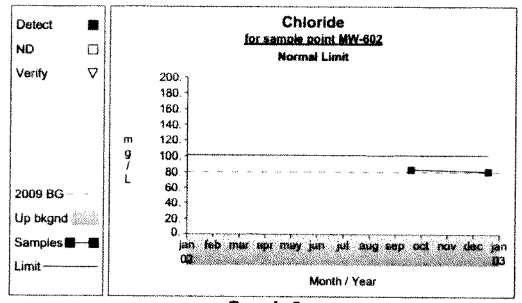
Beatty [wqdeep]

Analysis prepared on: 8/11/2010

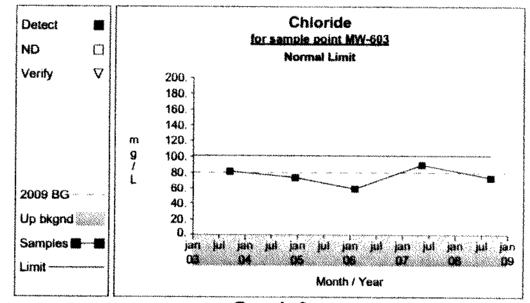
Up vs. Down Prediction Limits



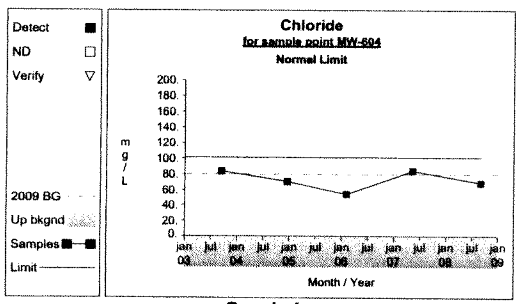
Graph 1



Graph 2



Graph 3



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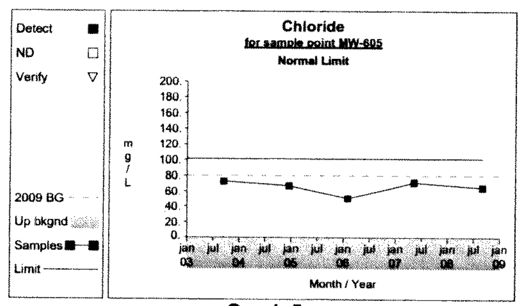
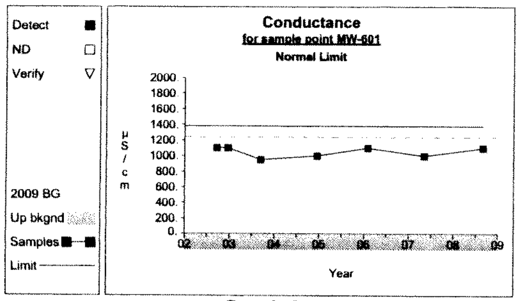
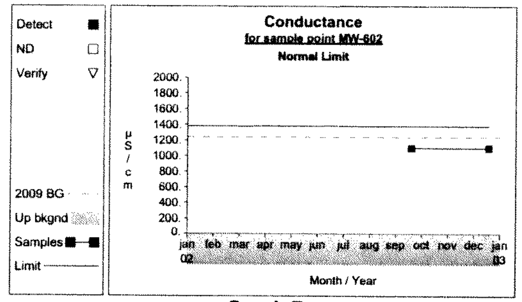


Graph 5

Up vs. Down Prediction Limits



Graph 6



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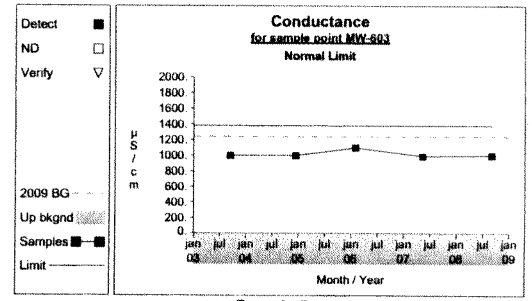

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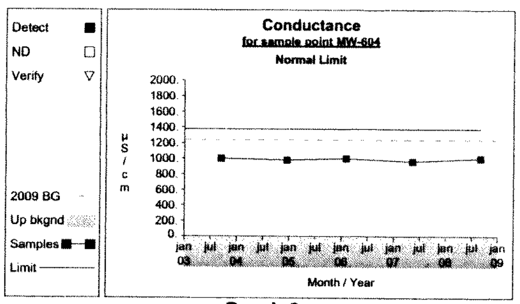

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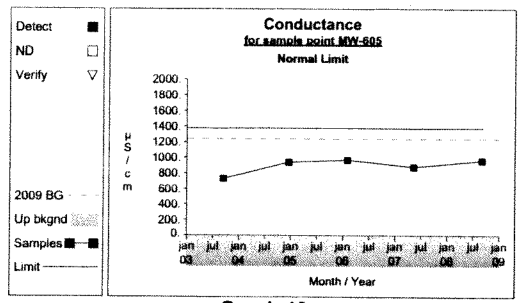
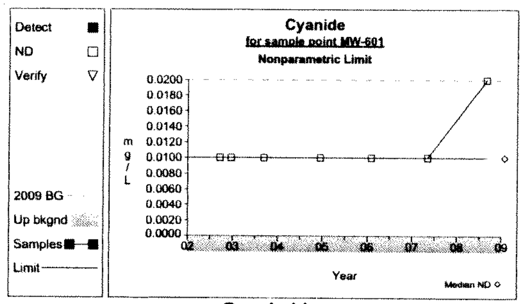


Graph 10

Up vs. Down Prediction Limits



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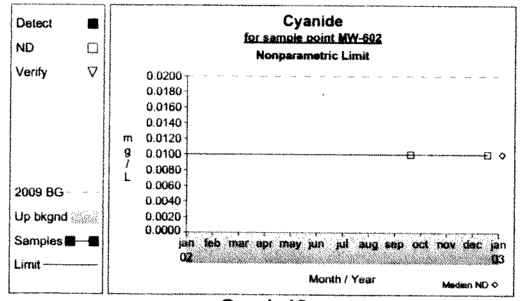

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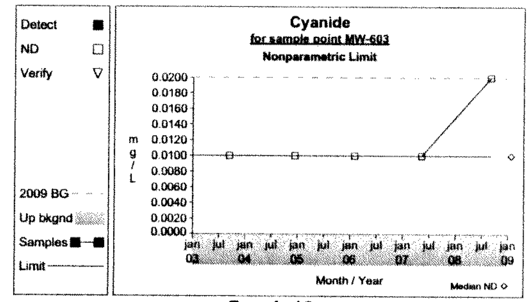

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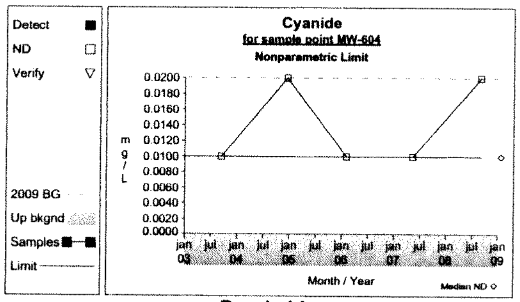

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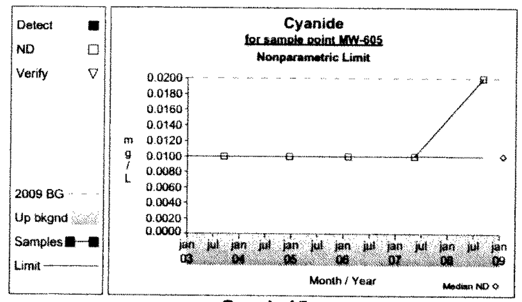
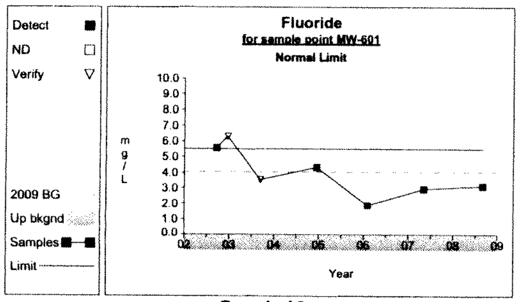


Graph 15

Up vs. Down Prediction Limits



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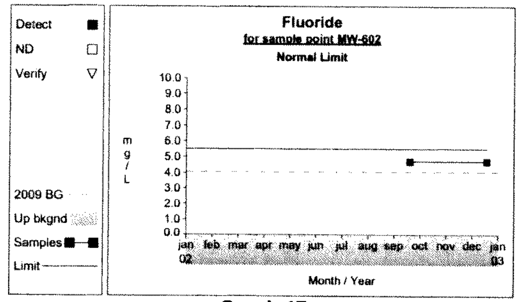

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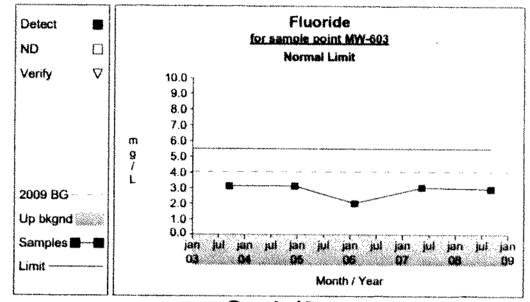

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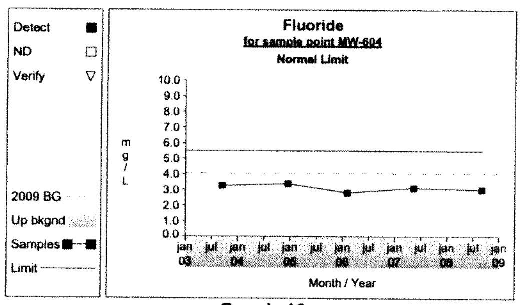

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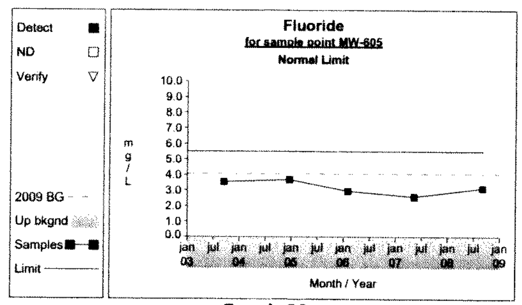
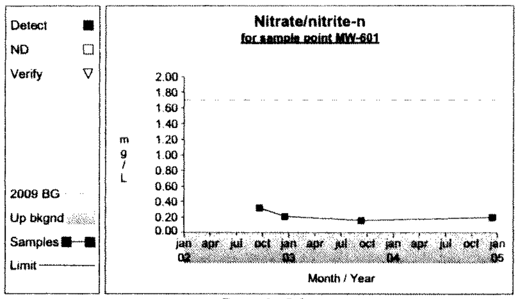


Graph 20

Up vs. Down Prediction Limits



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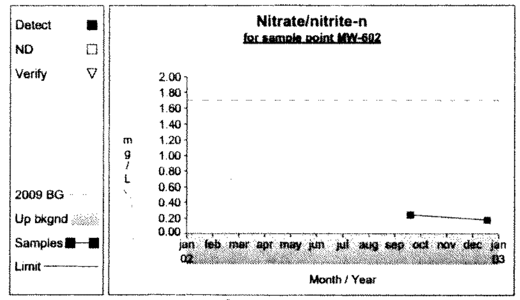

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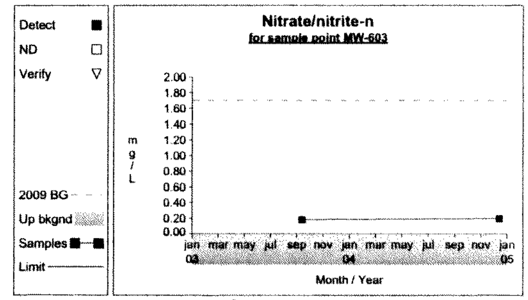

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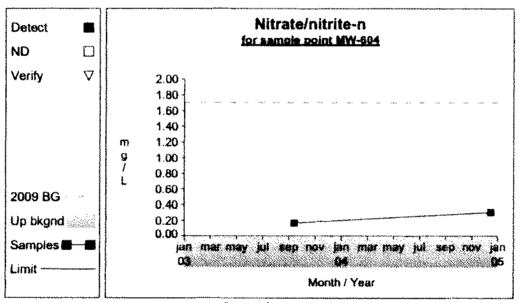

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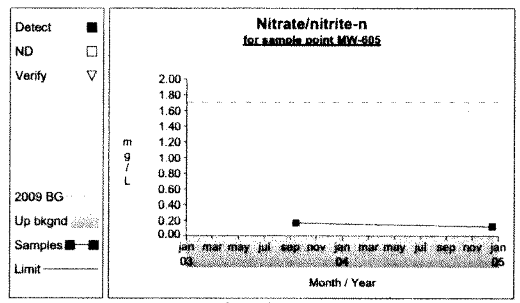

Graph 25

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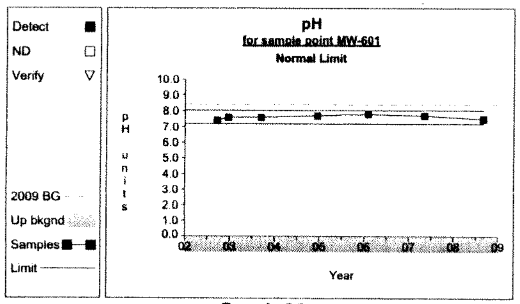

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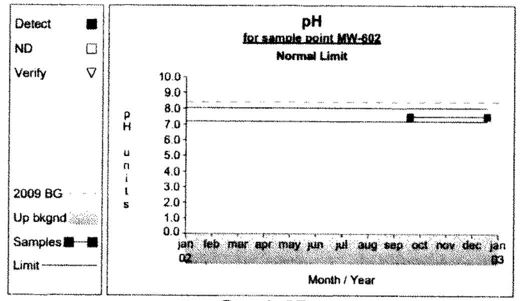

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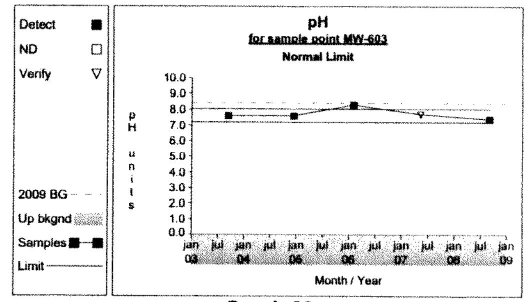

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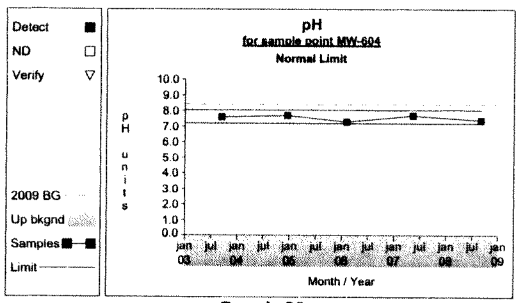

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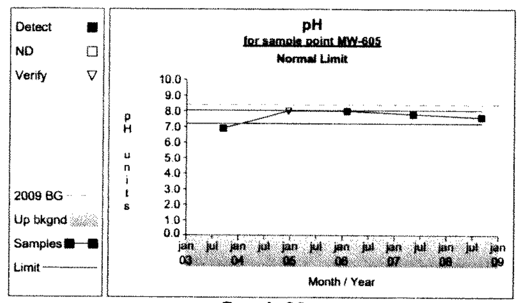

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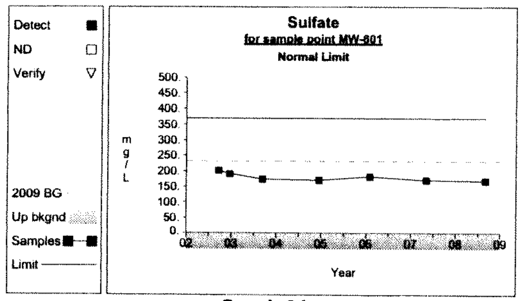

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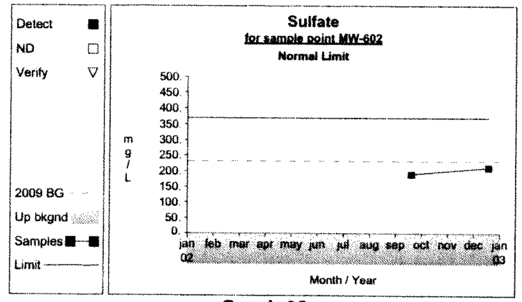

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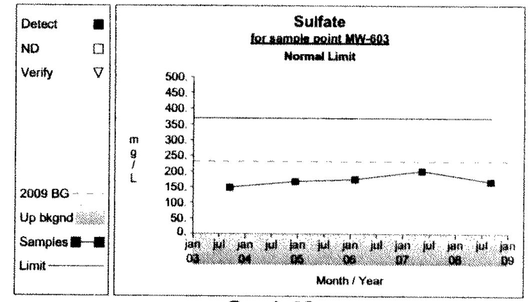

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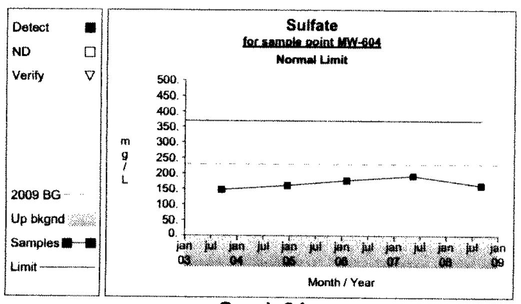

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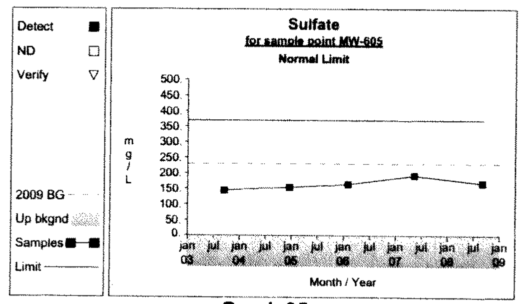
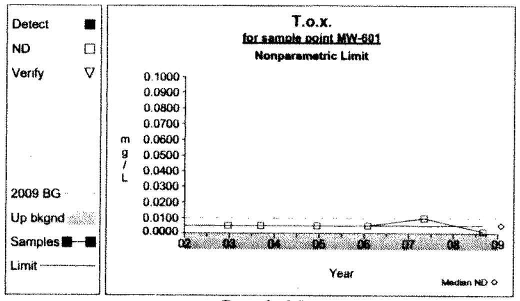


Graph 35

Up vs. Down Prediction Limits



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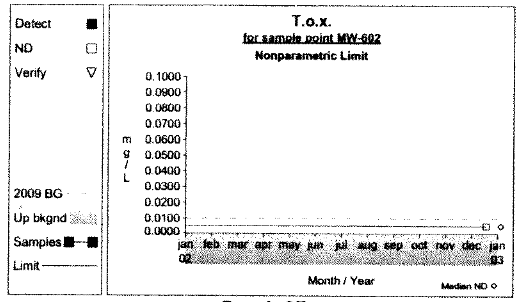

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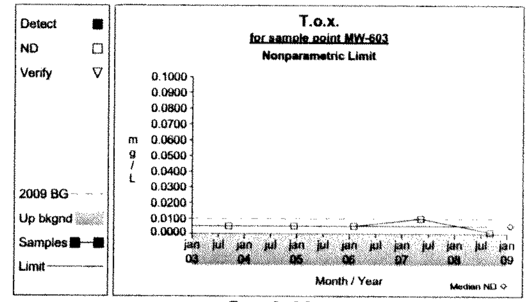

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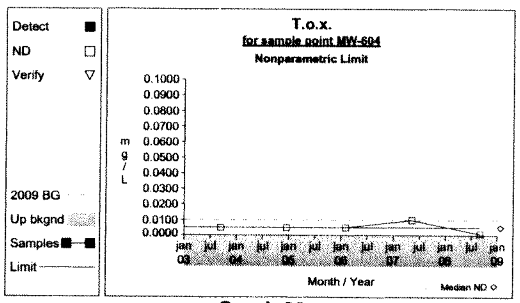

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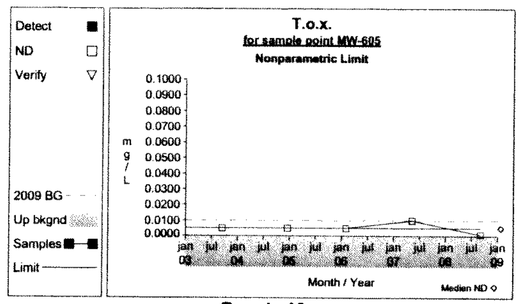
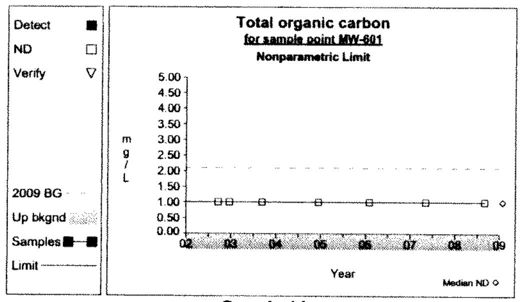


Graph 40

Up vs. Down Prediction Limits



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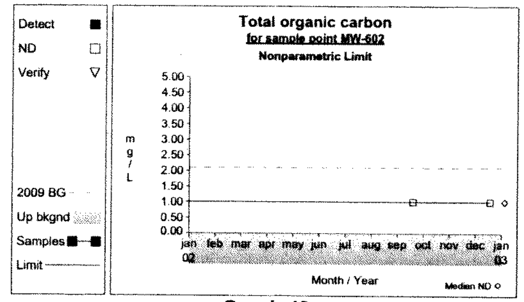

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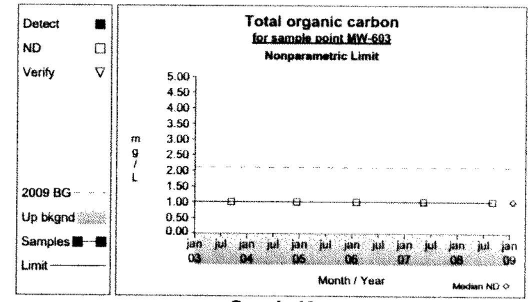

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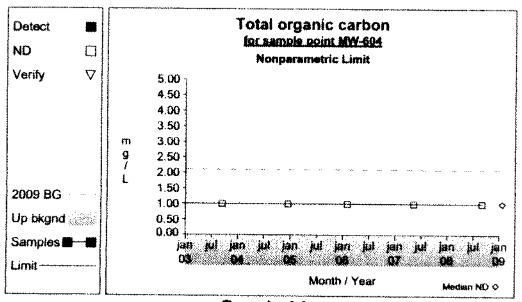

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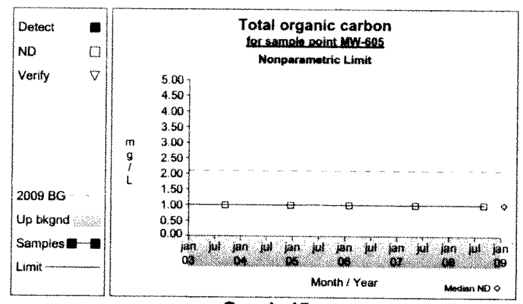

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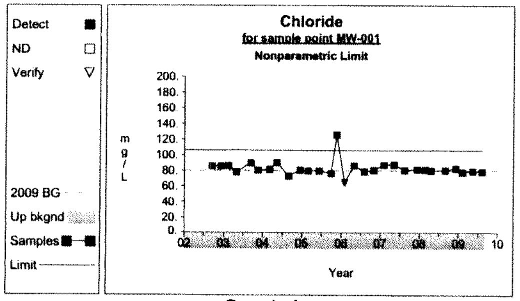
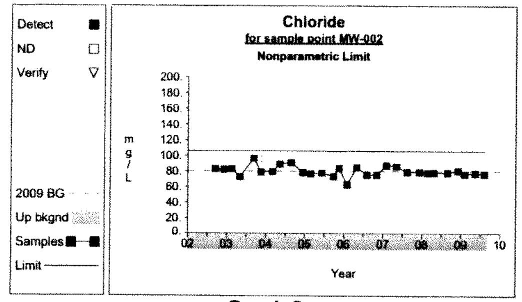
Up vs. Down Prediction Limits



Graph 1



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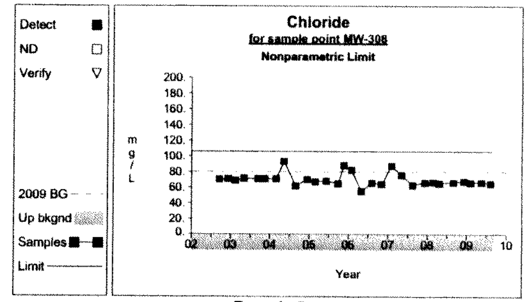

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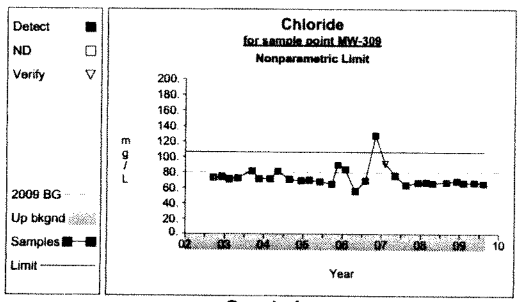

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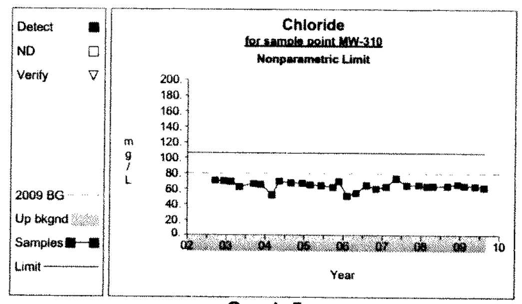

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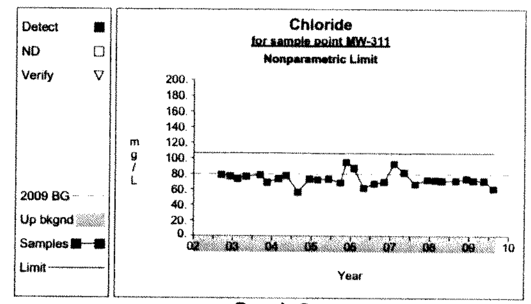
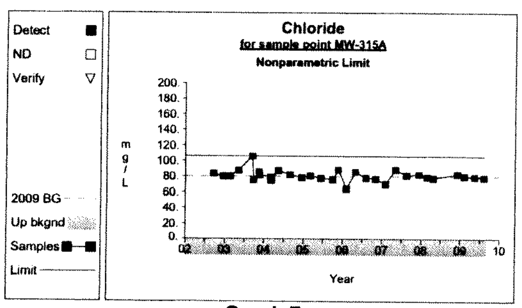


Graph 6



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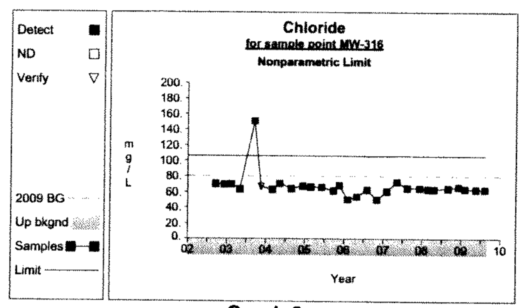
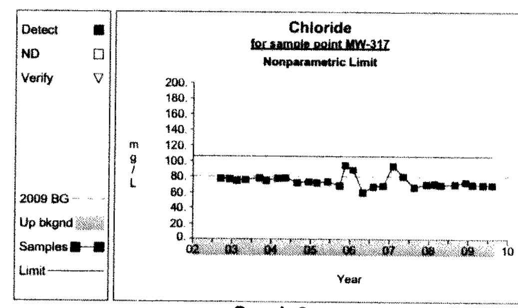


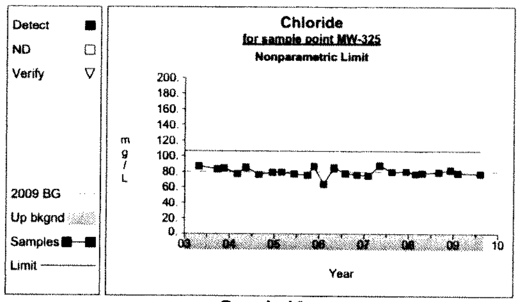
Graph 8



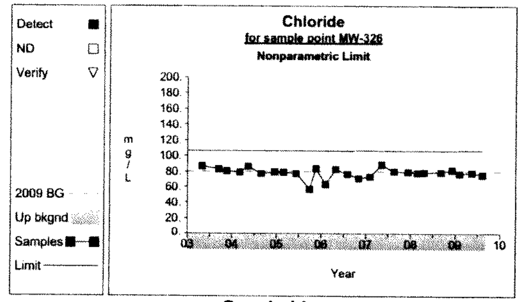
Graph 9

Prepared by: AquAeTer, Inc.

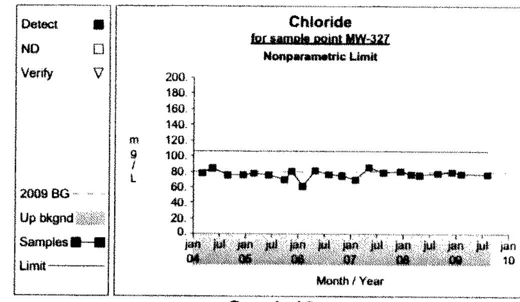
Up vs. Down Prediction Limits



Graph 10

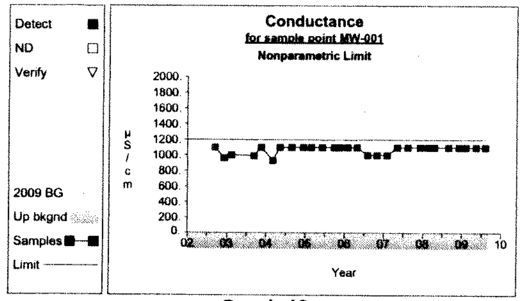


Graph 11

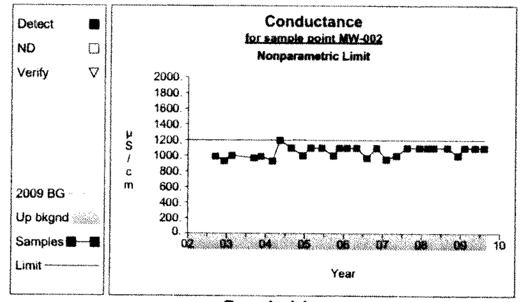


Graph 12

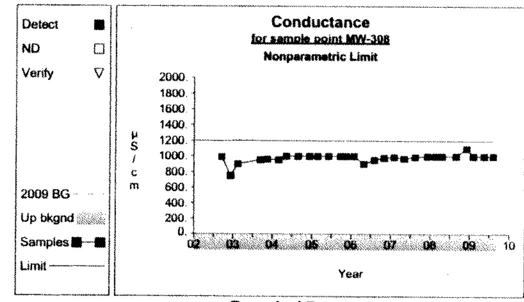
Up vs. Down Prediction Limits



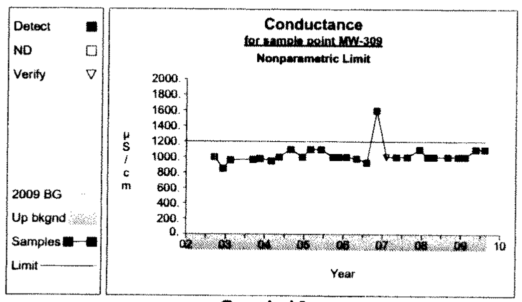
Graph 13



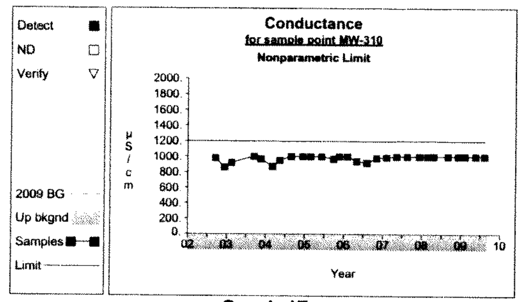
Graph 14



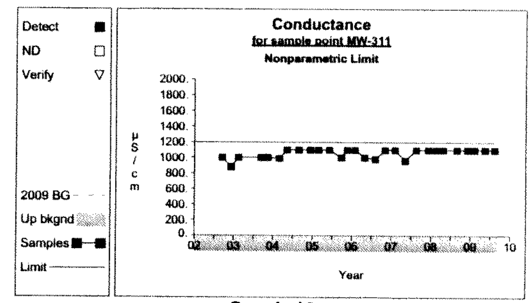
Graph 15



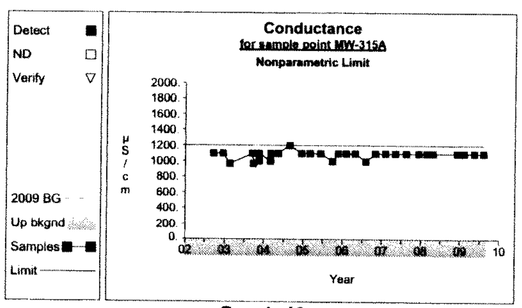
Graph 16



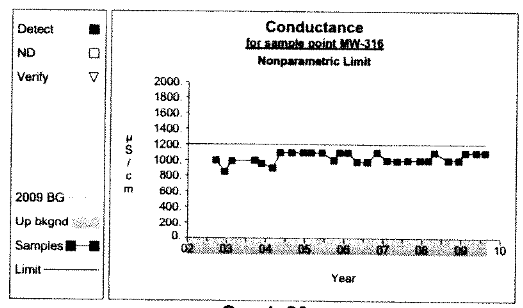
Graph 17



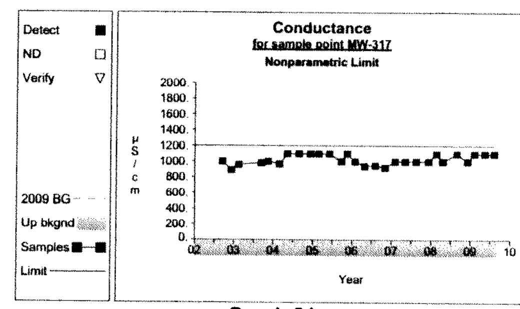
Graph 18



Graph 19

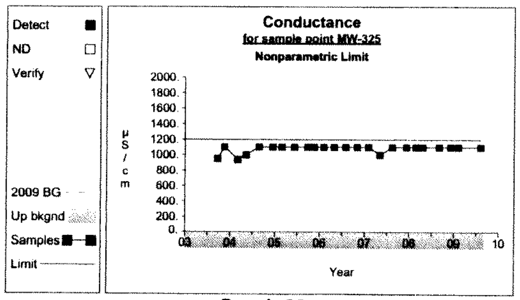


Graph 20

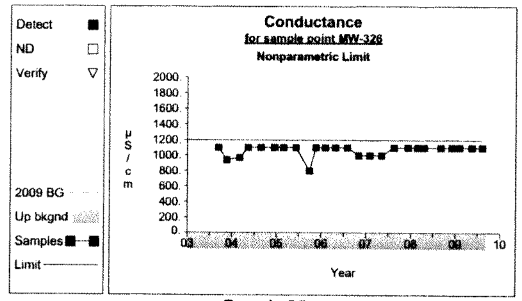


Graph 21

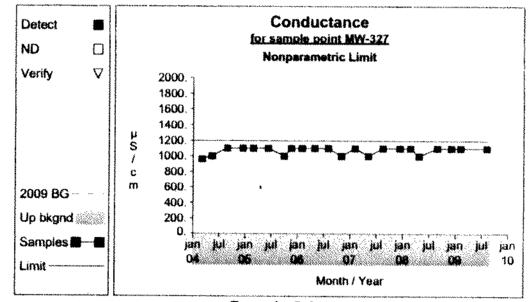
Up vs. Down Prediction Limits



Graph 22

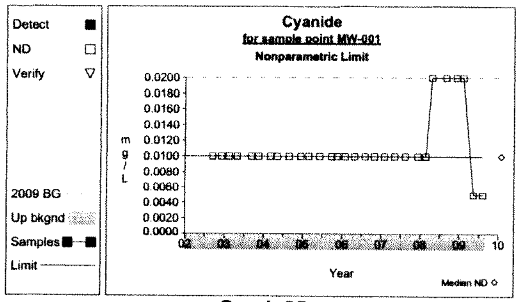


Graph 23

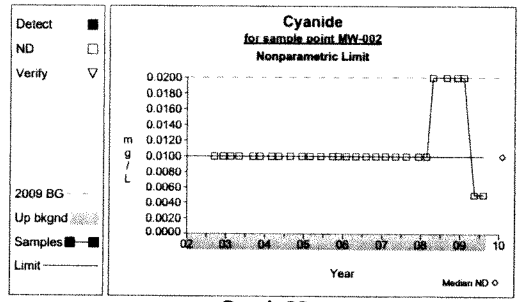


Graph 24

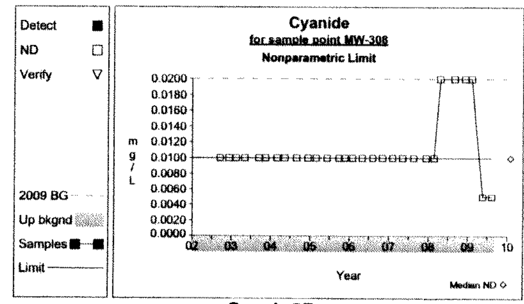
Up vs. Down Prediction Limits



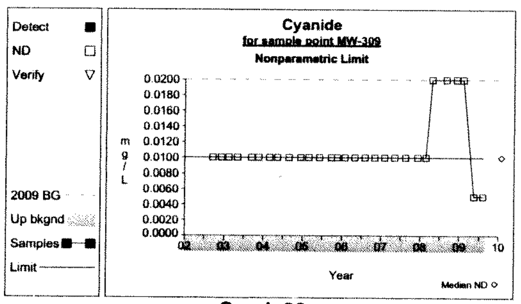
Graph 25



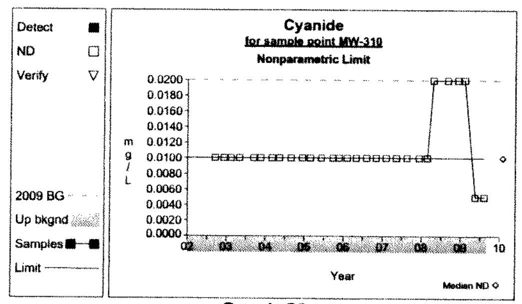
Graph 26



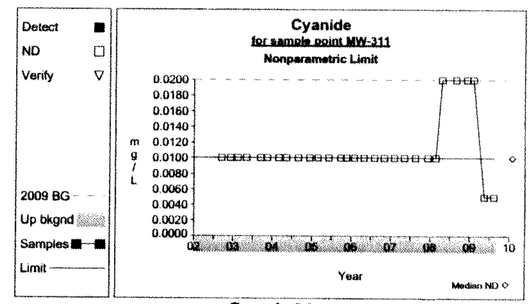
Graph 27



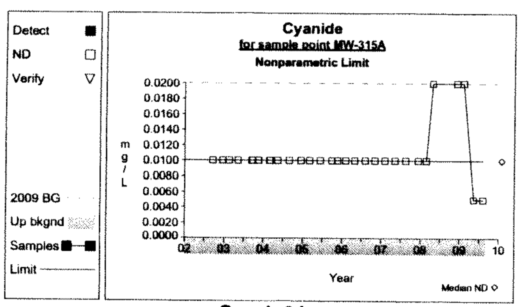
Graph 28



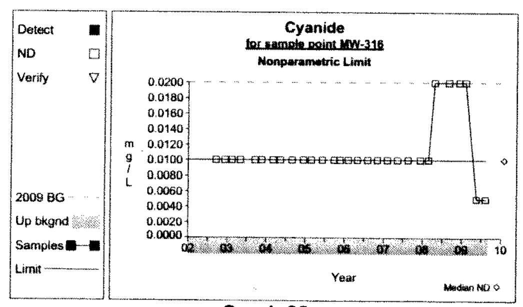
Graph 29



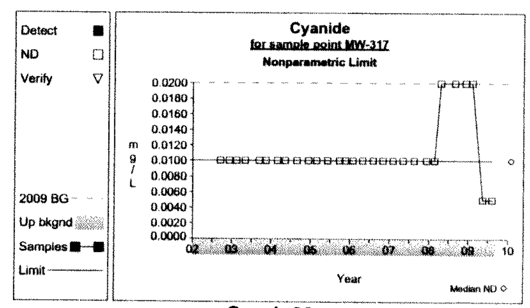
Graph 30



Graph 31

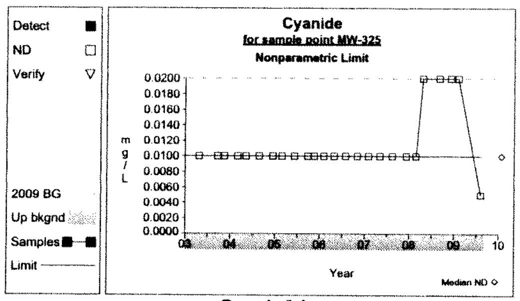


Graph 32

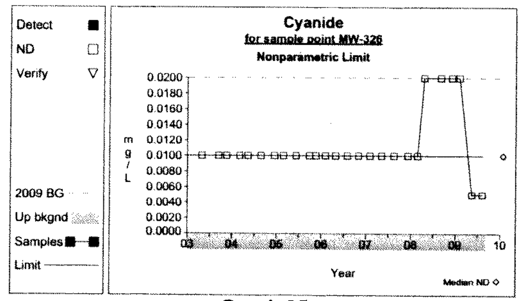


Graph 33

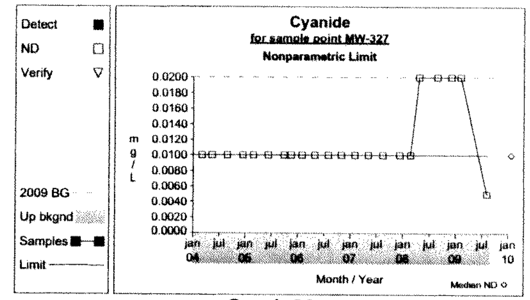
Up vs. Down Prediction Limits



Graph 34

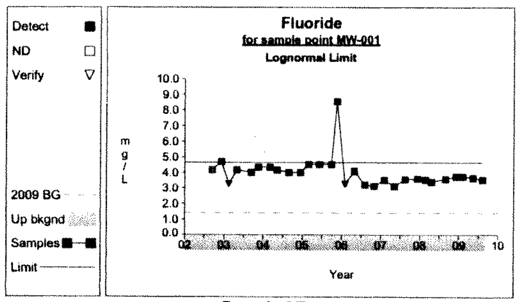


Graph 35

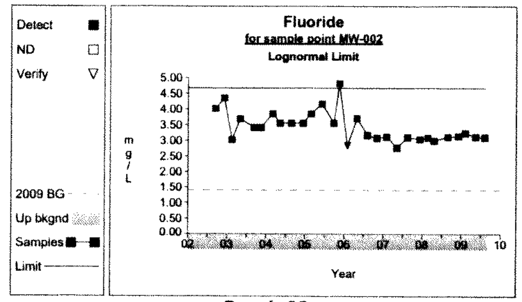


Graph 36

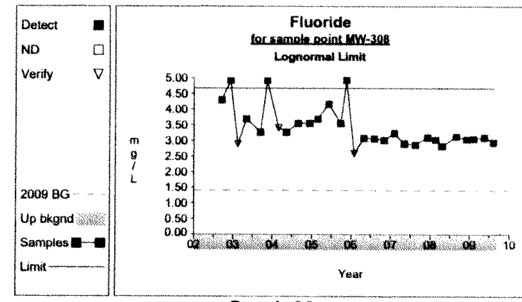
Up vs. Down Prediction Limits



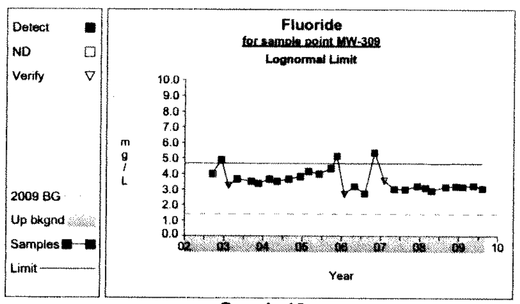
Graph 37



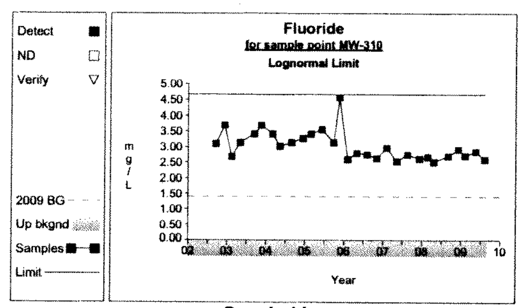
Graph 38



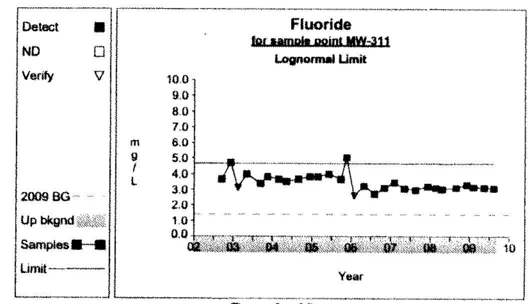
Graph 39



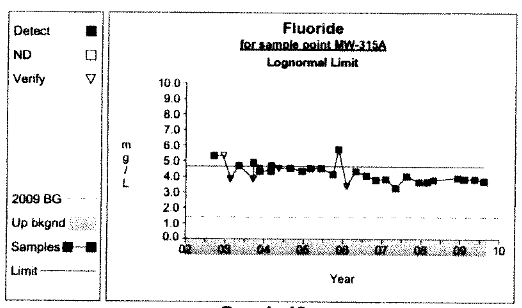
Graph 40



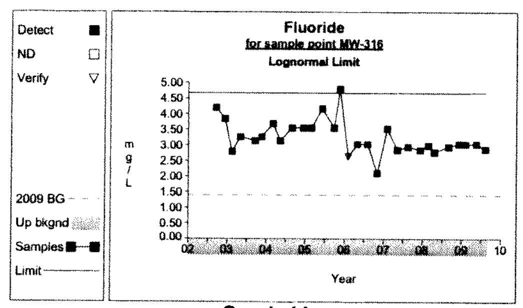
Graph 41



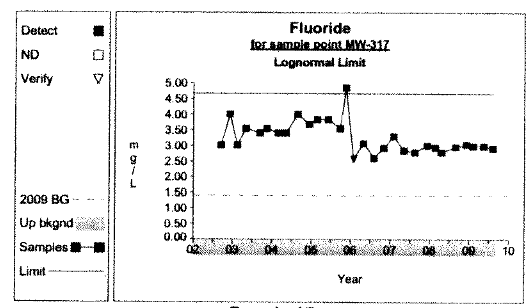
Graph 42



Graph 43

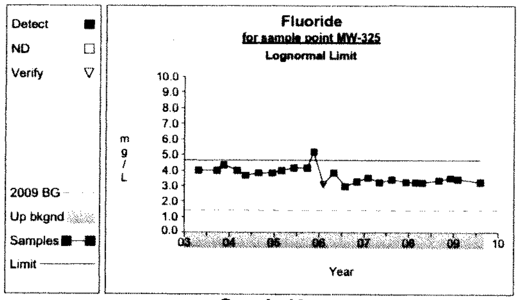


Graph 44

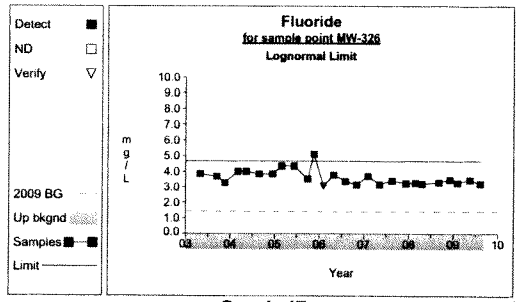


Graph 45

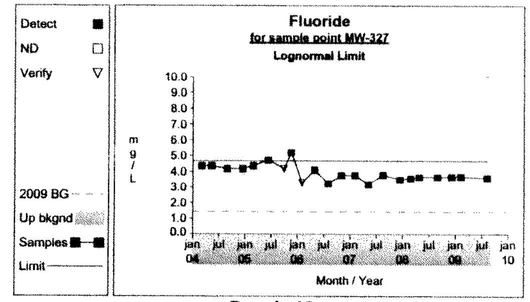
Up vs. Down Prediction Limits



Graph 46

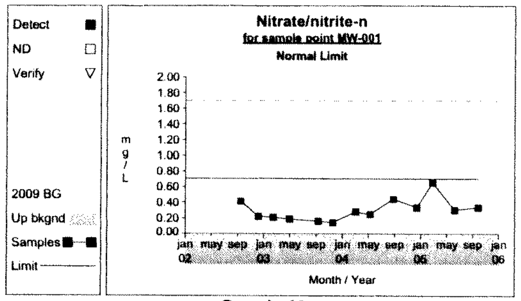


Graph 47

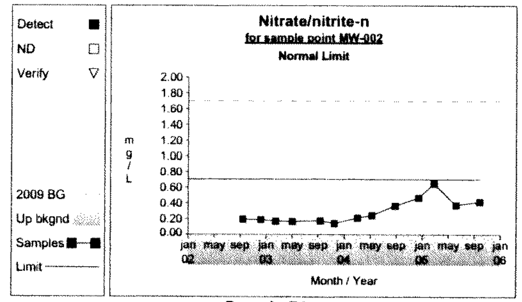


Graph 48

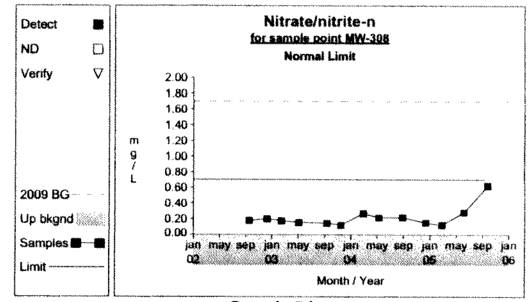
Up vs. Down Prediction Limits



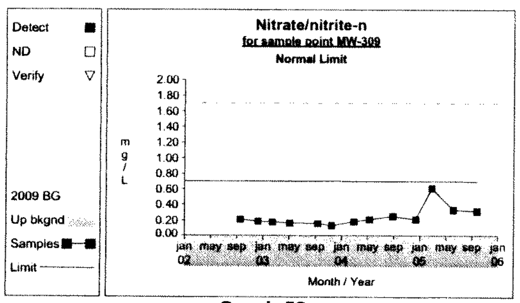
Graph 49



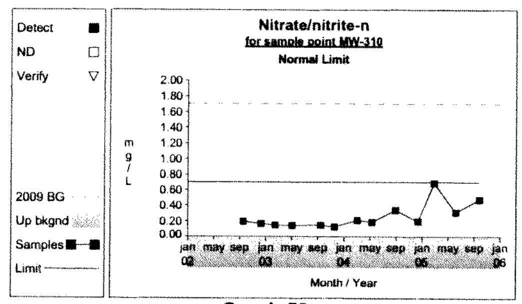
Graph 50



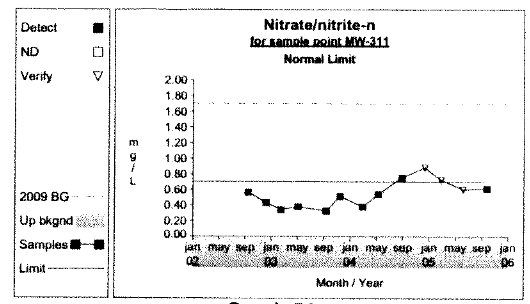
Graph 51



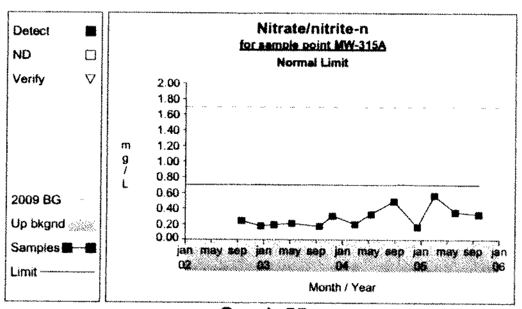
Graph 52



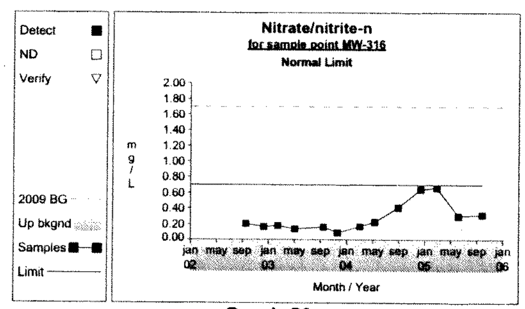
Graph 53



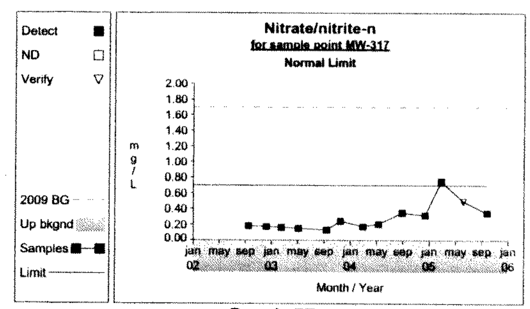
Graph 54



Graph 55

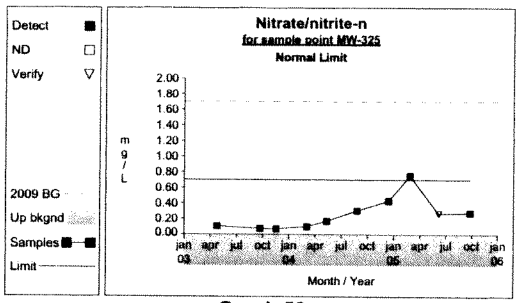


Graph 56

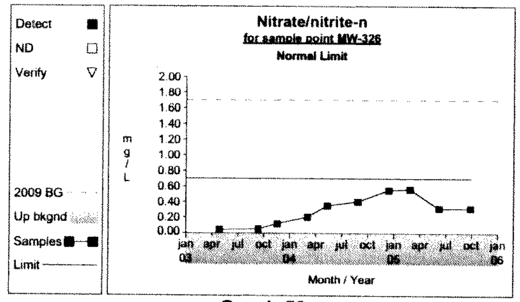


Graph 57

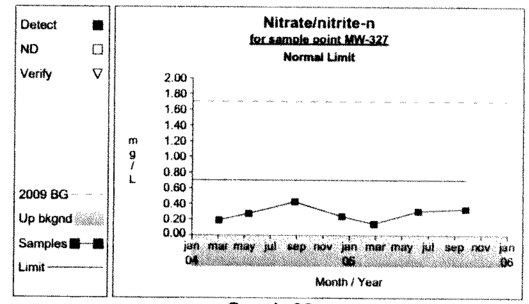
Up vs. Down Prediction Limits



Graph 58

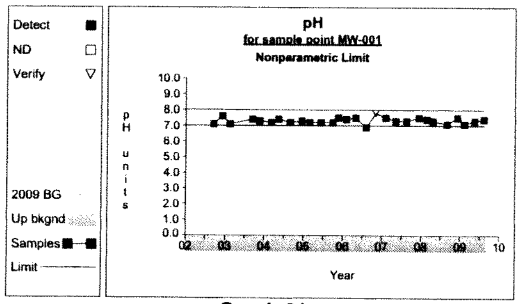


Graph 59

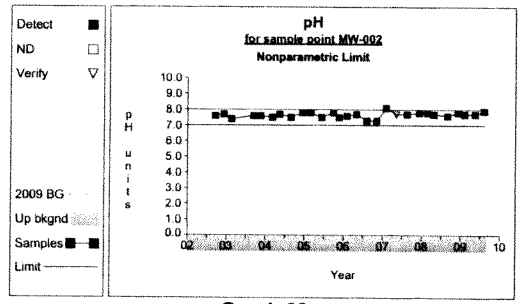


Graph 60

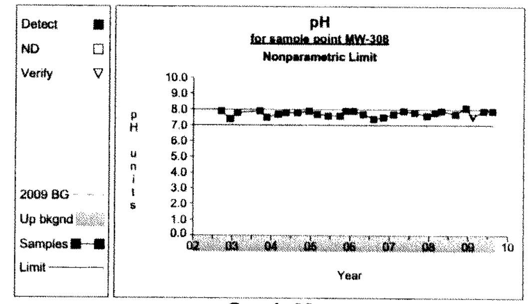
Up vs. Down Prediction Limits



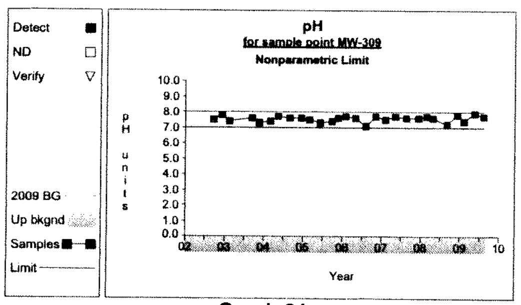
Graph 61



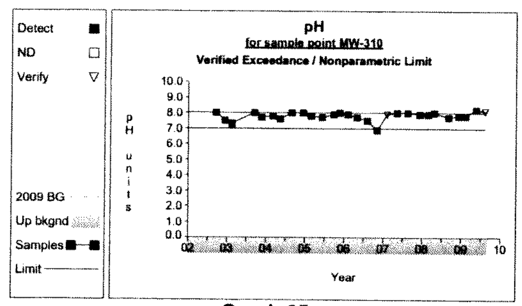
Graph 62



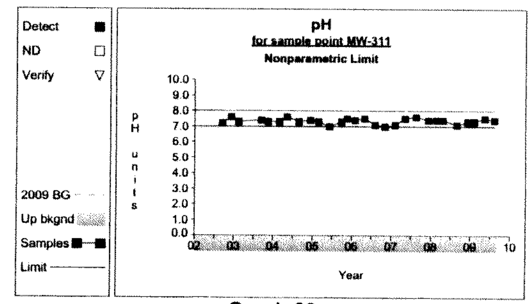
Graph 63



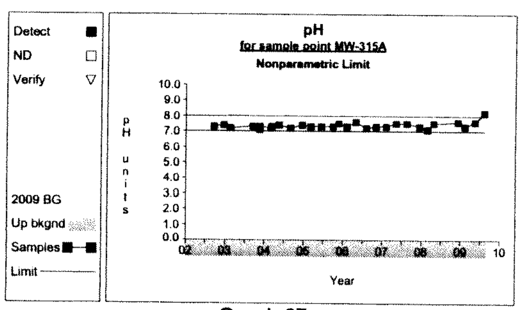
Graph 64



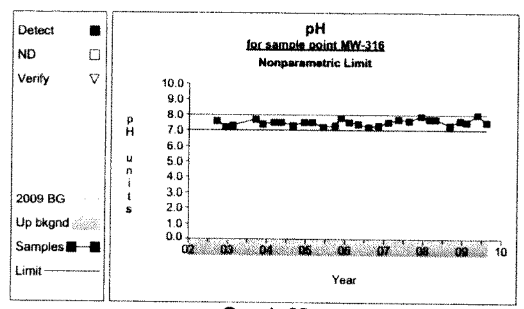
Graph 65



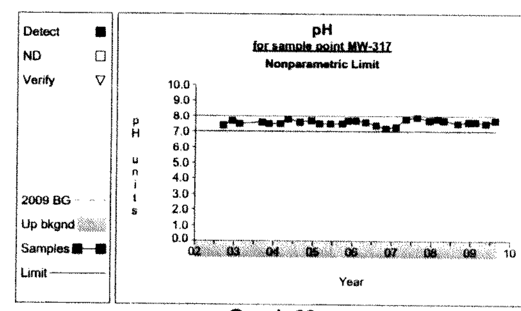
Graph 66



Graph 67

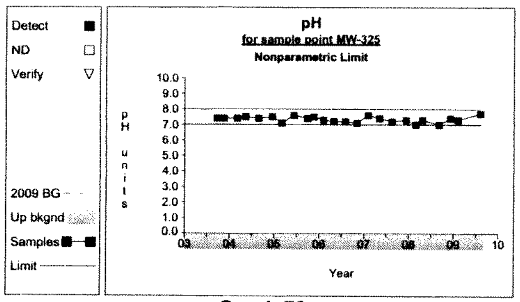


Graph 68

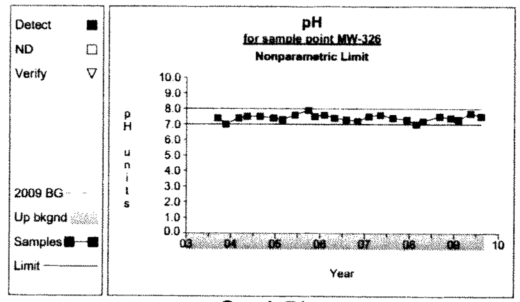


Graph 69

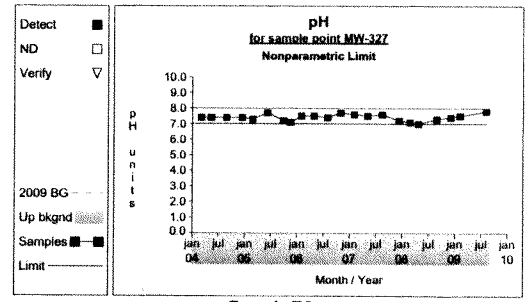
Up vs. Down Prediction Limits



Graph 70

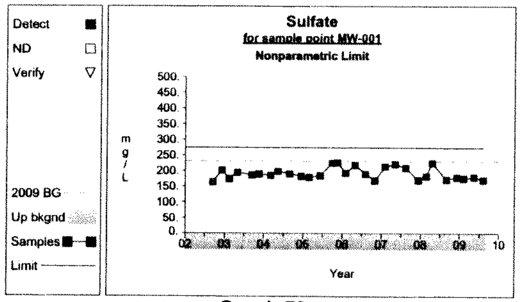


Graph 71

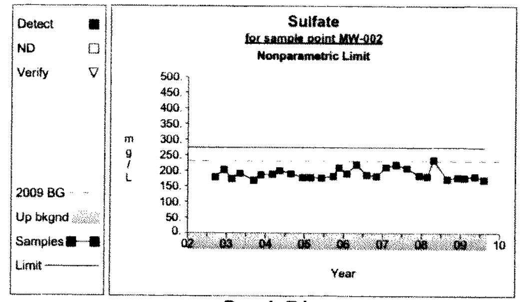


Graph 72

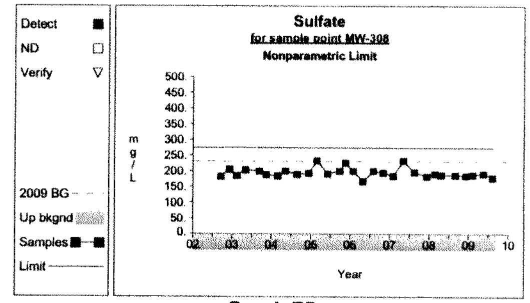
Up vs. Down Prediction Limits



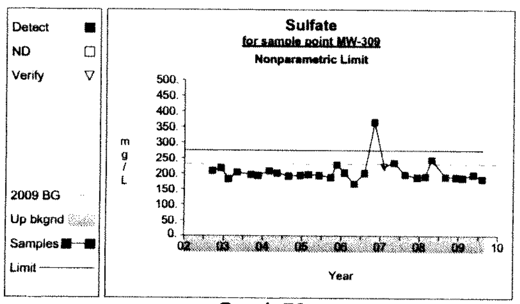
Graph 73



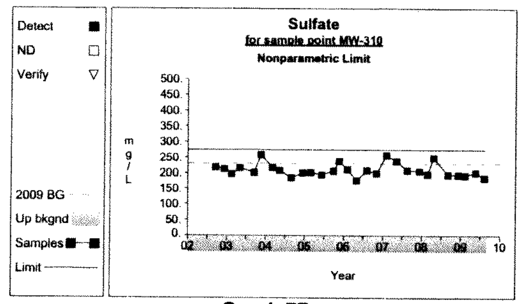
Graph 74



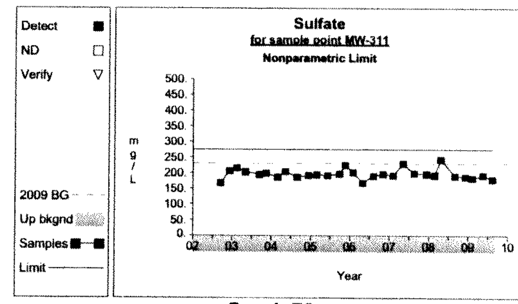
Graph 75



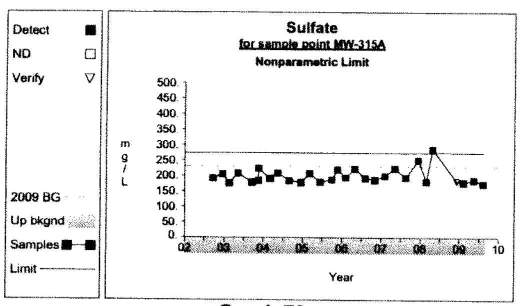
Graph 76



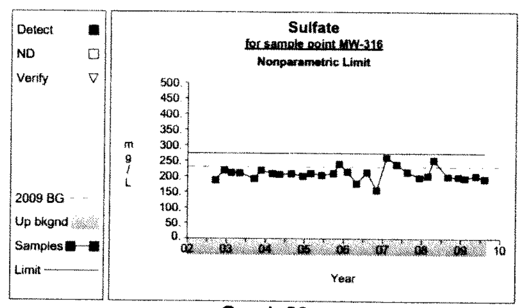
Graph 77



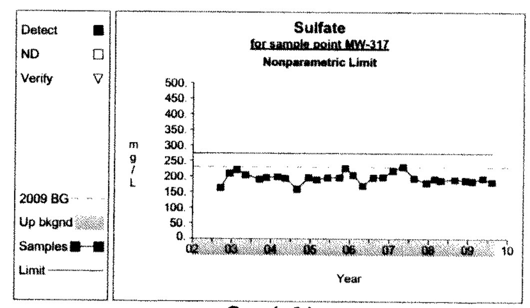
Graph 78



Graph 79

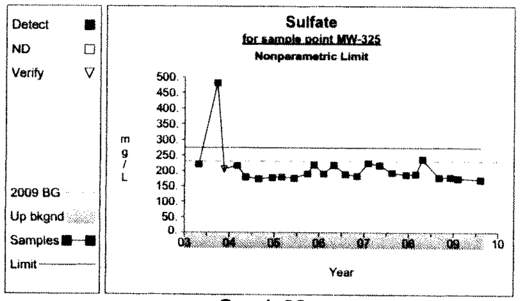


Graph 80

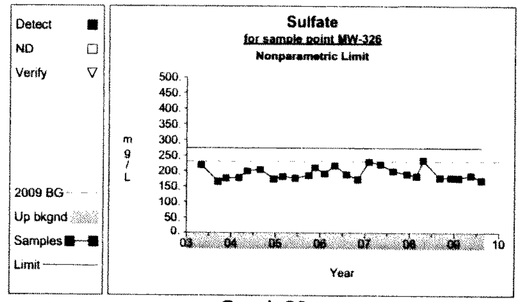


Graph 81

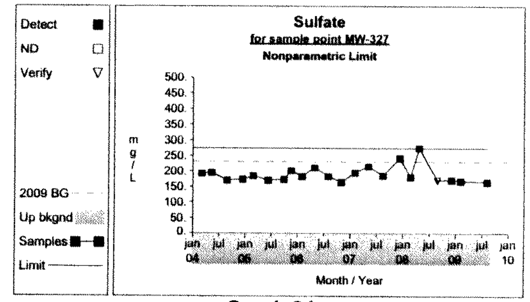
Up vs. Down Prediction Limits



Graph 82

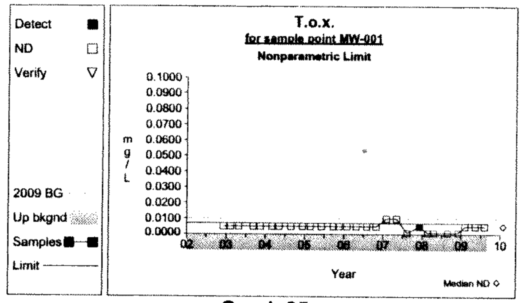


Graph 83

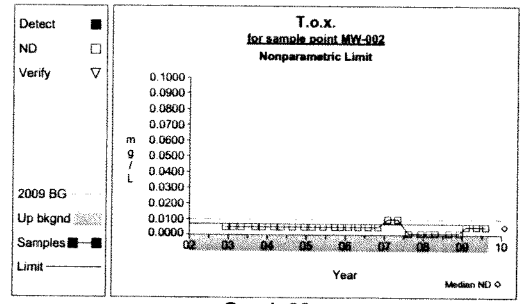


Graph 84

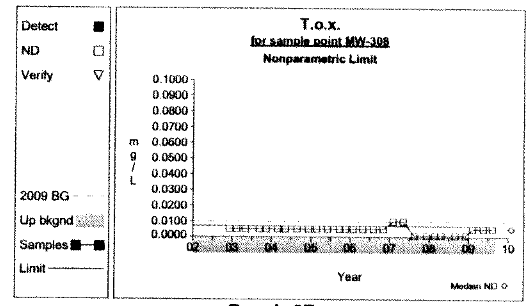
Up vs. Down Prediction Limits



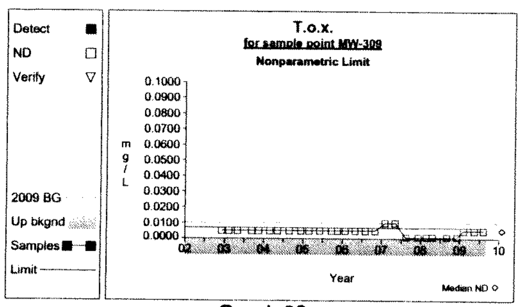
Graph 85



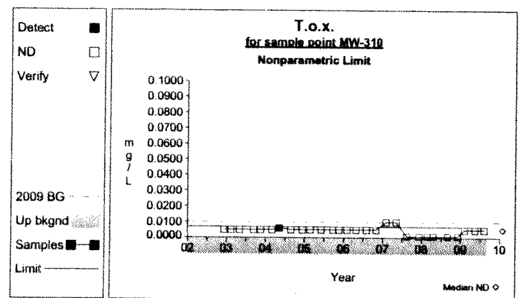
Graph 86



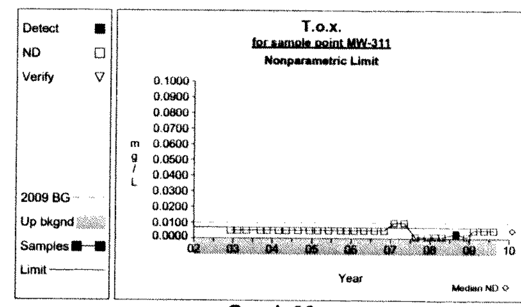
Graph 87



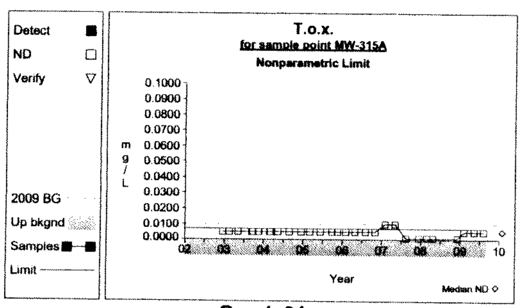
Graph 88



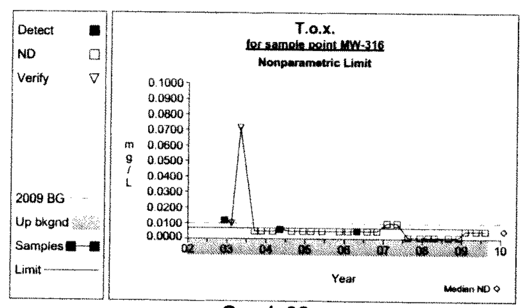
Graph 89



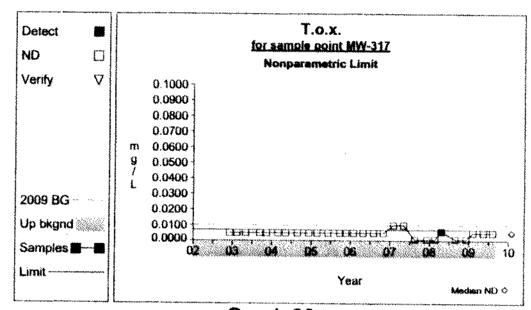
Graph 90



Graph 91

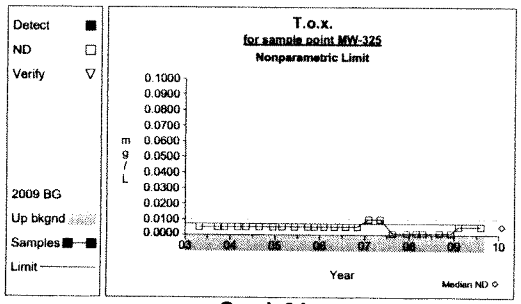


Graph 92

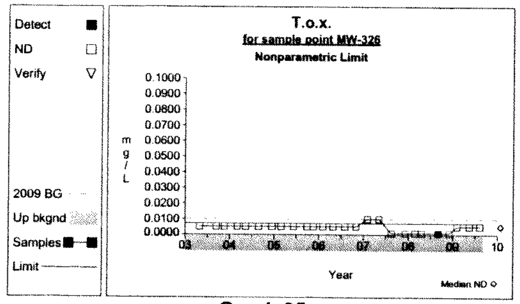


Graph 93

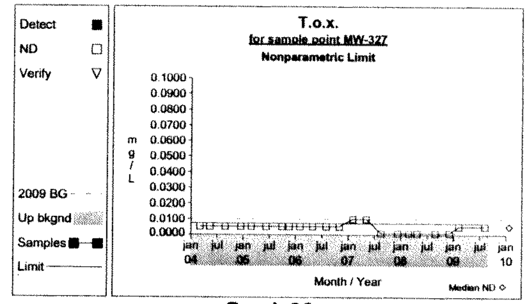
Up vs. Down Prediction Limits



Graph 94

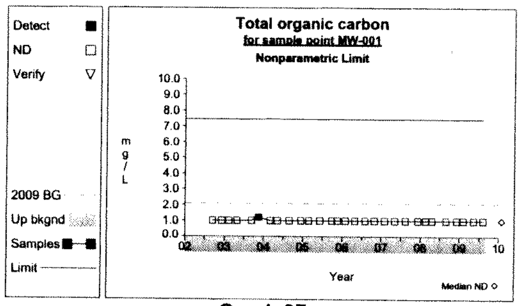


Graph 95

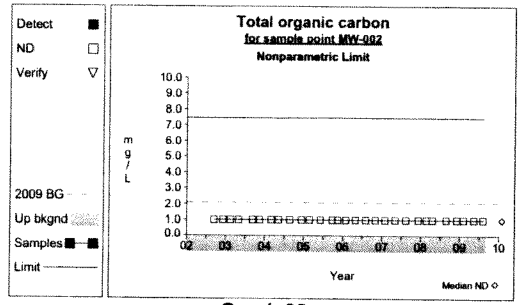


Graph 96

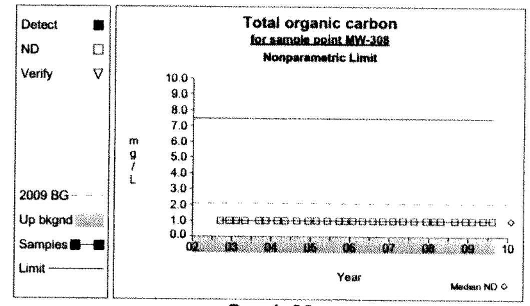
Up vs. Down Prediction Limits



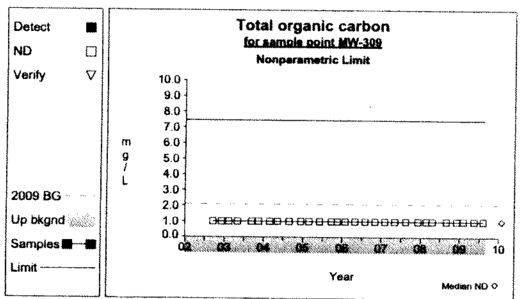
Graph 97



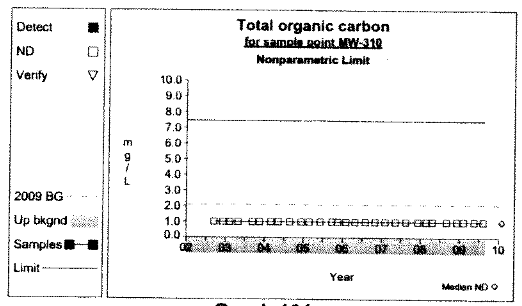
Graph 98



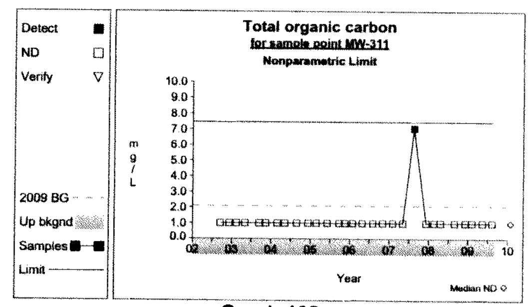
Graph 99



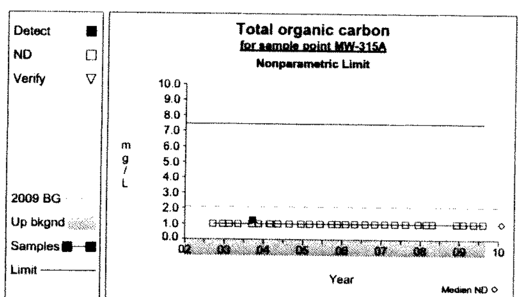
Graph 100



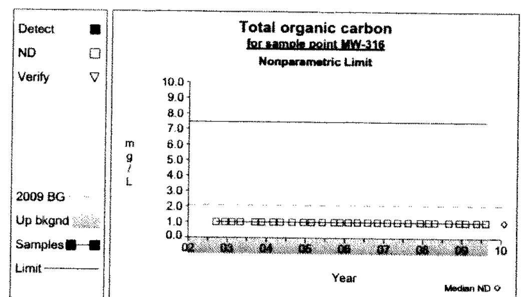
Graph 101



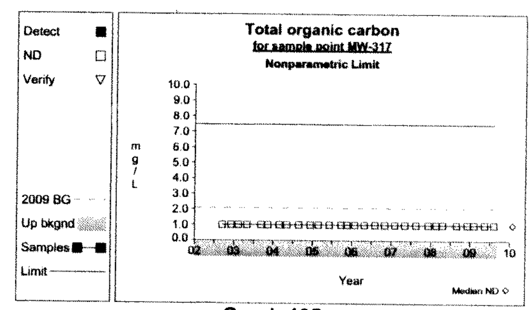
Graph 102



Graph 103

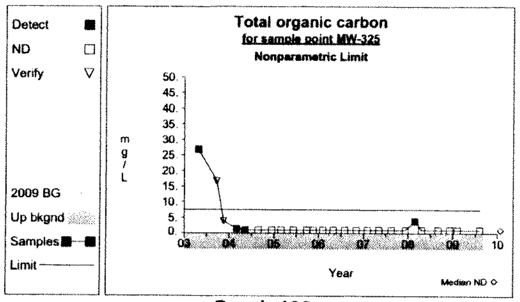


Graph 104

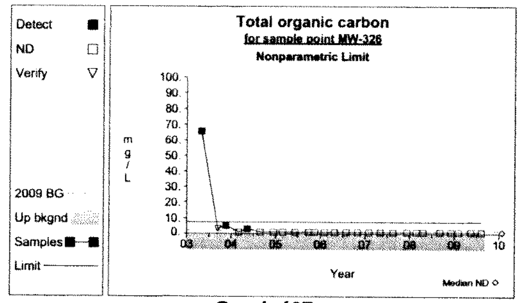


Graph 105

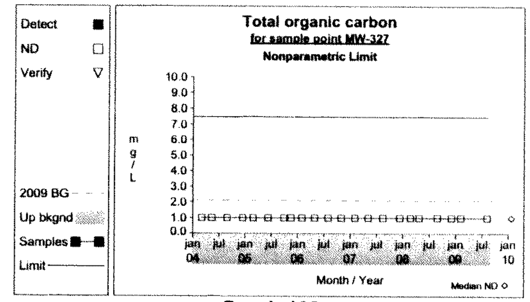
Up vs. Down Prediction Limits



Graph 106



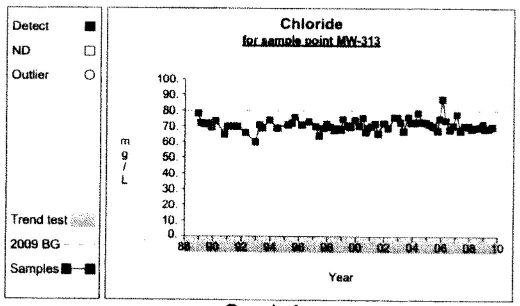
Graph 107



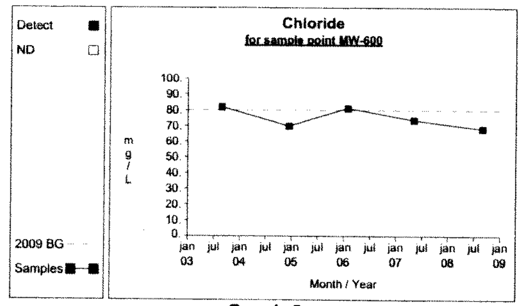
Graph 108

Analysis prepared on: 8/13/2010

Time Series

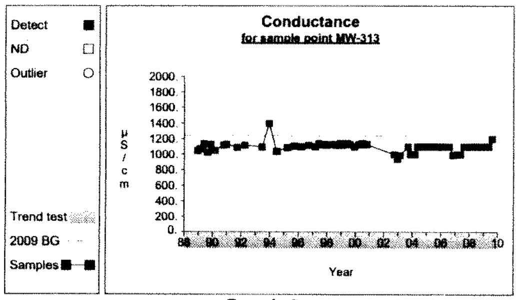


Graph 1

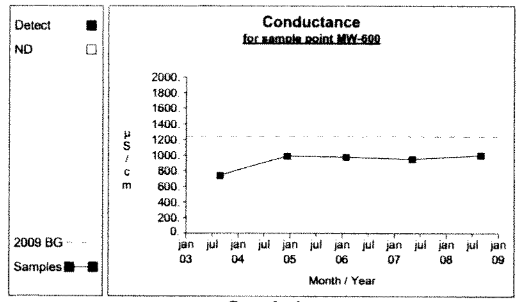


Graph 2

Time Series

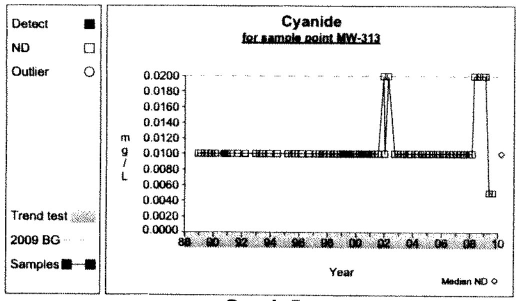


Graph 3

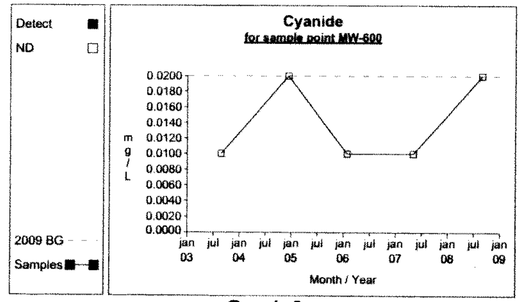


Graph 4

Time Series

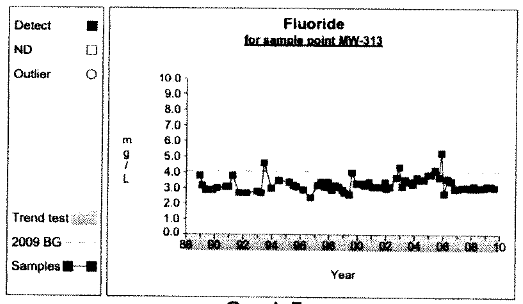


Graph 5

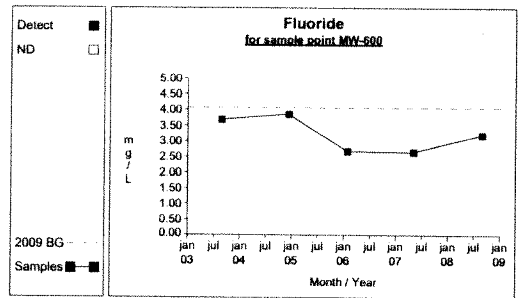


Graph 6

Time Series

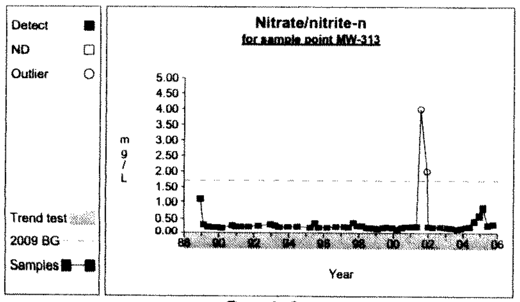


Graph 7

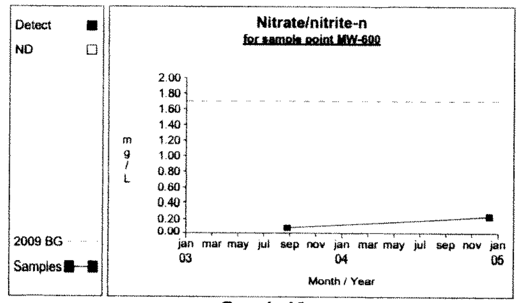


Graph 8

Time Series

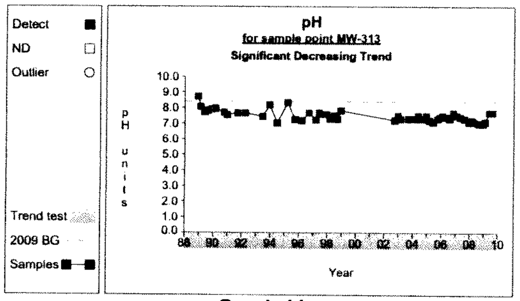


Graph 9

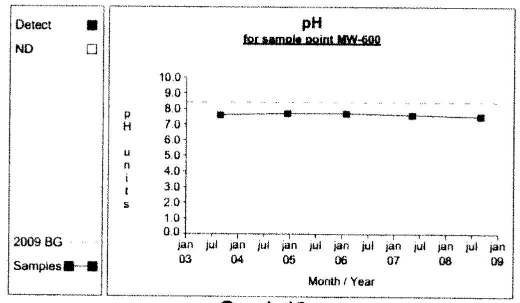


Graph 10

Time Series

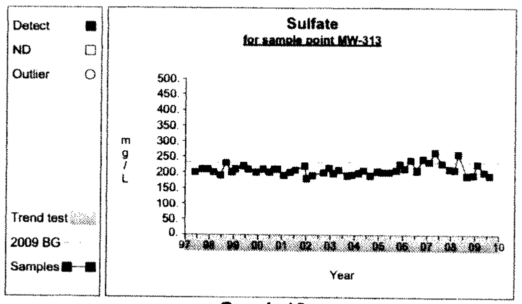


Graph 11

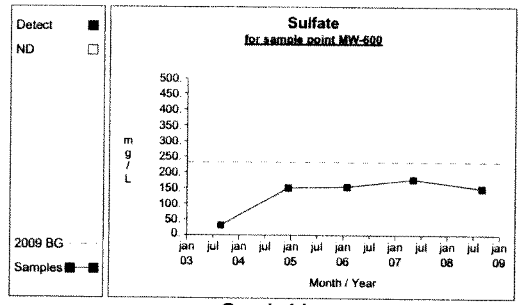


Graph 12

Time Series

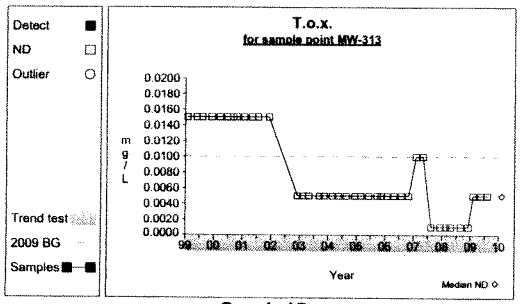


Graph 13

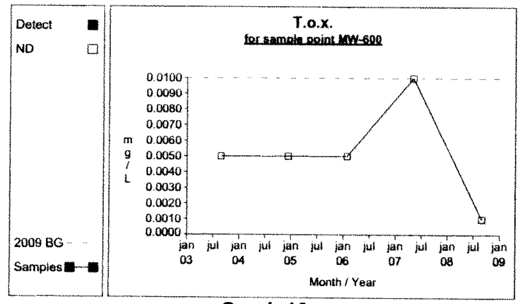


Graph 14

Time Series

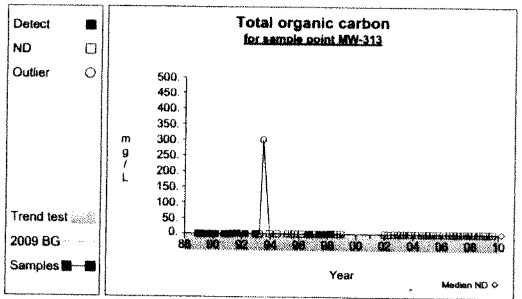


Graph 15

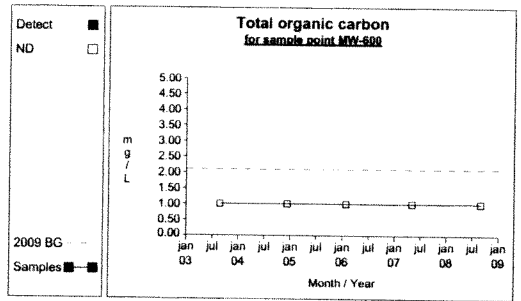


Graph 16

Time Series



Graph 17

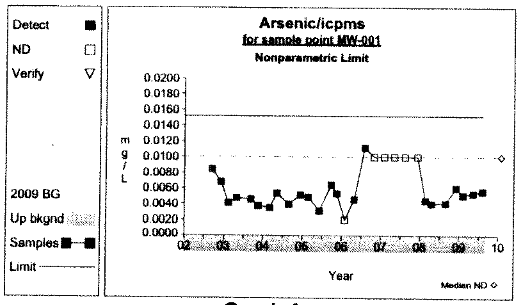


Graph 18

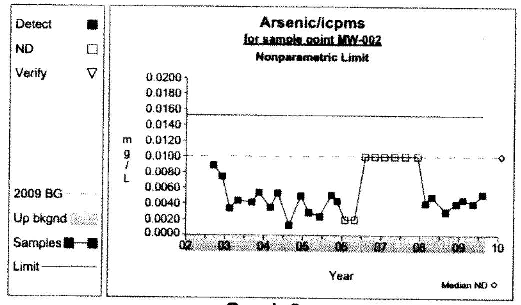
Beatty [mets_al]

Analysis prepared on: 12/30/2009

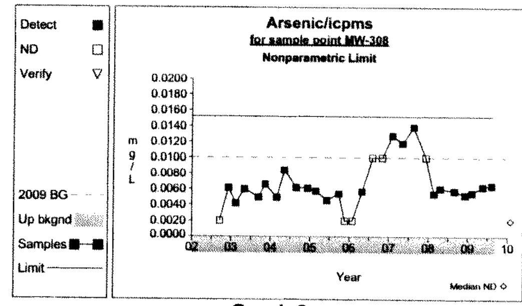
Up vs. Down Prediction Limits



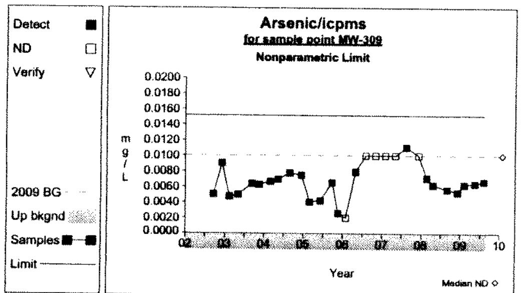
Graph 1



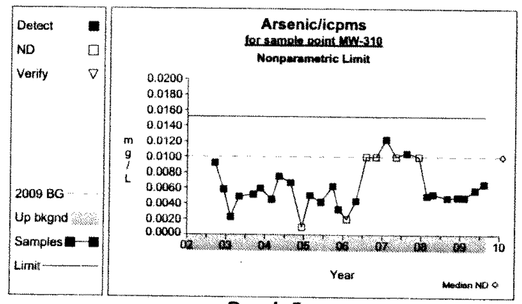
Graph 2



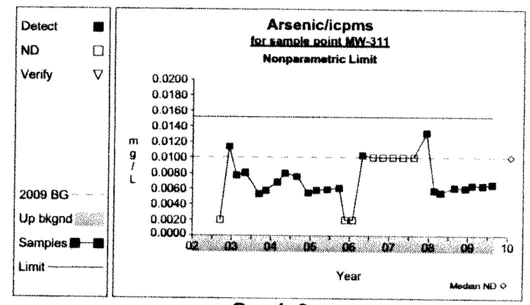
Graph 3



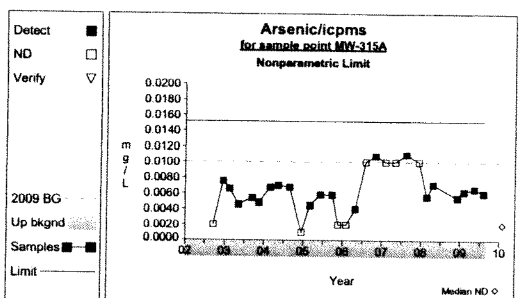
Graph 4



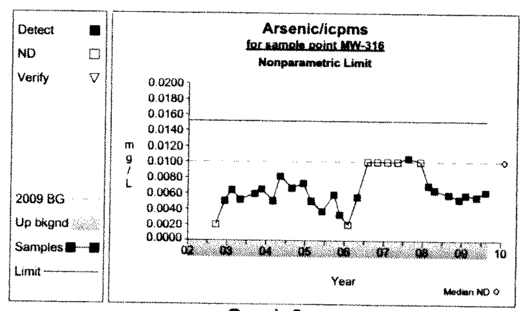
Graph 5



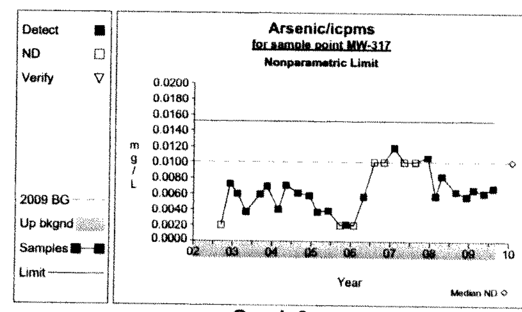
Graph 6



Graph 7



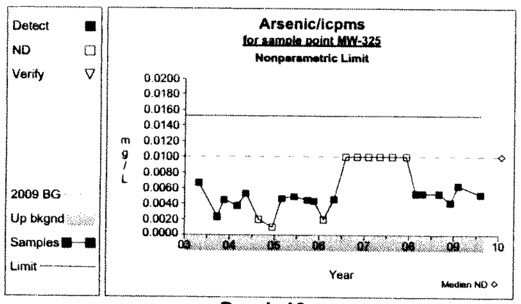
Graph 8



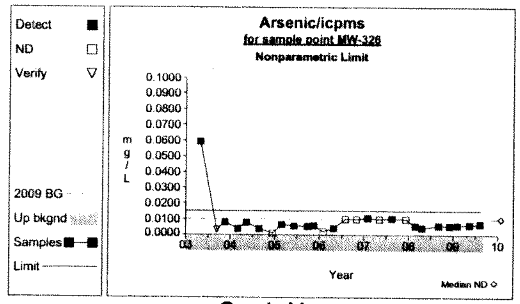
Graph 9

Prepared by: AquAeTer, Inc.

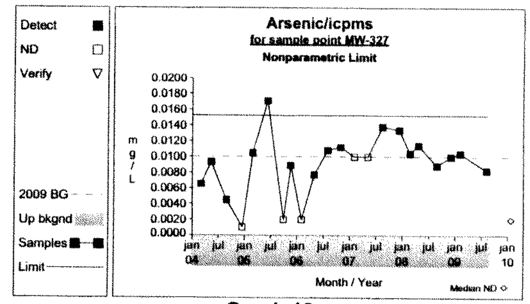
Up vs. Down Prediction Limits



Graph 10

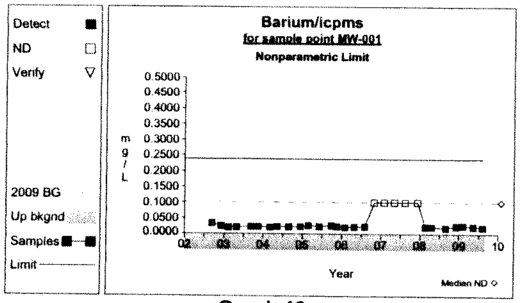


Graph 11

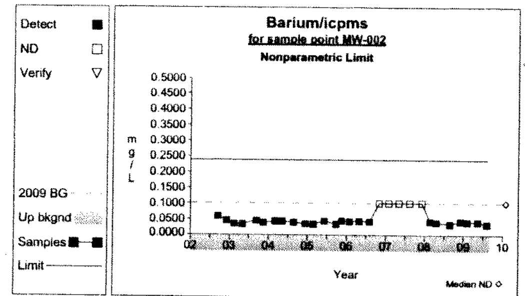


Graph 12

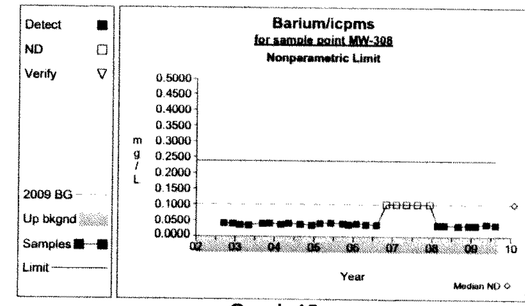
Up vs. Down Prediction Limits



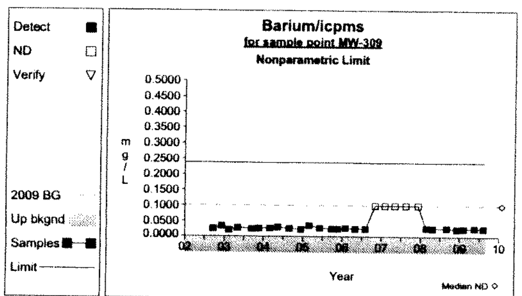
Graph 13



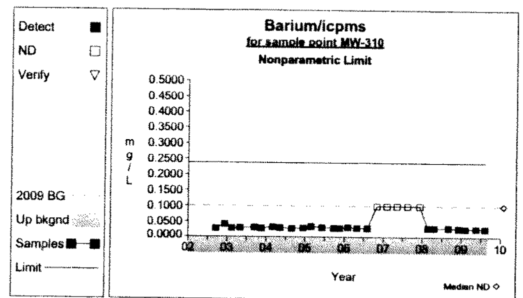
Graph 14



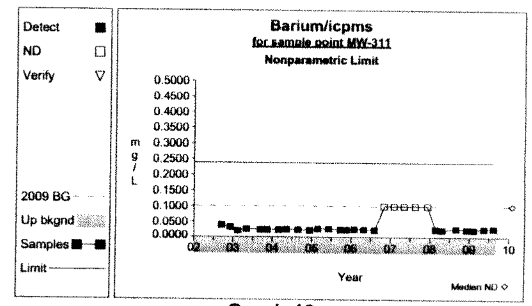
Graph 15



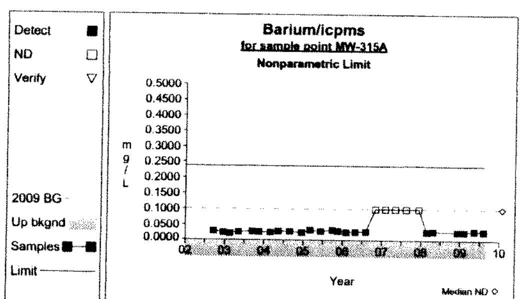
Graph 16



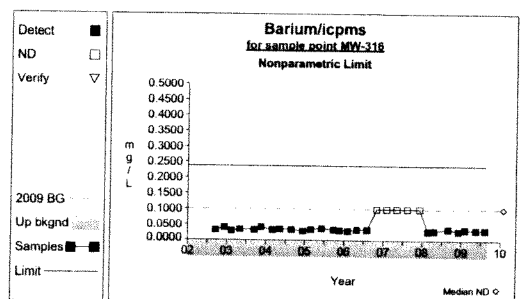
Graph 17



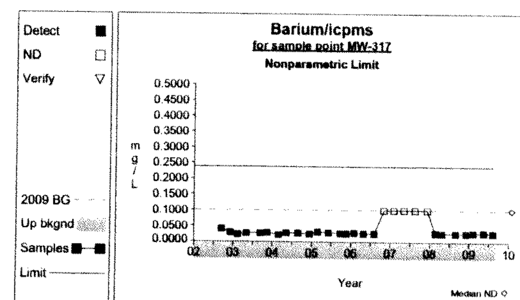
Graph 18



Graph 19

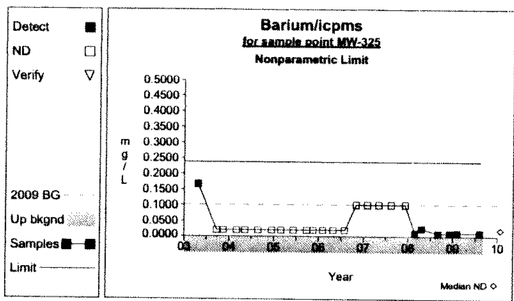


Graph 20

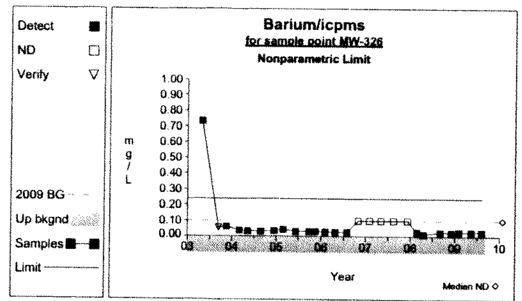


Graph 21

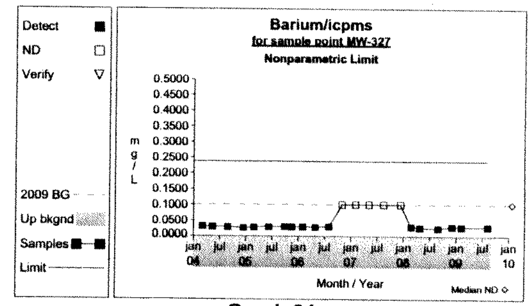
Up vs. Down Prediction Limits



Graph 22

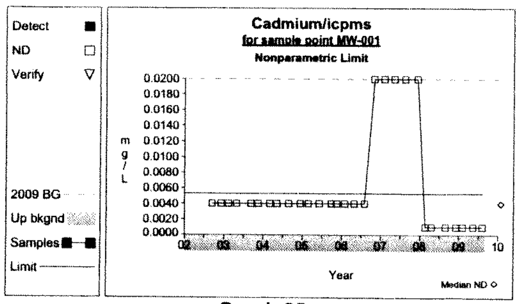


Graph 23

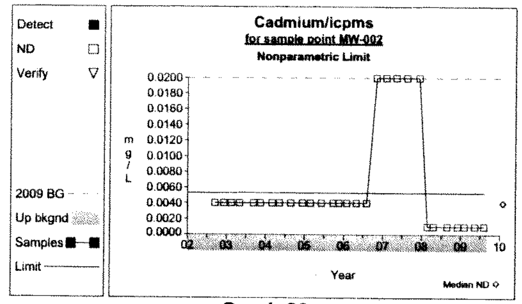


Graph 24

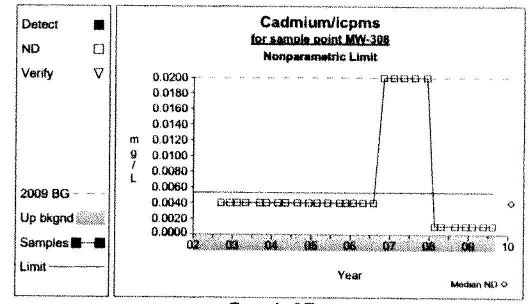
Up vs. Down Prediction Limits



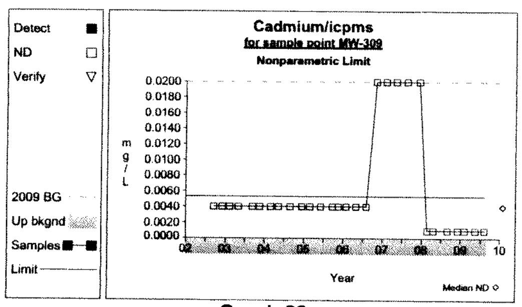
Graph 25



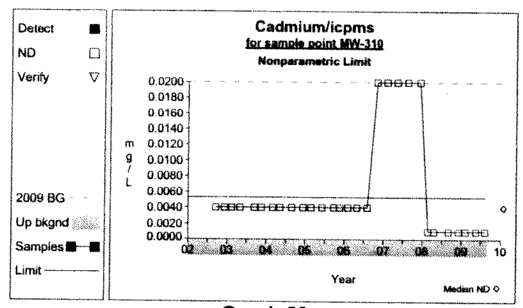
Graph 26



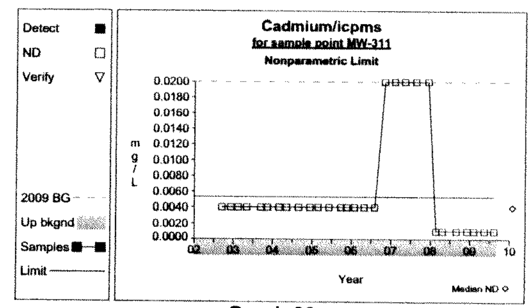
Graph 27



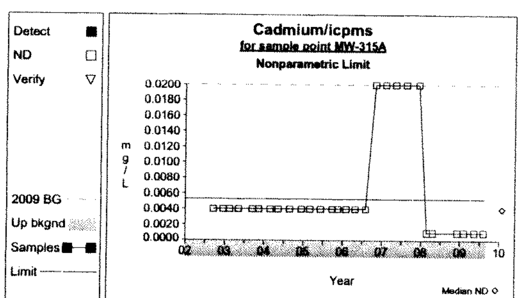
Graph 28



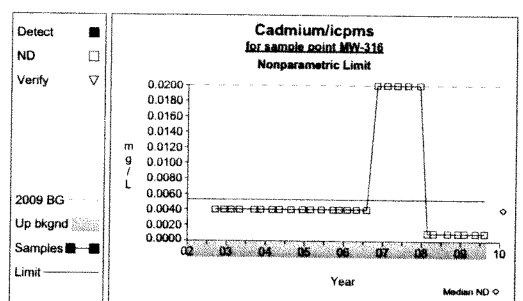
Graph 29



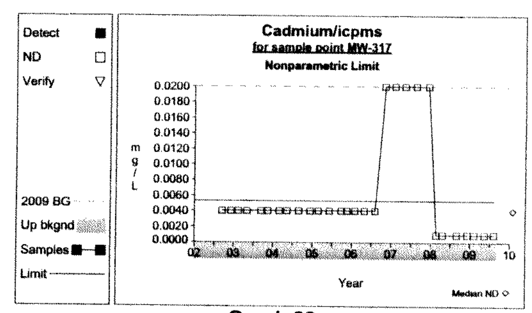
Graph 30



Graph 31

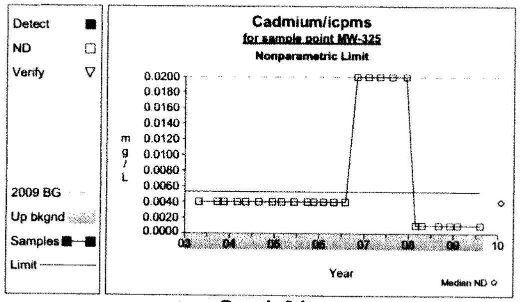


Graph 32

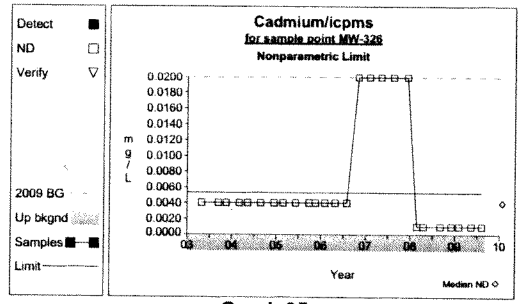


Graph 33

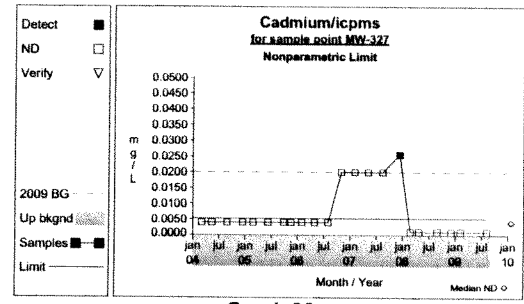
Up vs. Down Prediction Limits



Graph 34

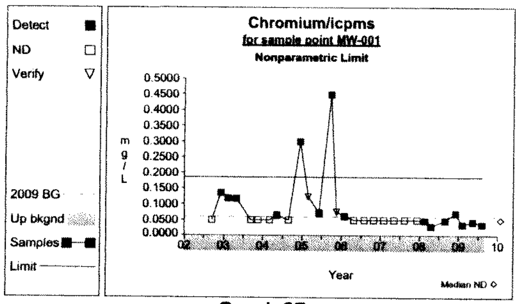


Graph 35

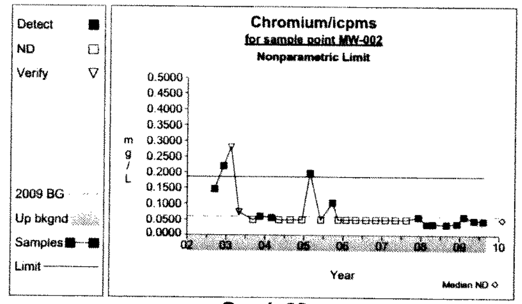


Graph 36

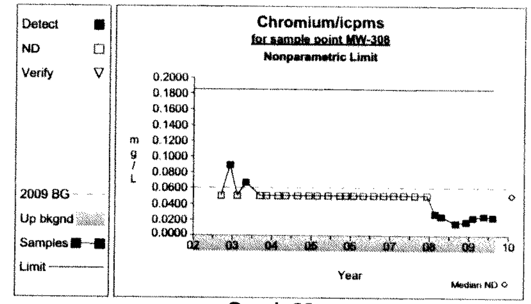
Up vs. Down Prediction Limits



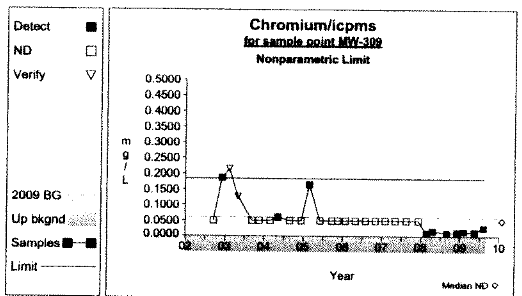
Graph 37



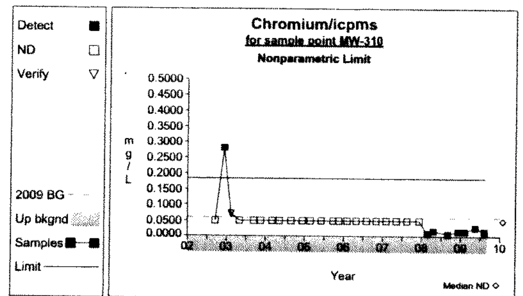
Graph 38



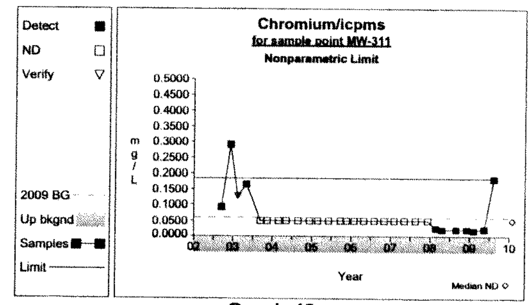
Graph 39



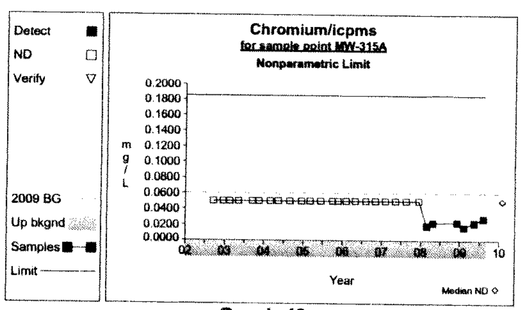
Graph 40



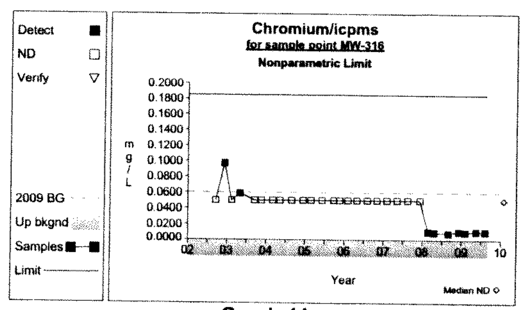
Graph 41



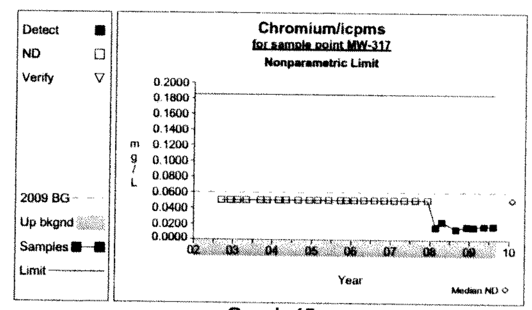
Graph 42



Graph 43

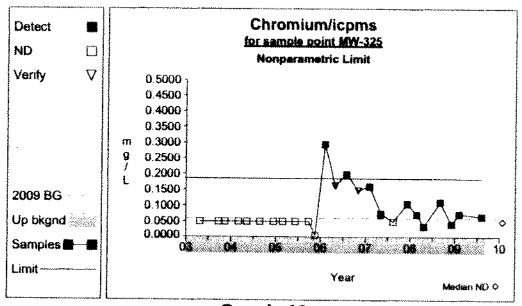


Graph 44

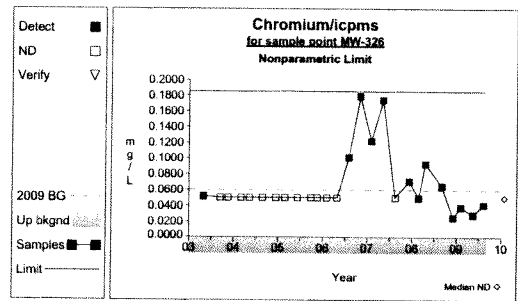


Graph 45

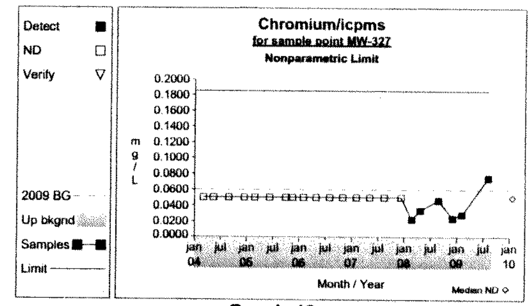
Up vs. Down Prediction Limits



Graph 46

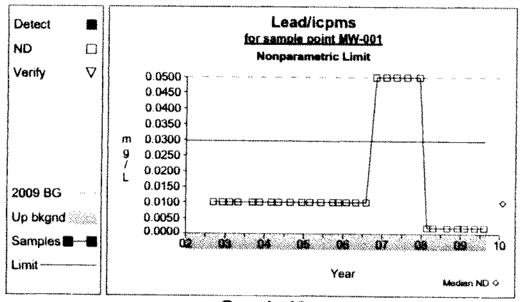


Graph 47

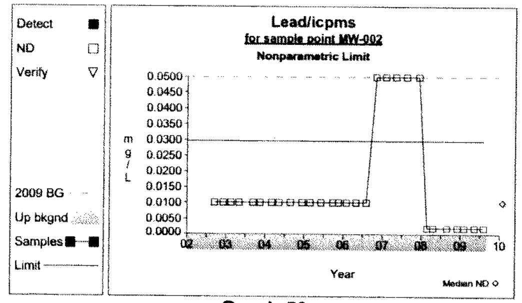


Graph 48

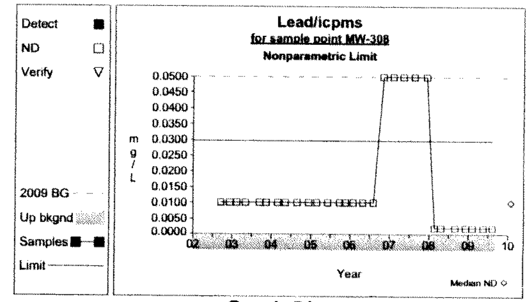
Up vs. Down Prediction Limits



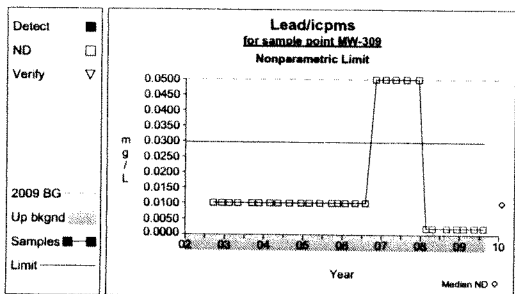
Graph 49



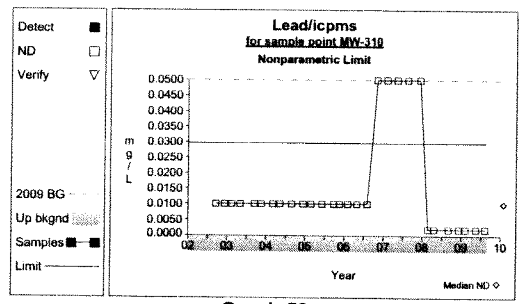
Graph 50



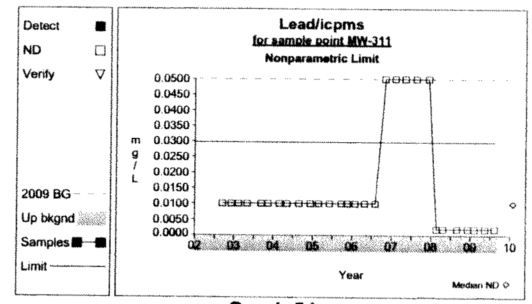
Graph 51



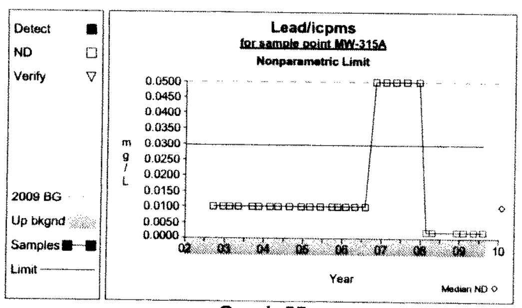
Graph 52



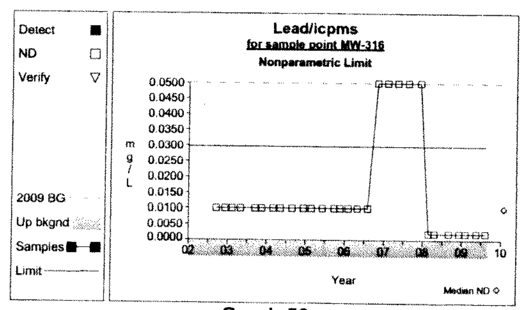
Graph 53



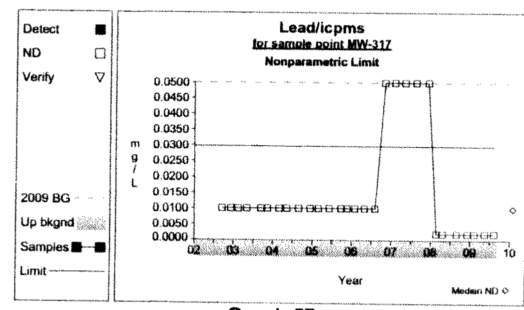
Graph 54



Graph 55

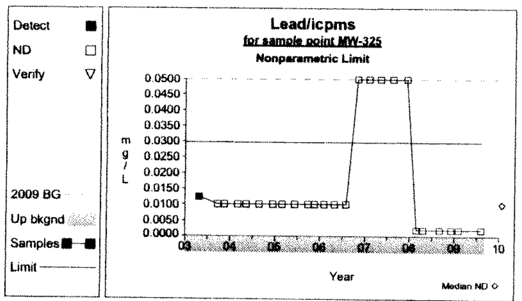


Graph 56

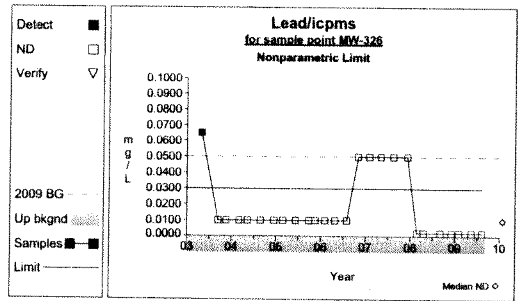


Graph 57

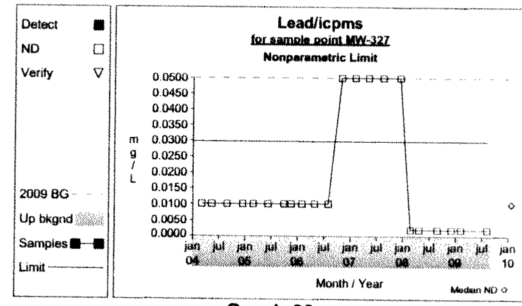
Up vs. Down Prediction Limits



Graph 58

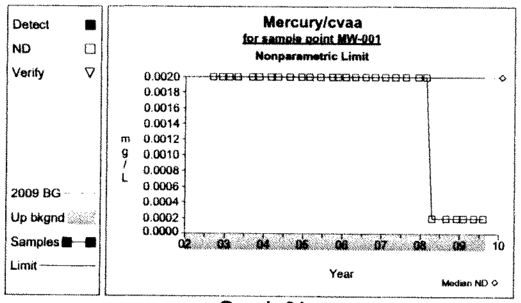


Graph 59

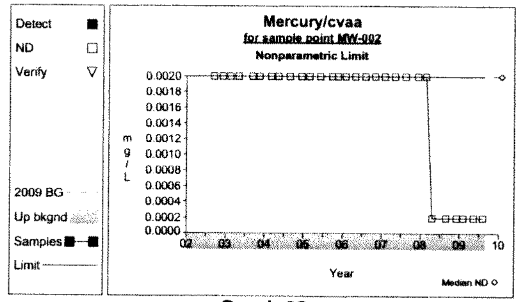


Graph 60

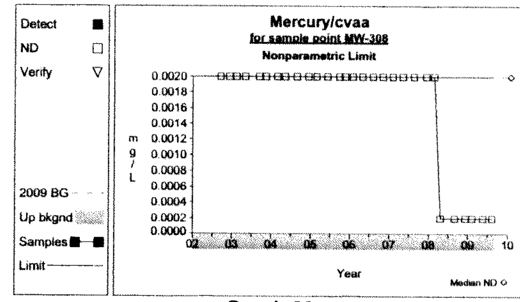
Up vs. Down Prediction Limits



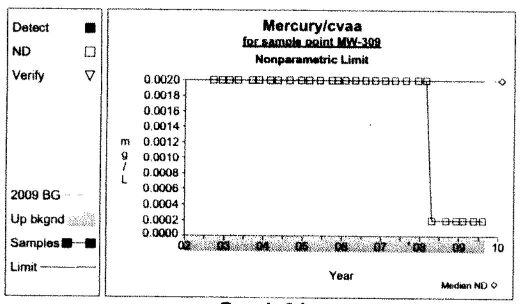
Graph 61



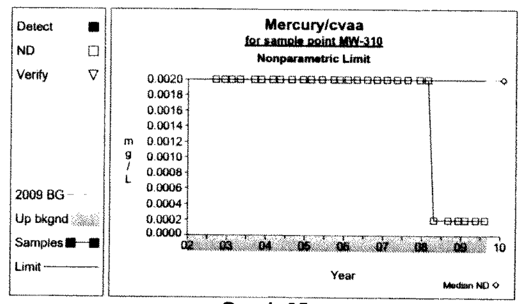
Graph 62



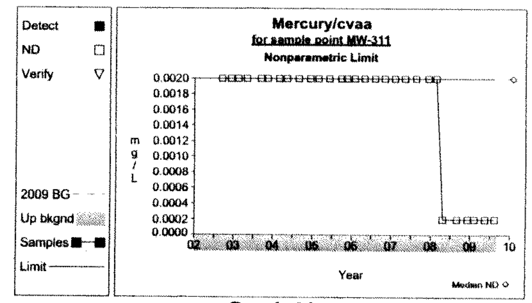
Graph 63



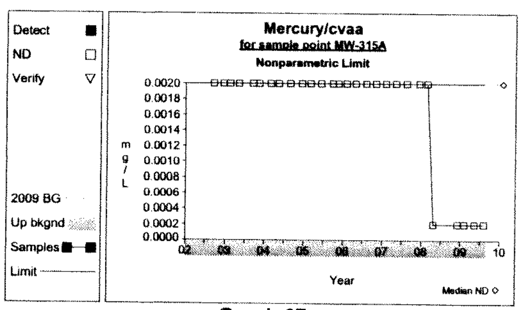
Graph 64



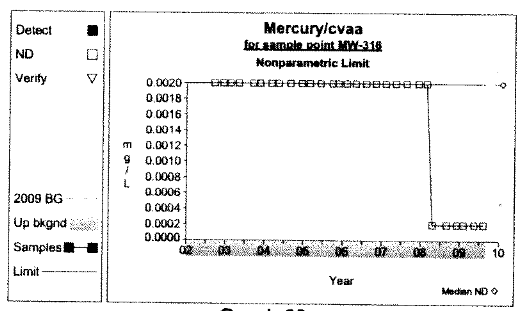
Graph 65



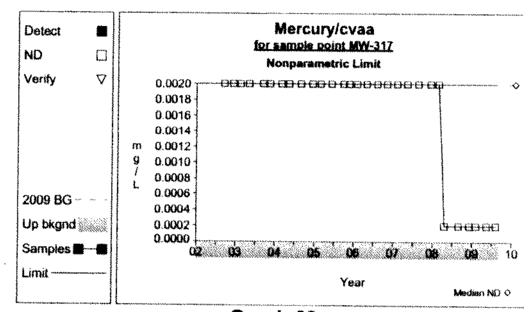
Graph 66



Graph 67

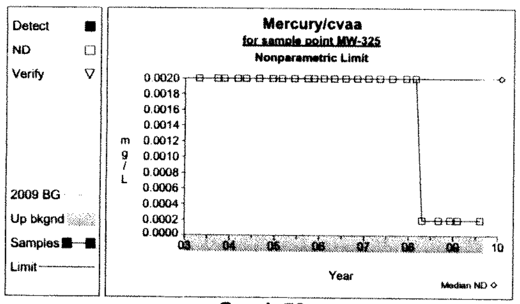


Graph 68

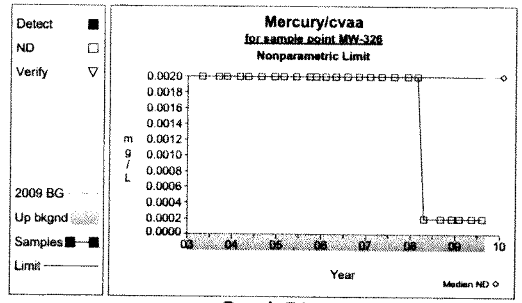


Graph 69

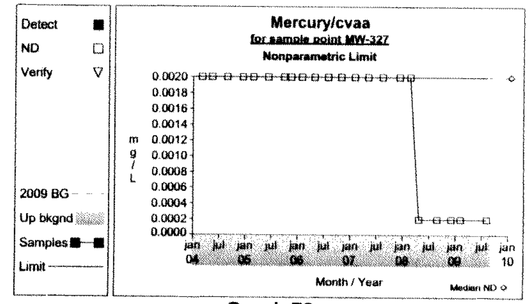
Up vs. Down Prediction Limits



Graph 70

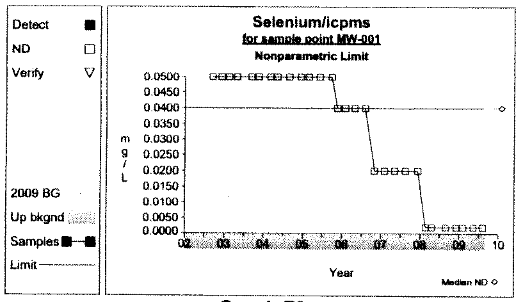


Graph 71

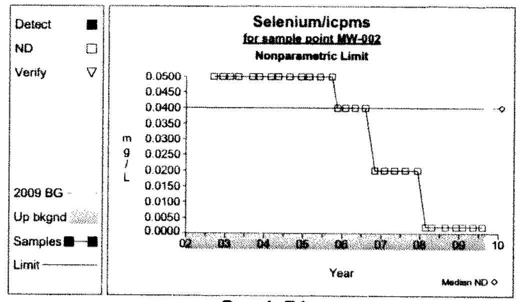


Graph 72

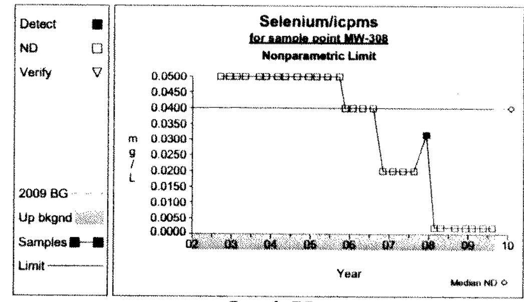
Up vs. Down Prediction Limits



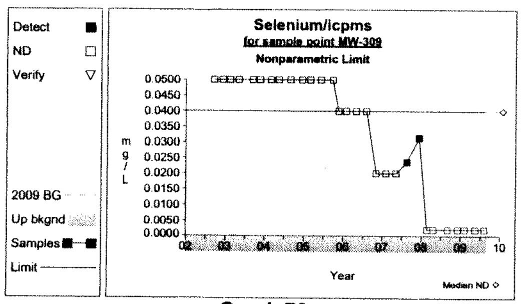
Graph 73



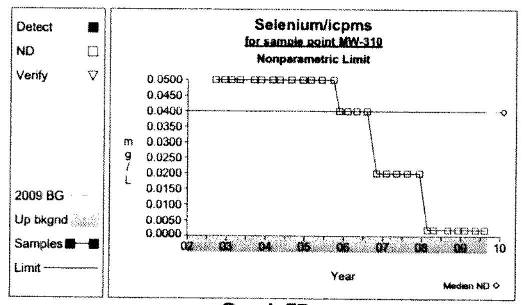
Graph 74



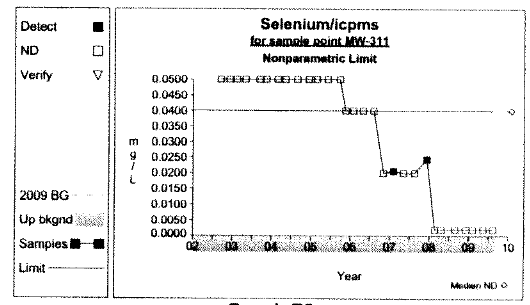
Graph 75



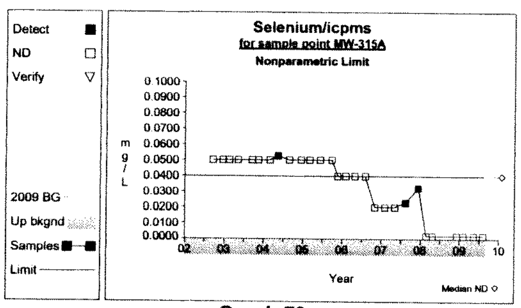
Graph 76



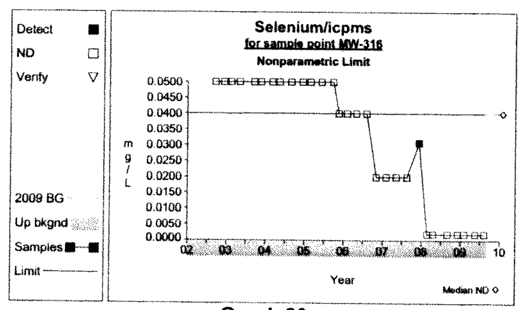
Graph 77



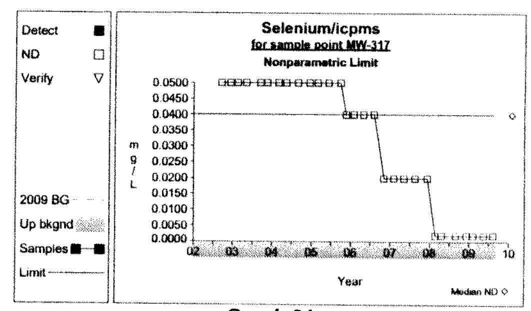
Graph 78



Graph 79

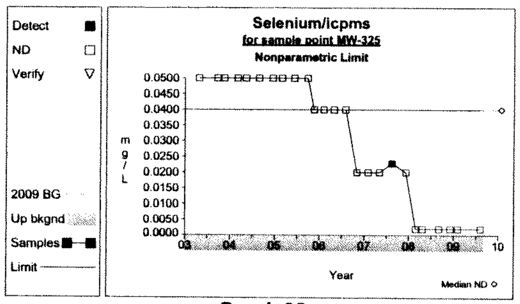


Graph 80

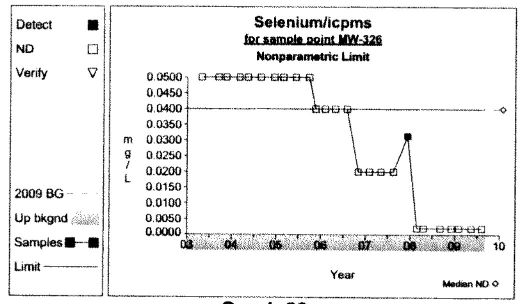


Graph 81

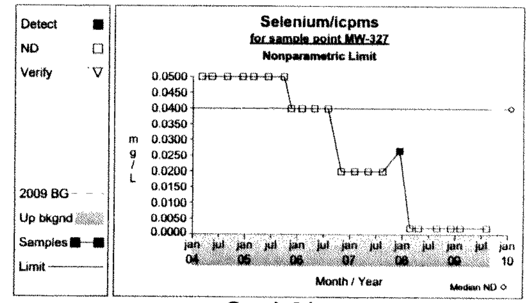
Up vs. Down Prediction Limits



Graph 82

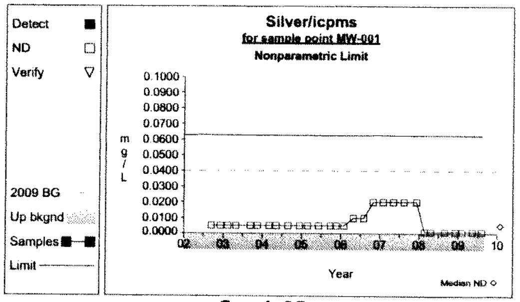


Graph 83

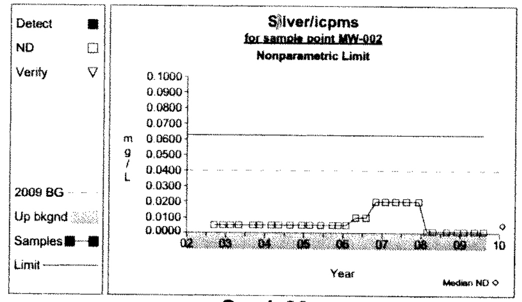


Graph 84

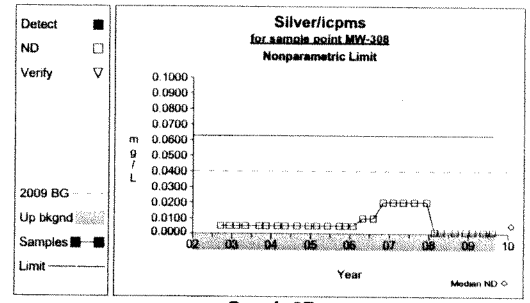
Up vs. Down Prediction Limits



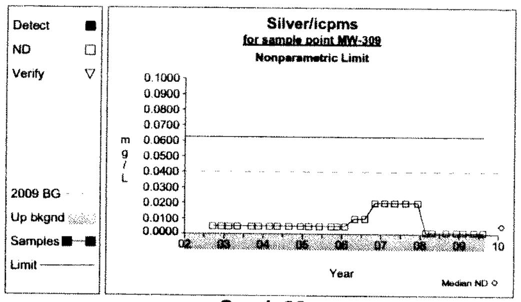
Graph 85



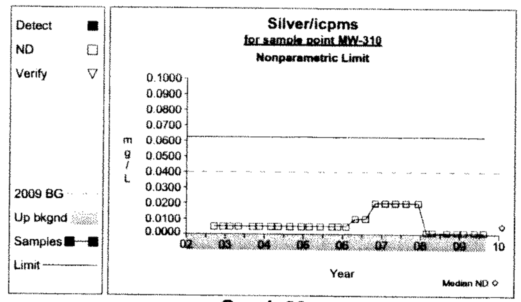
Graph 86



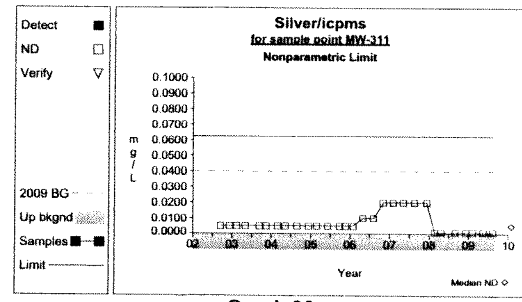
Graph 87



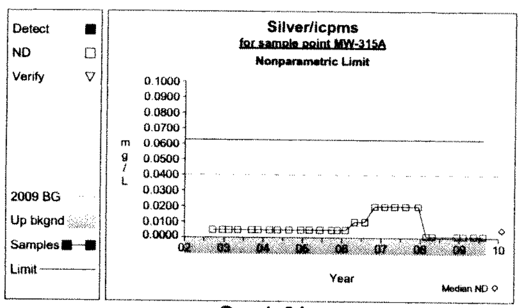
Graph 88



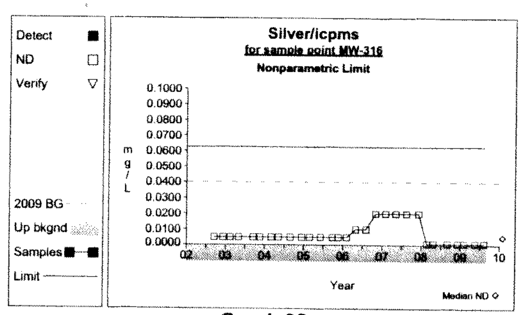
Graph 89



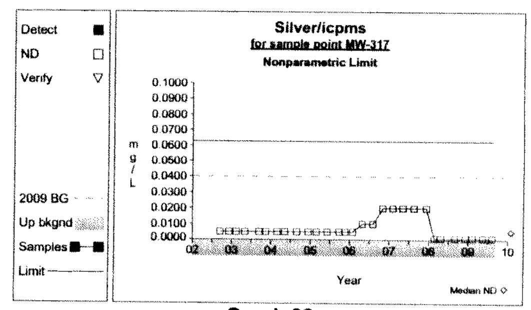
Graph 90



Graph 91

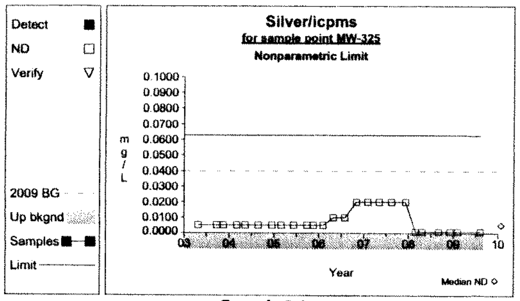


Graph 92

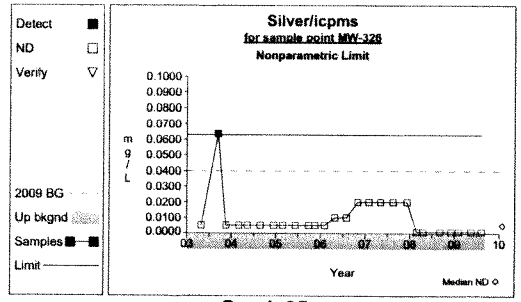


Graph 93

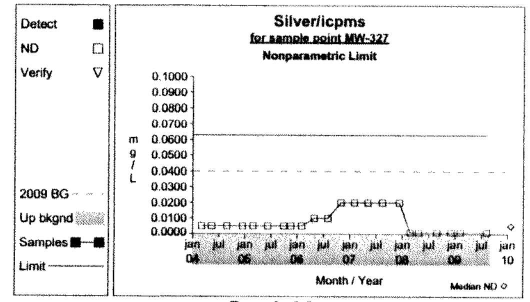
Up vs. Down Prediction Limits



Graph 94

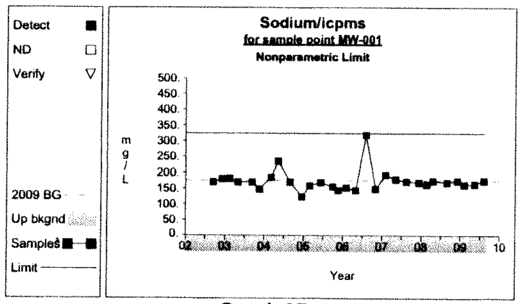


Graph 95

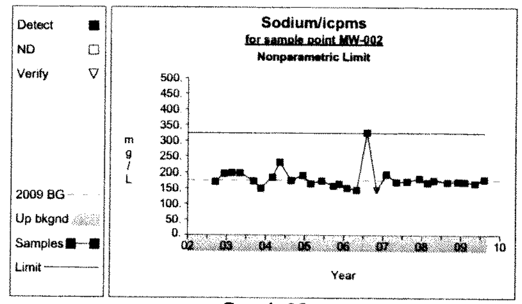


Graph 96

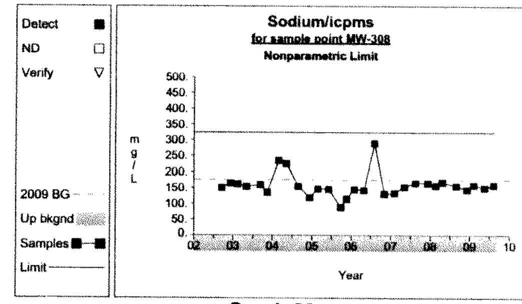
Up vs. Down Prediction Limits



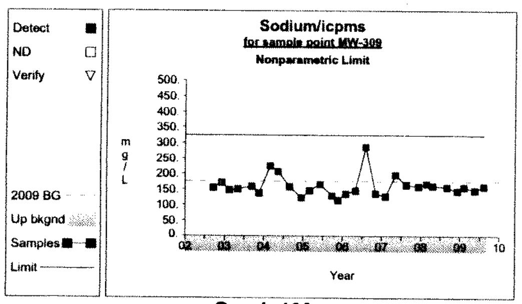
Graph 97



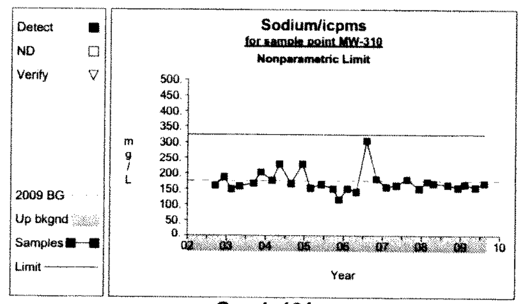
Graph 98



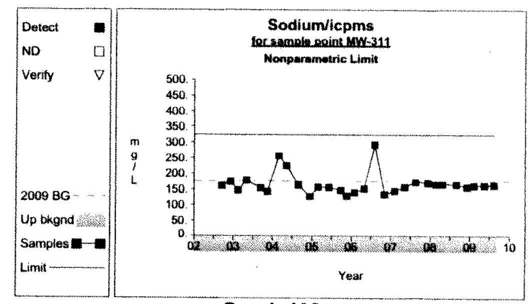
Graph 99



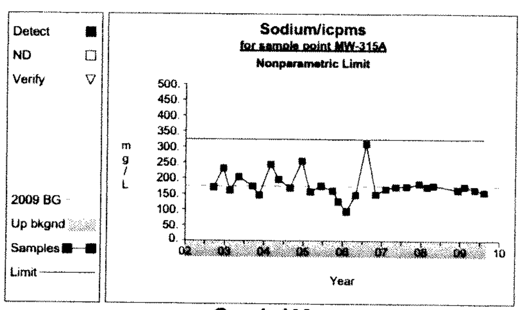
Graph 100



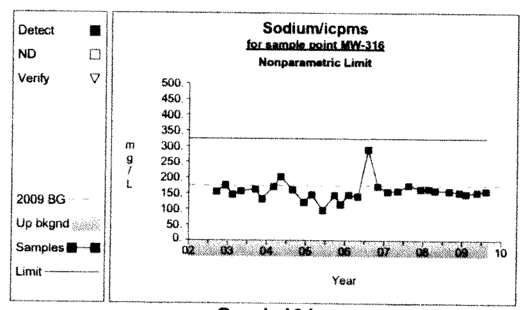
Graph 101



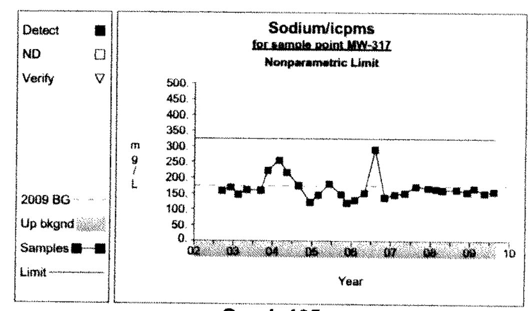
Graph 102



Graph 103

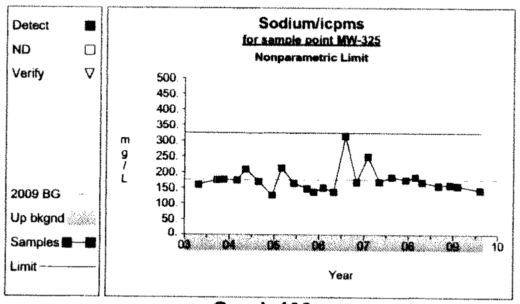


Graph 104

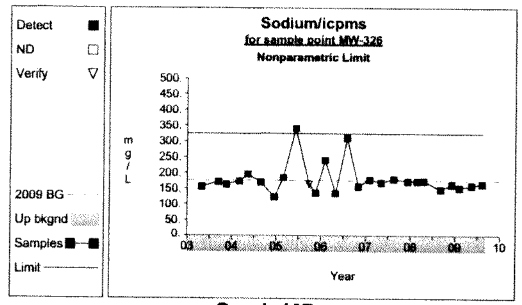


Graph 105

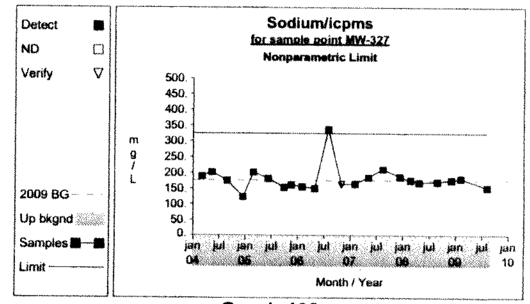
Up vs. Down Prediction Limits



Graph 106



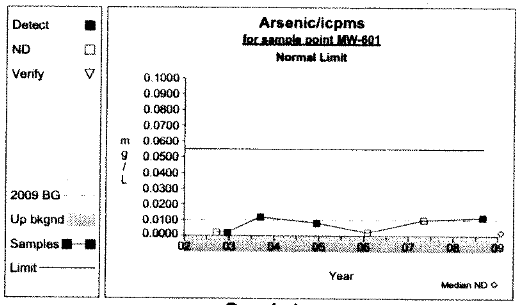
Graph 107



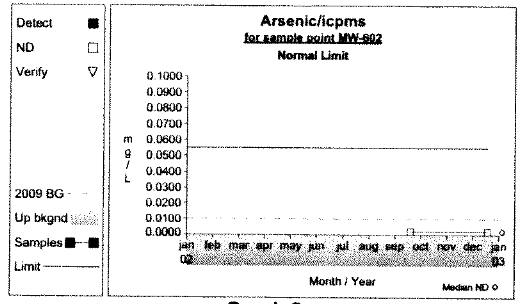
Graph 108

Analysis prepared on: 8/11/2010

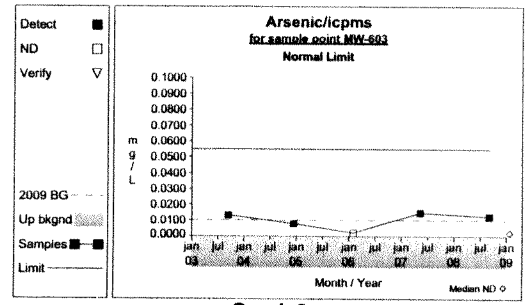
Up vs. Down Prediction Limits



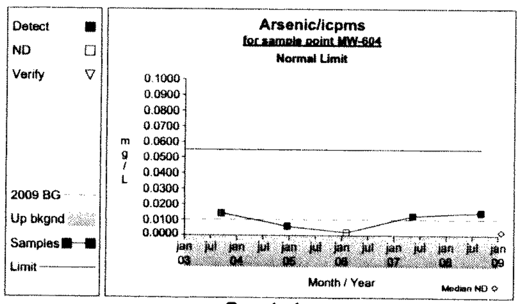
Graph 1



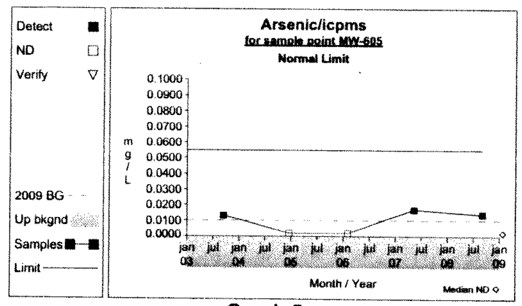
Graph 2



Graph 3

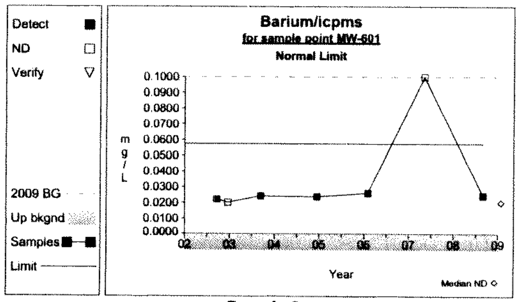


Graph 4

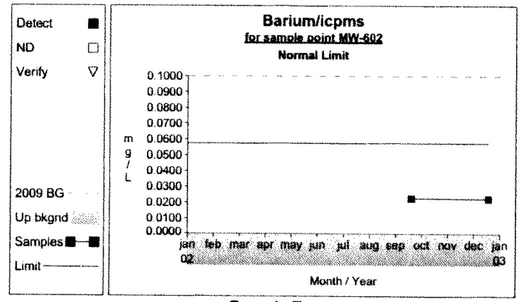


Graph 5

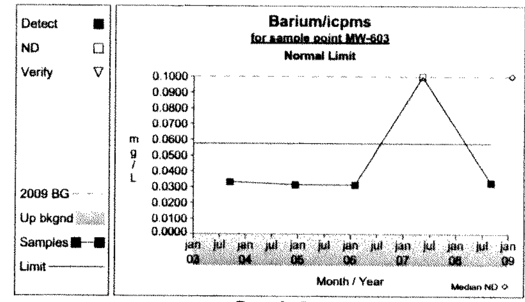
Up vs. Down Prediction Limits



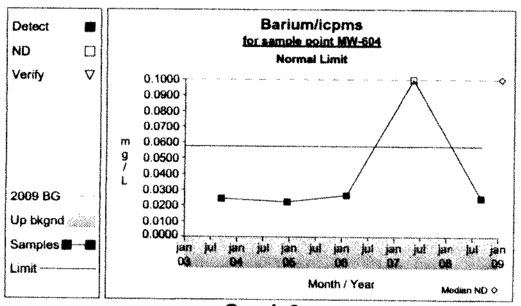
Graph 6



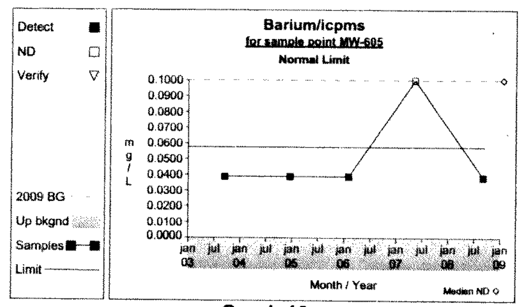
Graph 7



Graph 8

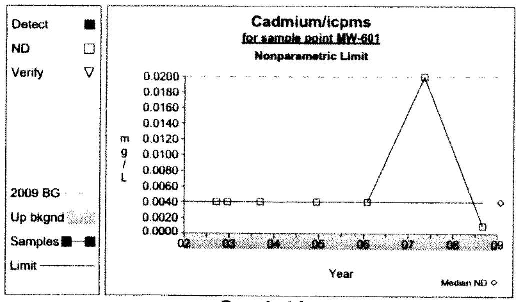


Graph 9

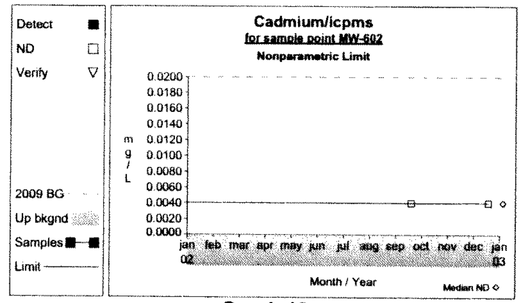


Graph 10

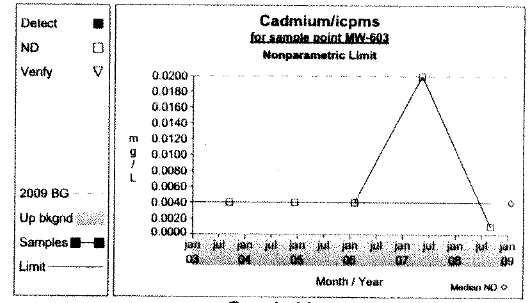
Up vs. Down Prediction Limits



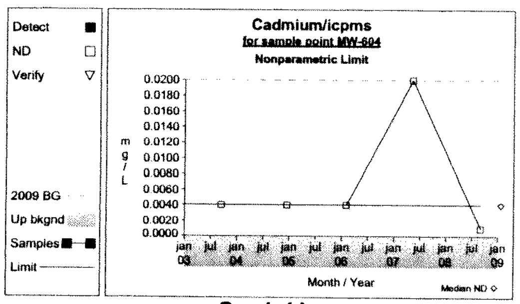
Graph 11



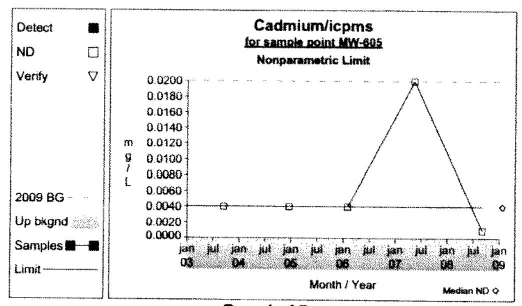
Graph 12



Graph 13

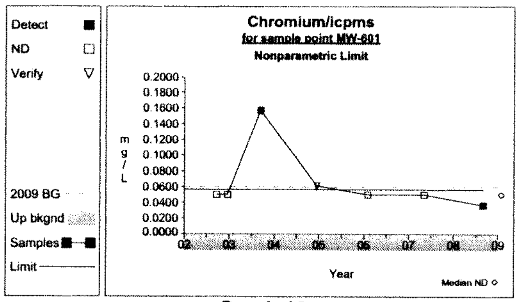


Graph 14

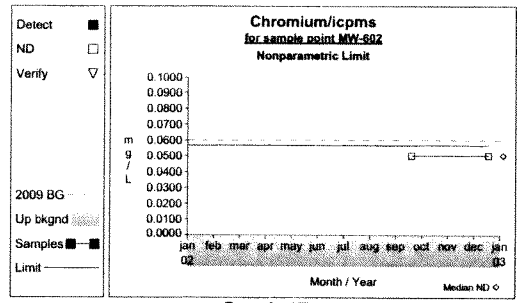


Graph 15

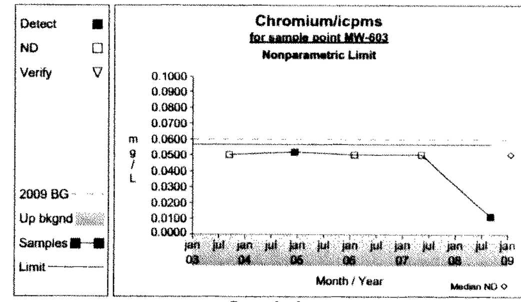
Up vs. Down Prediction Limits



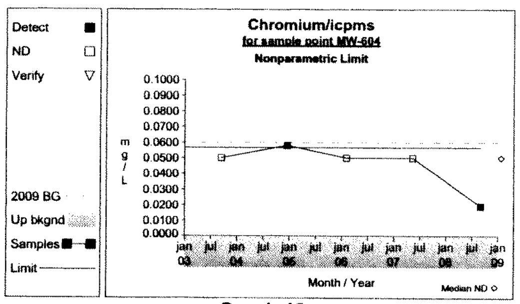
Graph 16



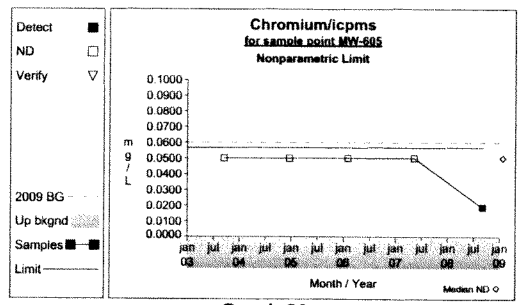
Graph 17



Graph 18

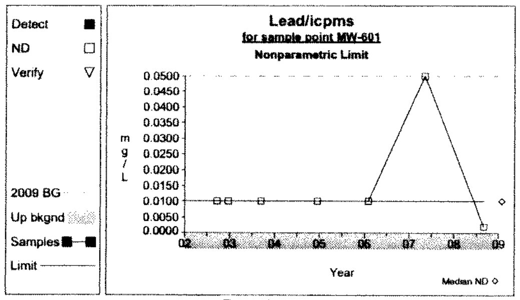


Graph 19

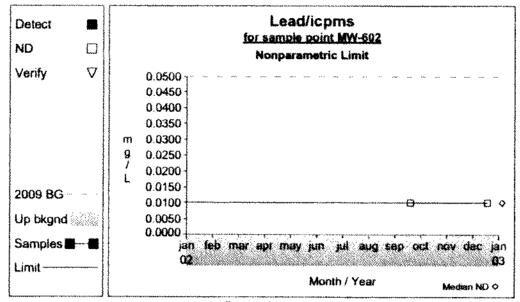


Graph 20

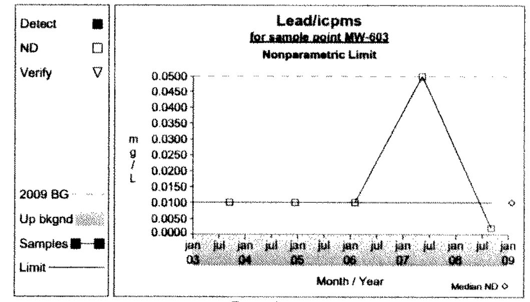
Up vs. Down Prediction Limits



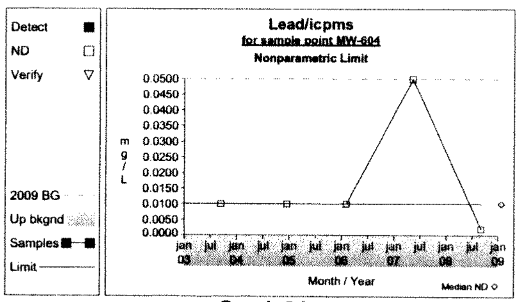
Graph 21



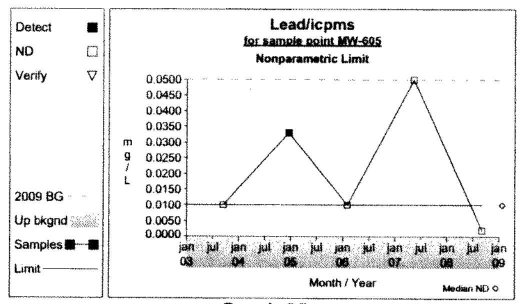
Graph 22



Graph 23

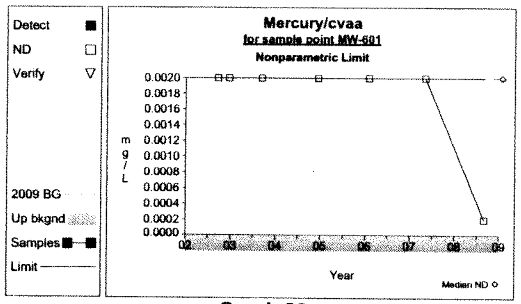


Graph 24

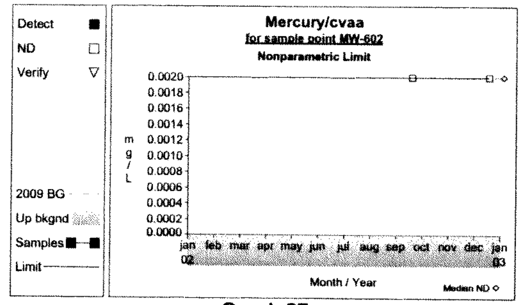


Graph 25

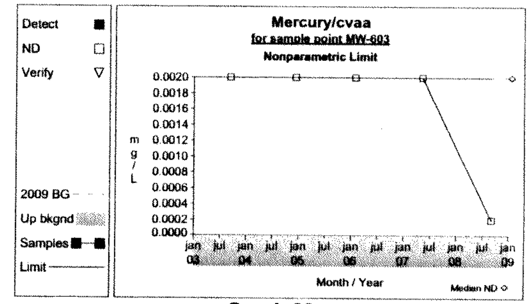
Up vs. Down Prediction Limits



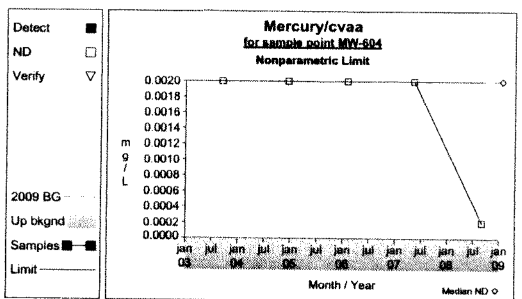
Graph 26



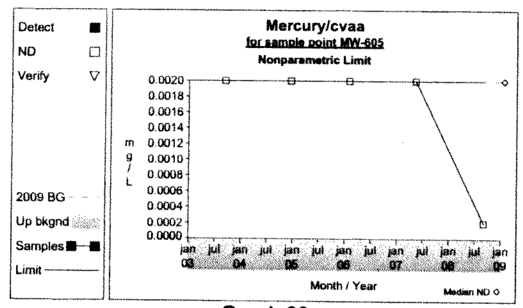
Graph 27



Graph 28

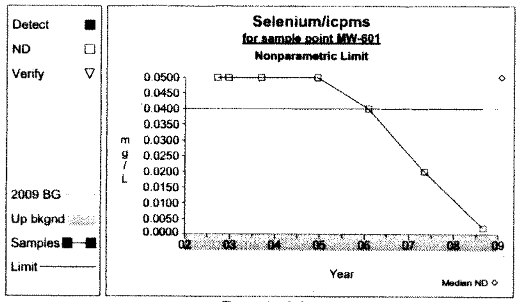


Graph 29

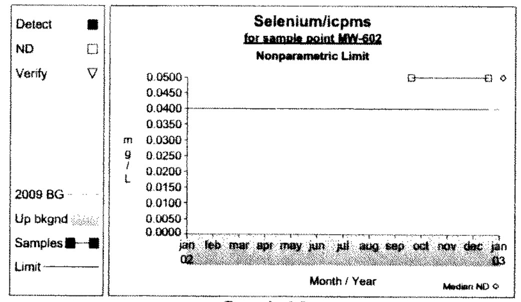


Graph 30

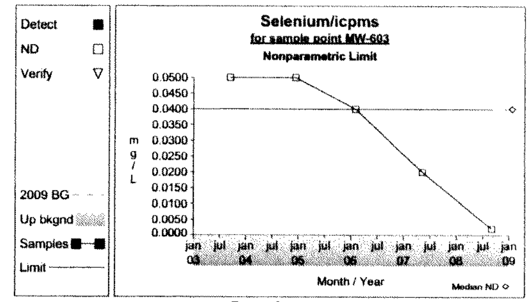
Up vs. Down Prediction Limits



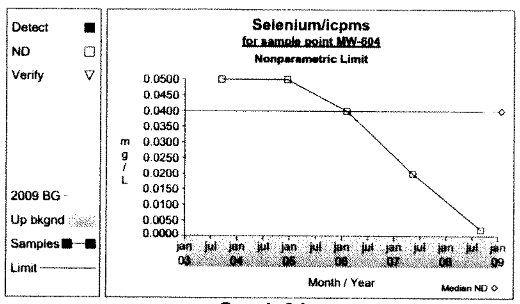
Graph 31



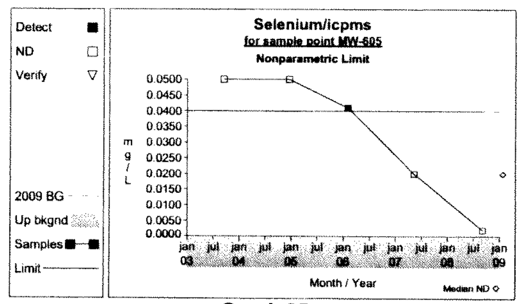
Graph 32



Graph 33

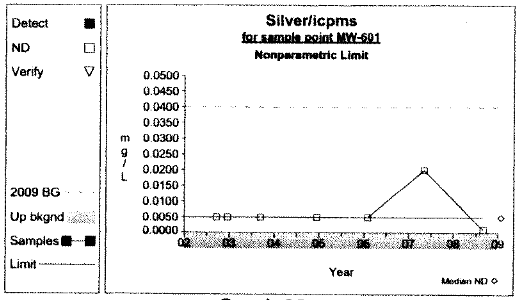


Graph 34

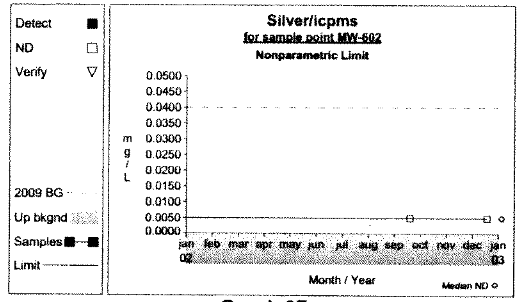


Graph 35

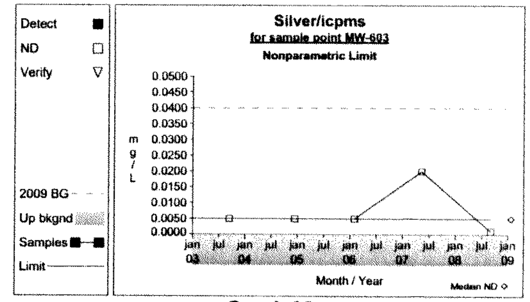
Up vs. Down Prediction Limits



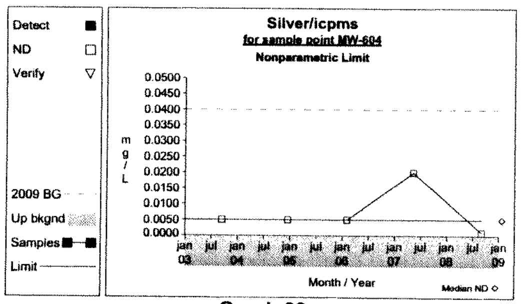
Graph 36



Graph 37



Graph 38



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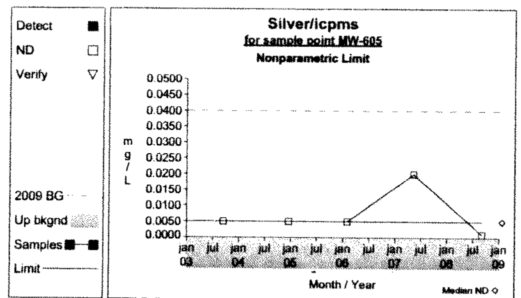
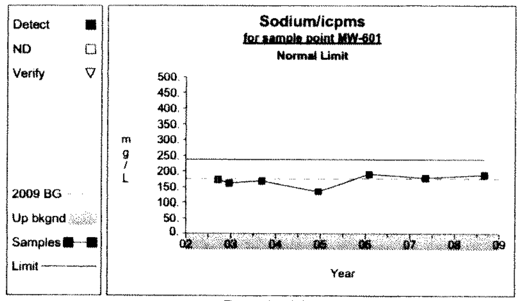
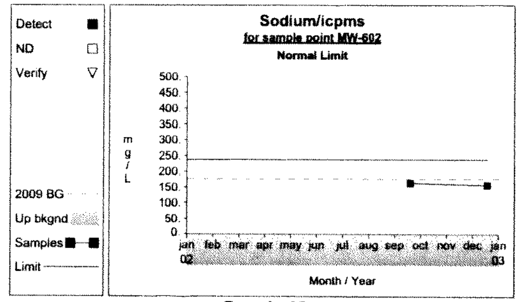


Graph 40

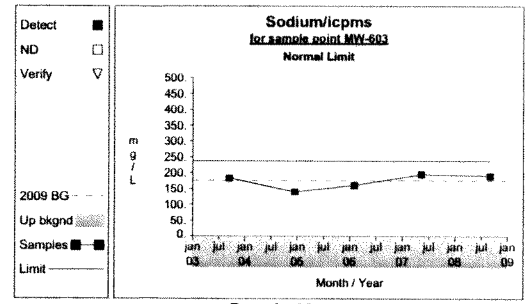
Up vs. Down Prediction Limits



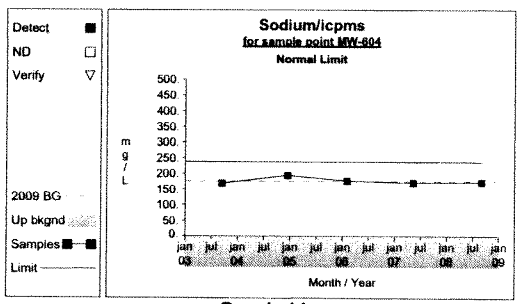
Graph 41



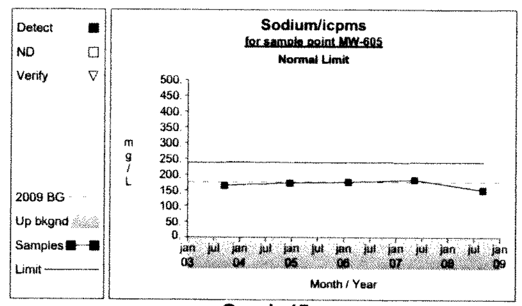
Graph 42



Graph 43

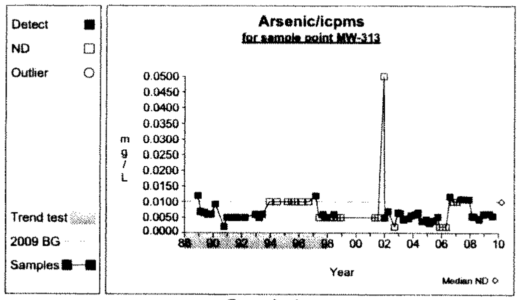


Graph 44

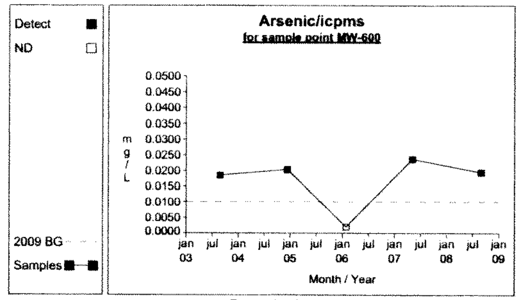


Graph 45

Time Series

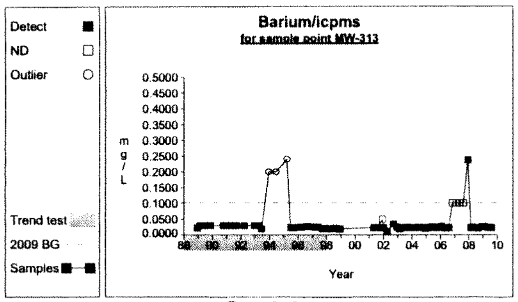


Graph 1

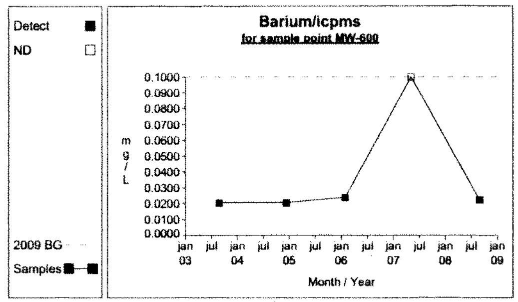


Graph 2

Time Series

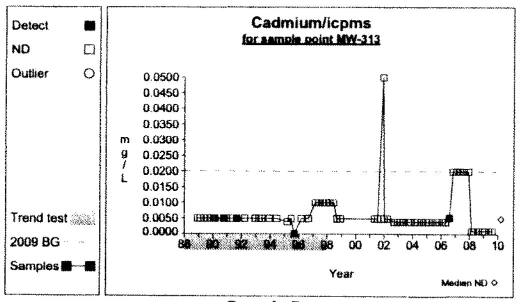


Graph 3

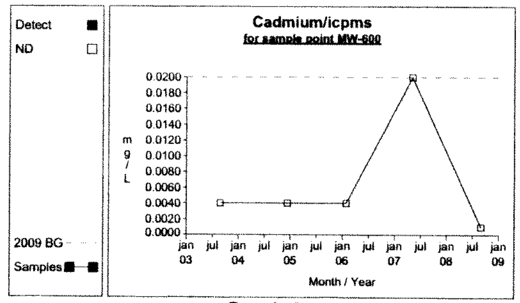


Graph 4

Time Series

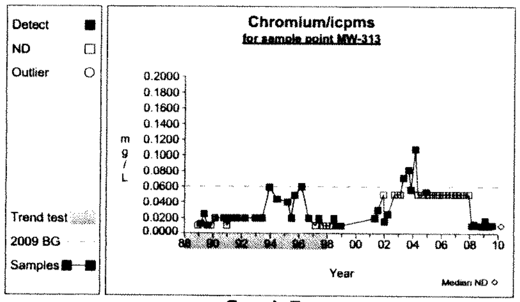


Graph 5

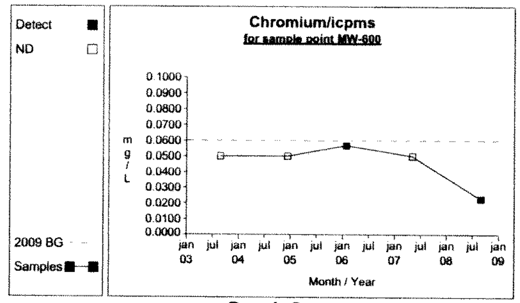


Graph 6

Time Series

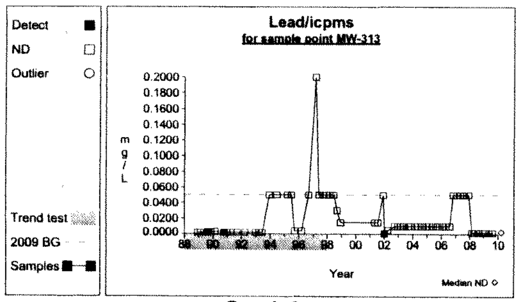


Graph 7

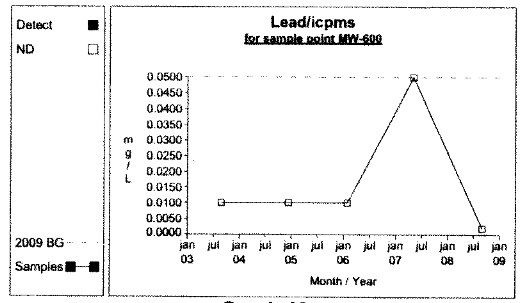


Graph 8

Time Series

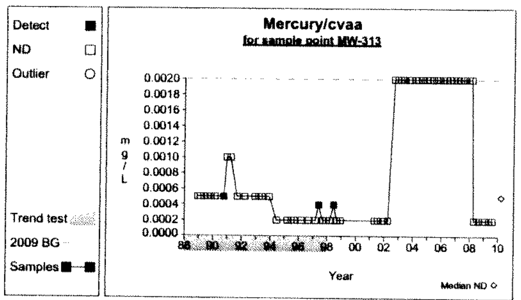


Graph 9

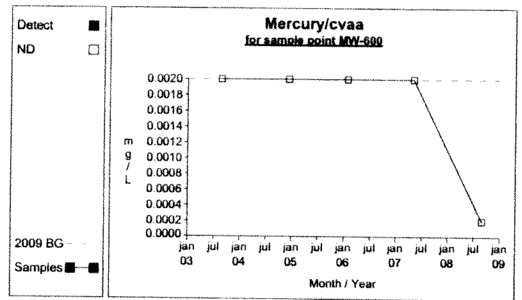


Graph 10

Time Series

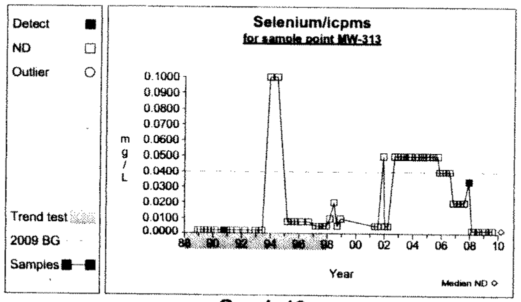


Graph 11

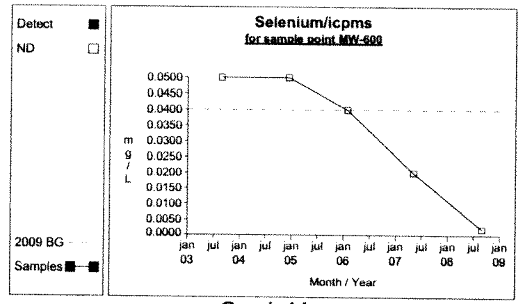


Graph 12

Time Series

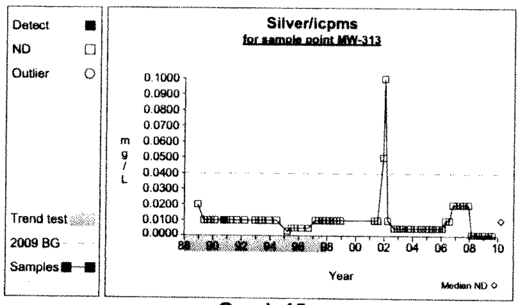


Graph 13

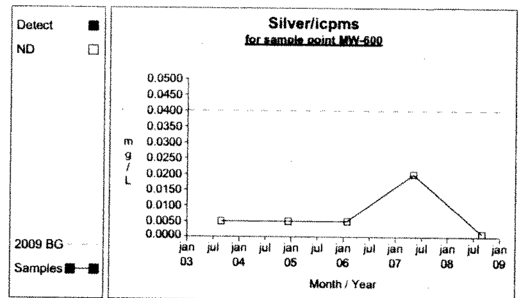


Graph 14

Time Series

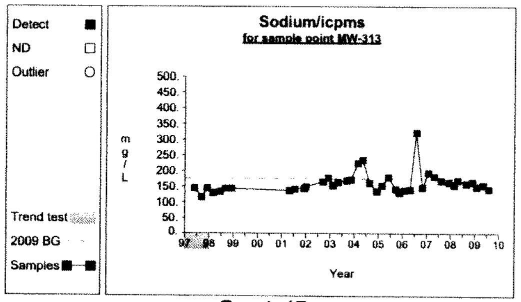


Graph 15

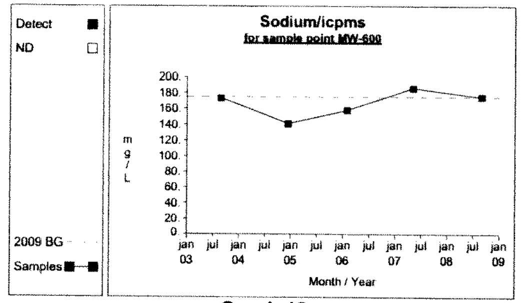


Graph 16

Time Series



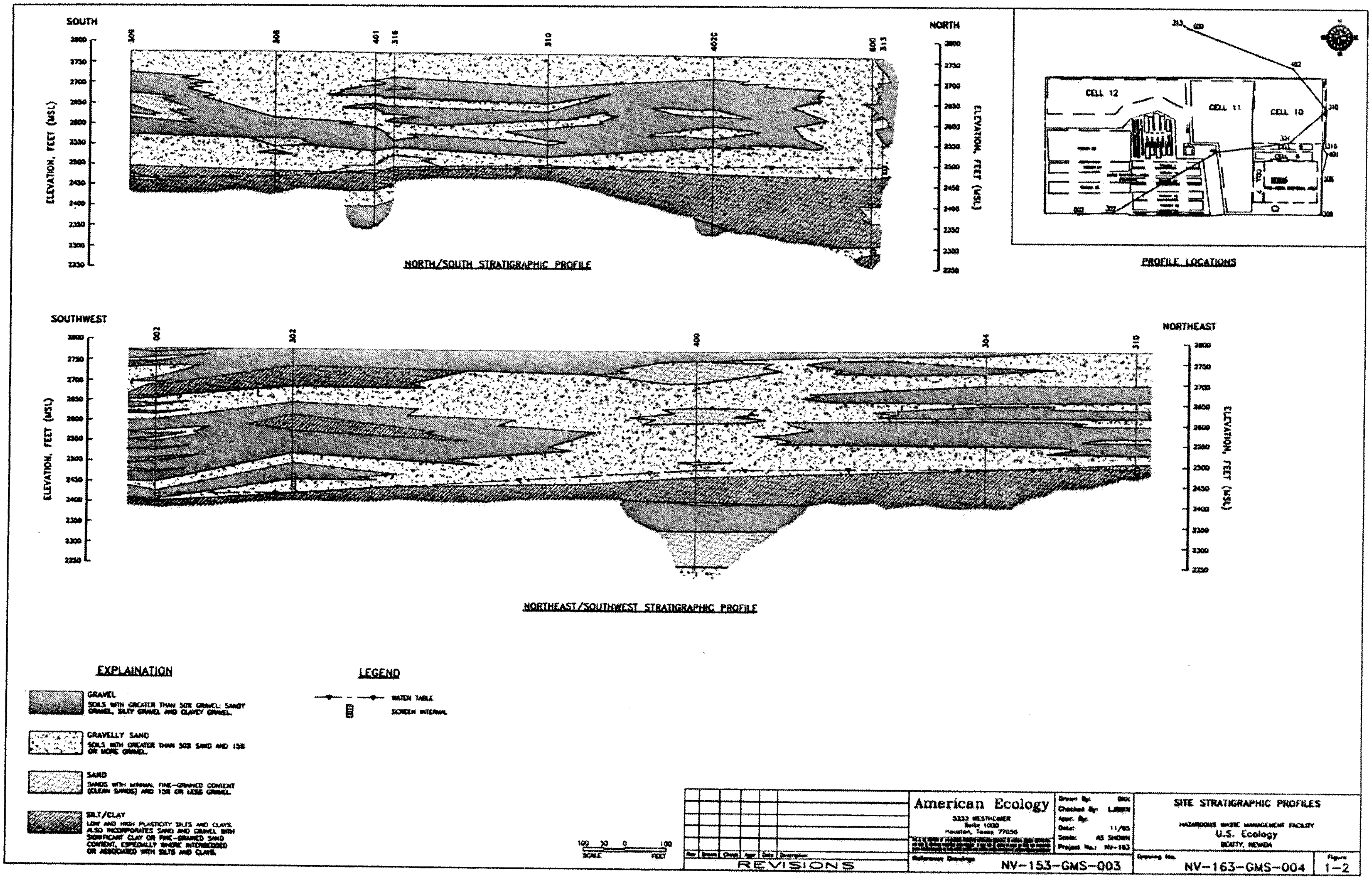
Graph 17

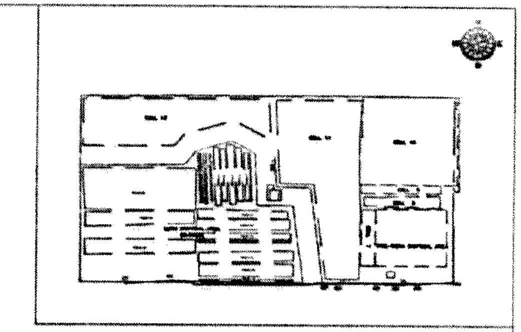


Graph 18

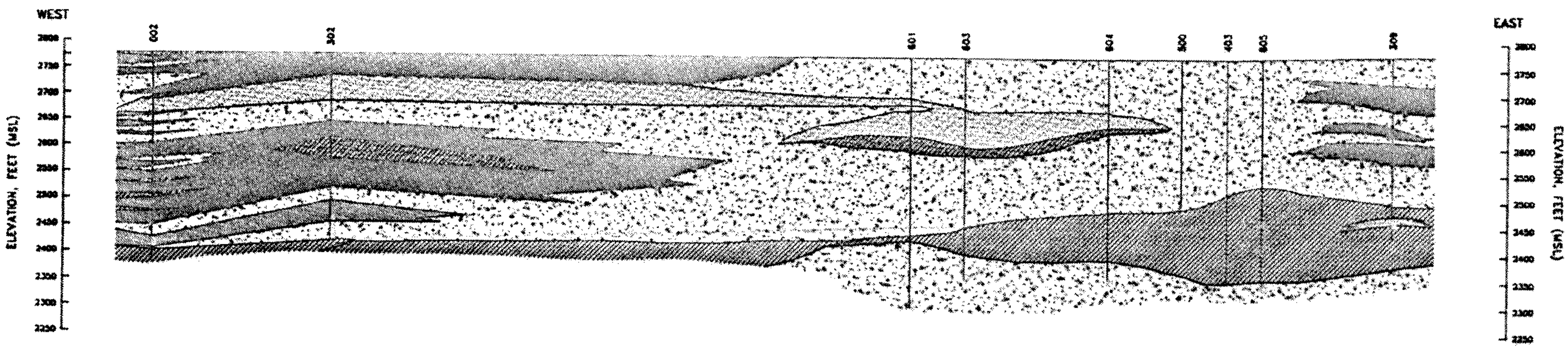
ATTACHMENT 2

CROSS-SECTIONS


SOUTH
NORTH
ELEVATION, FEET (MSL)
NORTH/SOUTH STRATIGRAPHIC PROFILE
PROFILE LOCATIONS
CELL 12
CELL 11
CELL 10
SOUTHWEST
NORTHEAST
NORTHEAST/SOUTHWEST STRATIGRAPHIC PROFILE
EXPLAINATION
GRAVEL
SOILS WITH GREATER THAN 50% GRAVEL; SANDY GRAVEL, SILTY GRAVEL AND CLAYEY GRAVEL.
GRAVELLY SAND
SOILS WITH GREATER THAN 50% SAND AND 15% OR MORE GRAVEL.
SAND
SANDS WITH MINIMAL FINE-GRAINED CONTENT (CLEAN SANDS) AND 15% OR LESS GRAVEL.
SILT/CLAY
LOW AND HIGH PLASTICITY SILTS AND CLAYS. ALSO INCORPORATES SAND AND GRAVEL WITH SIGNIFICANT CLAY OR FINE-GRAINED SAND CONTENT, ESPECIALLY WHERE INTERBEDDED OR ASSOCIATED WITH SILTS AND CLAYS.
LEGEND
WATER TABLE
SCREEN INTERVAL
SCALE FEET
REVISIONS
American Ecology
3333 WESTHEIMER
Suite 1000
Houston, Texas 77056
Date: 11/95
Scale: AS SHOWN
Reference Drawings NV-153-GMS-003
SITE STRATIGRAPHIC PROFILES
HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology
BEATTY, NEVADA
Drawing No. NV-163-GMS-004
Figure 1-2



PROFILE LOCATION



EAST/WEST STRATIGRAPHIC PROFILE

EXPLAINATION

GRAVEL
SOILS WITH GREATER THAN 50% GRAVEL: SANDY GRAVEL, SILTY GRAVEL AND CLAYEY GRAVEL.

GRAVELLY SAND
SOILS WITH GREATER THAN 50% SAND AND 15% OR MORE GRAVEL.

SAND
SANDS WITH MINIMAL FINE-GRAINED CONTENT (CLEAN SANDS) AND 15% OR LESS GRAVEL.

SILT/CLAY
LOW AND HIGH PLASTICITY SILTS AND CLAYS. ALSO INCORPORATES SAND AND GRAVEL WITH SIGNIFICANT CLAY OR FINE-GRAINED SAND CONTENT, ESPECIALLY WHERE INTERBEDDED OR ASSOCIATED WITH SILTS AND CLAYS.

LEGEND

WATER TABLE
SCREEN INTERVAL

100 50 0 100
SCALE FEET

Rev	Drawn	Check	Appr	Date	Description

REVISIONS

American Ecology
5333 WESTHEIMER
Suite 1000
Houston, Texas 77056

Drawn By: DKK
Checked By: L.BRINK
Appr. By:
Date: 11/95
Scale: AS SHOWN
Project No.: NV-163

Reference Drawings: NV-153-GMS-004

SITE STRATIGRAPHIC PROFILE
HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology
BEATTY, NEVADA

Drawing No. NV-163-GMS-005

Figure 1-3

ATTACHMENT 3

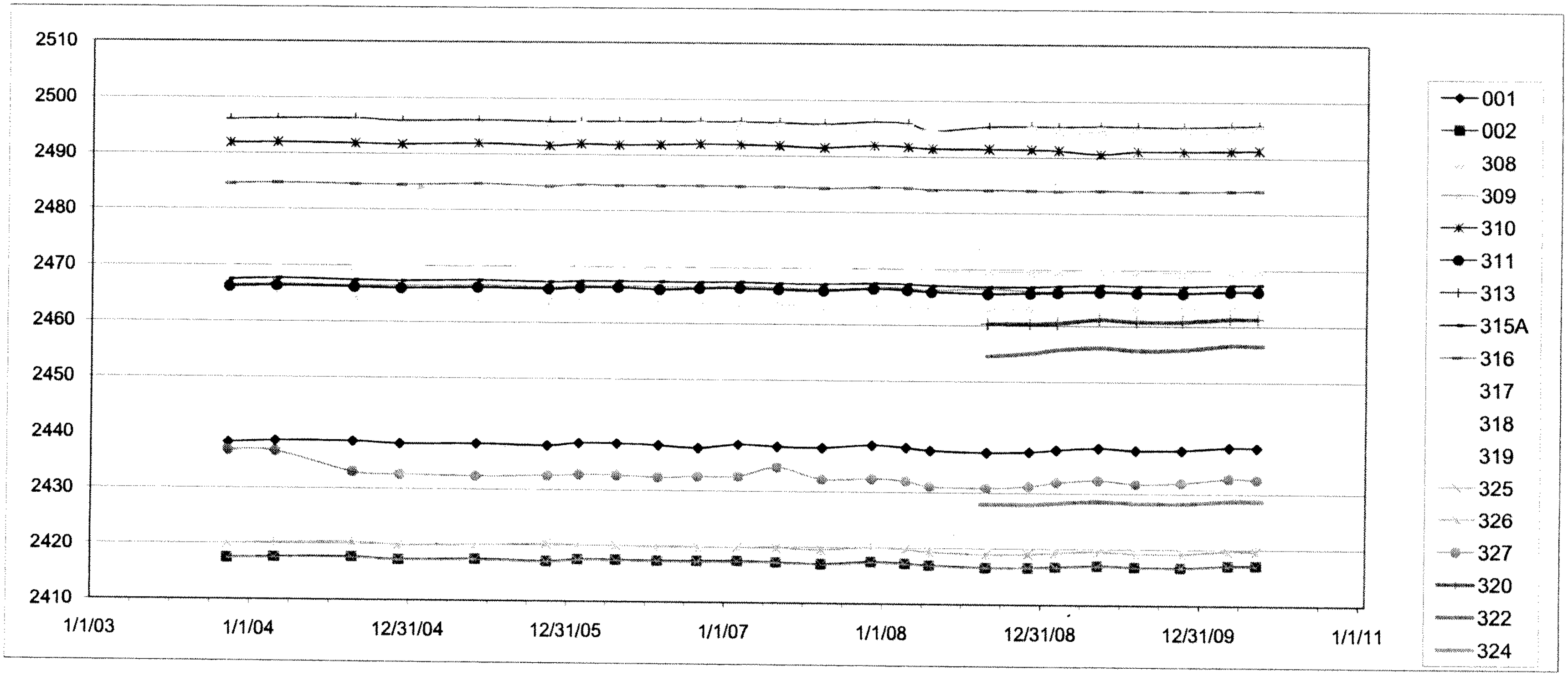
HISTORICAL POTENTIOMETRIC SURFACE MAPS

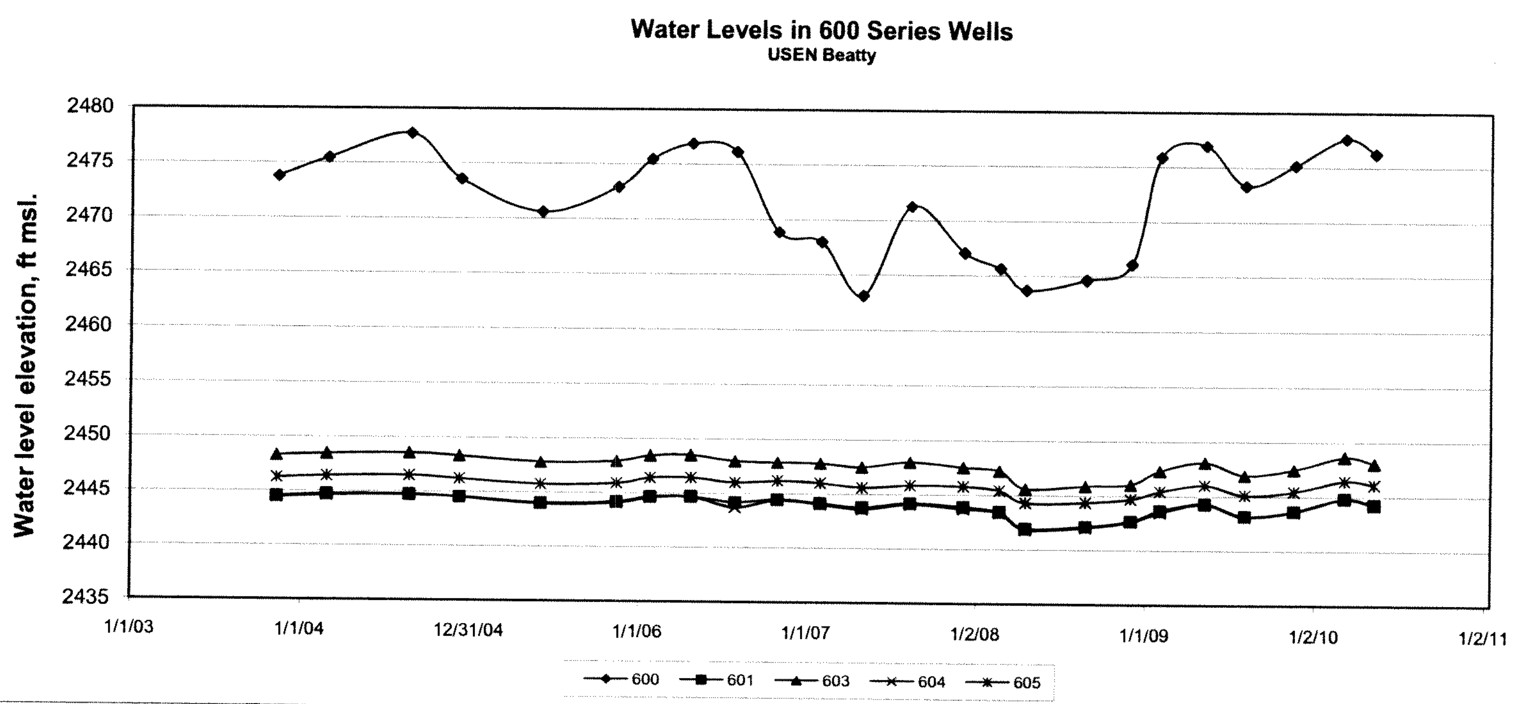
TABLE 1. MONITOR WELL CONSTRUCTION SUMMARY

WELL ID	WELL TYPE	WELL STATUS	COORDINATES NORTH	COORDINATES EAST	ELEVATION DATUM* (NGVD)	BORING DEPTH (fbgs)	WELL DEPTH (fbgs)	TOP OF SCREEN DEPTH (fbgs)	TOP OF SCREEN ELEVATION (NGVD)	BOTTOM OF SCREEN DEPTH (fbgs)	BOTTOM OF SCREEN ELEVATION (NGVD)	Length of Screen/Slot Size (feet/inch)	Installed By	Date Installed
001	S	ACTIVE	6101.13	4953.73	2783.32	366.0	360.7	340.7	2442.6	360.7	2422.6	20.0/0.010		9/5/1990
002	S	ACTIVE	6165.77	4955.54	2778.15	390.0	374.0	354	2424.2	374	2404.2	20.0/0.010		9/5/1990
308	S	ACTIVE	7541.22	4435.32		338.0	323.0	298.2		318.0		19.8/0.040		9/3/1988
309	S	ACTIVE	7185.59	4927.82		340.0	325.9	301.1		320.9		19.8/0.040		10/20/1988
310	S	ACTIVE	6576.73	4963.54		299.5	299.5	274.7		294.5		19.8/0.040		8/4/1988
311	S	ACTIVE	5500.63	4960.87		330.0	324.4	257.6		299.6		42.0/0.040		10/27/1988
313	S	ACTIVE	5040.72	3680.02		320.0	307.2	282.4		302.2		19.8/0.040		8/12/1988
315A	S	ACTIVE	5557.96	4960.34		313.0	312.5	292.5		312.5		20.0/0.040		3/19/1996
316	S	ACTIVE				314.0	311.9	279.4		299.2		19.8/0.04		10/1/1988
317	S	ACTIVE				340.0	321.4	301.6		321.4		19.8/0.04		10/25/1988
318	S	ACTIVE												
319	S	ACTIVE												
325	S	ACTIVE												
326	S	ACTIVE												
327	S	ACTIVE												
320	S	ACTIVE												
322	S	ACTIVE												
324	S	ACTIVE												
600	D	ACTIVE			2783.52	502.0	471.5	461.3	2322.2	471.5	2312.0	10.2/0.040	G&M	9/7/1990
601	D	ACTIVE			2767.68	420.0	379.5	369.5	2398.2	379.5	2388.2	10.0/0.040	G&M	9/10/1990
603	D	ACTIVE			2767.64	415.0	385.1	375.1	2392.5	385.1	2382.5	10.0/0.040	G&M	9/11/1990
604	D	ACTIVE			2769.95	436.2	425.0	415.0	2355.0	425.0	2345.0	10.0/0.040	G&M	9/12/1990
605	D	ACTIVE			2769.34	441.8	436.8	426.6	2342.7	436.8	2332.5	10.2/0.040	G&M	9/13/1990

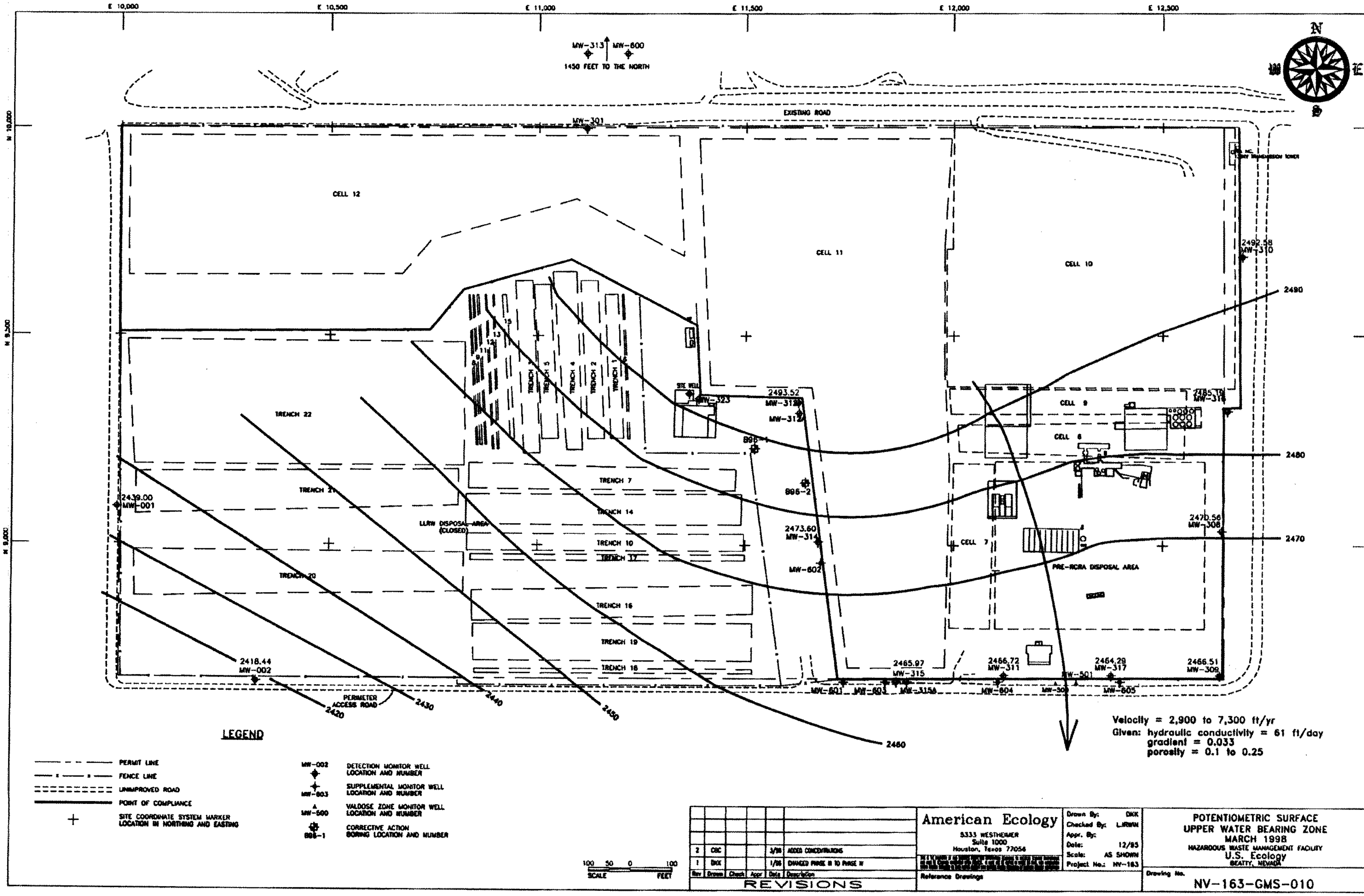
Notes:
*Datum is Top of PVC Casing.
All elevations and depths are in feet. Boring depth, bottom of screen, top of screen, and stick up are relative to Datum.
fbgs = feet below ground surface.
NGVD is feet above National Geodetic Vertical Datum.
ABND = Abandoned.
G&M = Geraghty & Miller, Inc.
S = Shallow Zone well; D = Deep Zone well

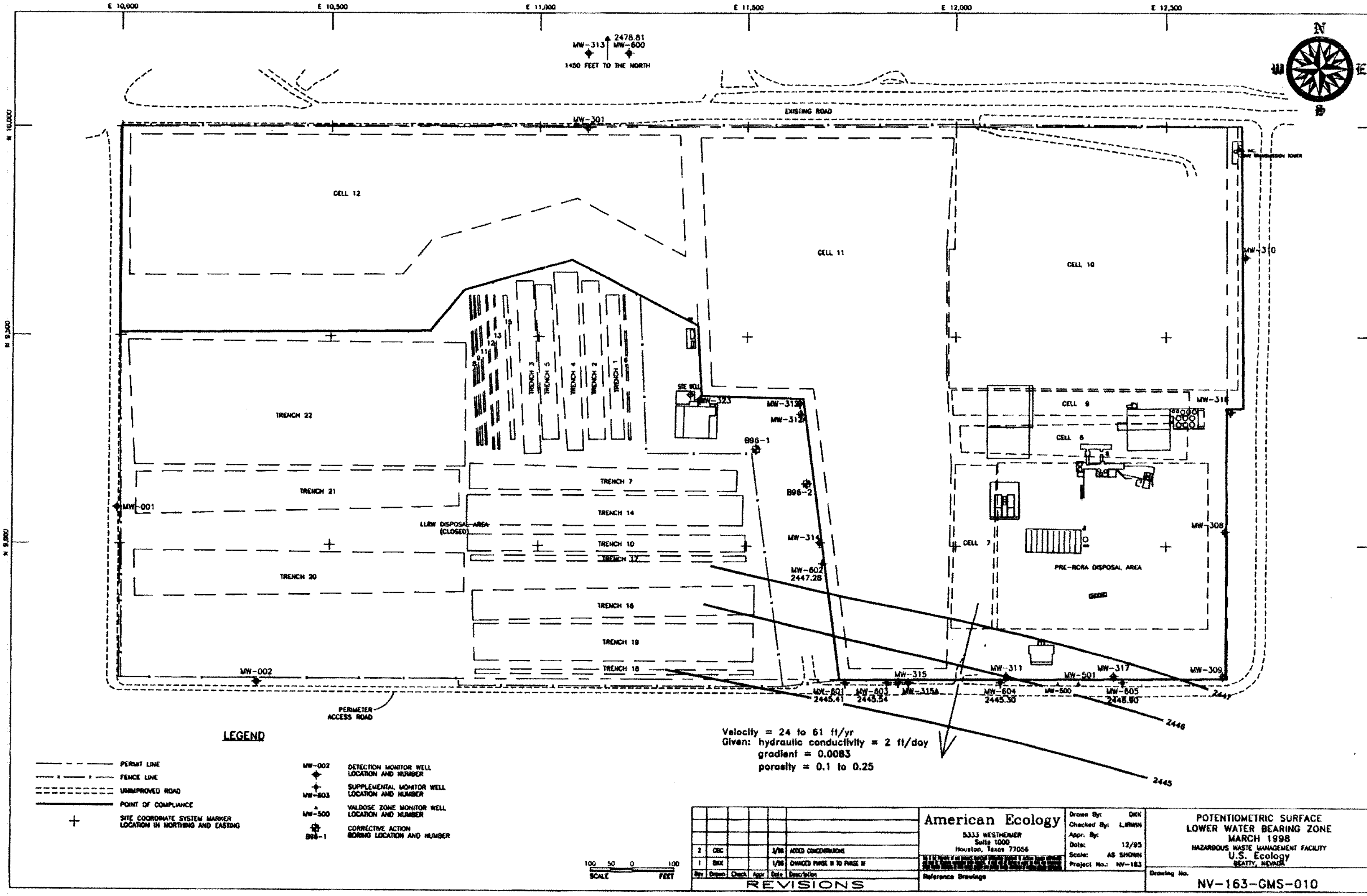
Last updated: July 2010


2510
2500
2490
2480
2470
2460
2450
2440
2430
2420
2410
1/1/03
1/1/04
12/31/04
12/31/05
1/1/07
1/1/08
12/31/08
12/31/09
1/1/11
001
002
308
309
310
311
313
315A
316
317
318
319
325
326
327
320
322
324

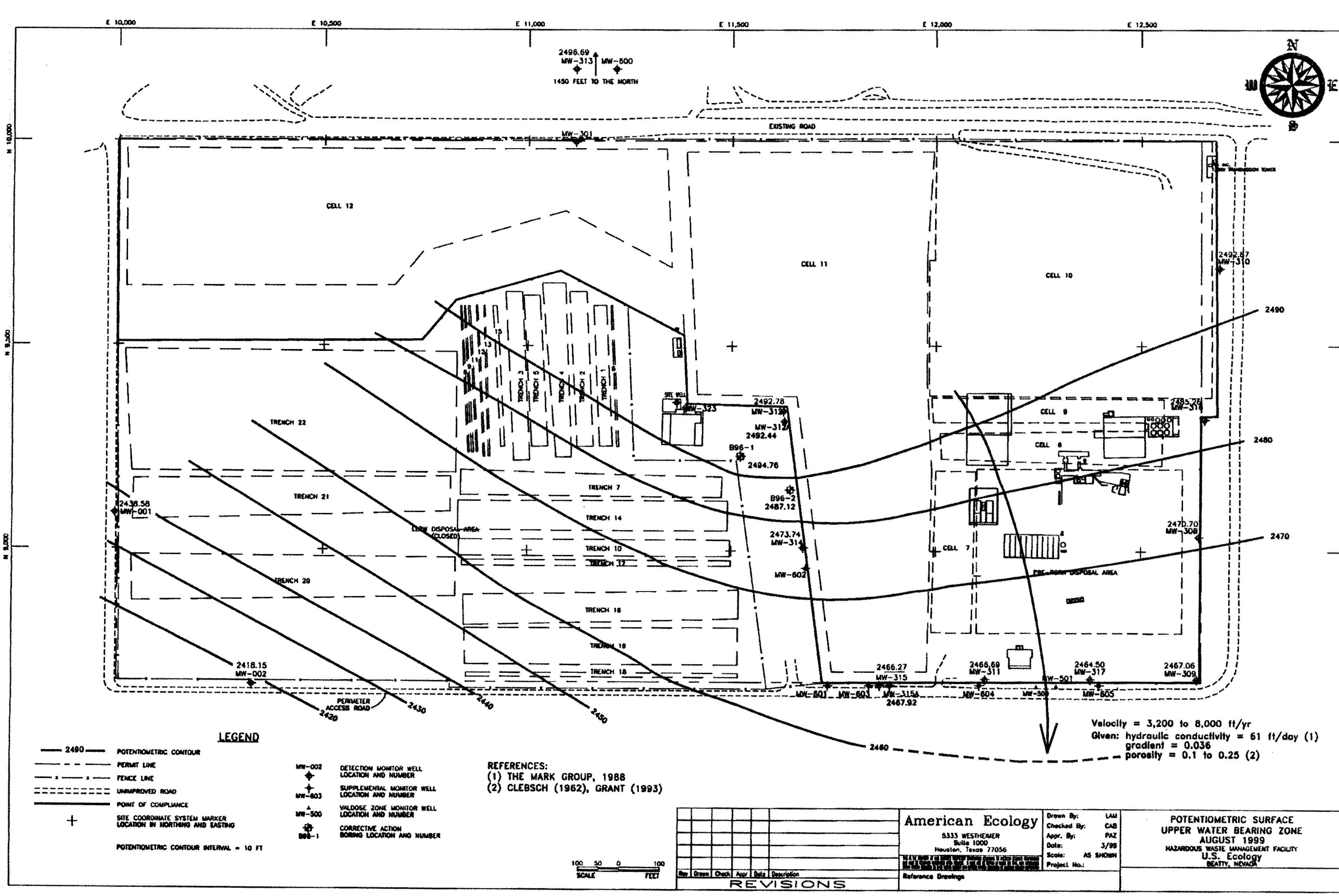

Water Levels in 600 Series Wells
USEN Beatty
Water level elevation, ft msl.
2480
2475
2470
2465
2460
2455
2450
2445
2440
2435
1/1/03
1/1/04
12/31/04
1/1/06
1/1/07
1/2/08
1/1/09
1/2/10
1/2/11
600
601
603
604
605

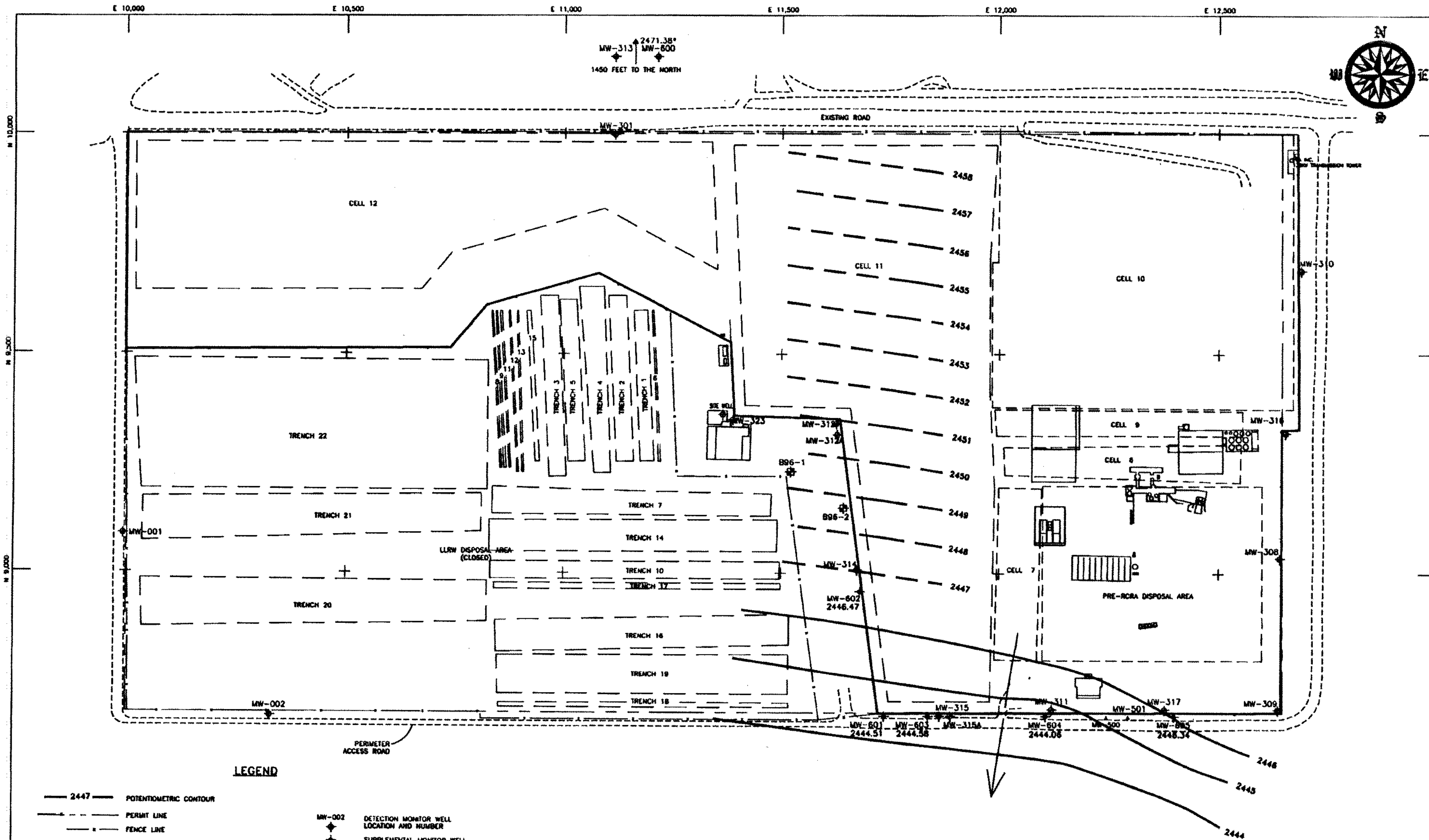
8/16/2010


E 10,000
E 10,500
E 11,000
E 11,500
E 12,000
E 12,500
N 10,000
N 9,500
N 9,000
MW-313 MW-600
1450 FEET TO THE NORTH
EXISTING ROAD
MW-301
CELL 12
CELL 11
CELL 10
CELL 9
CELL 8
CELL 7
PRE-RCRA DISPOSAL AREA
LLRW DISPOSAL AREA (CLOSED)
TRENCH 22
TRENCH 21
TRENCH 20
TRENCH 7
TRENCH 14
TRENCH 10
TRENCH 17
TRENCH 16
TRENCH 19
TRENCH 18
TRENCH 1
TRENCH 2
TRENCH 4
TRENCH 5
SITE WELL
MW-323
2493.52
MW-313
MW-312
B96-1
B96-2
2473.60
MW-314
MW-602
2492.58
MW-310
2485.79
MW-318
2470.56
MW-308
2466.51
MW-309
2464.29
MW-317
MW-501
MW-605
MW-309
2466.72
MW-311
MW-604
2465.97
MW-315
MW-601
MW-603
MW-315A
2439.00
MW-001
2418.44
MW-002
PERIMETER ACCESS ROAD
2490
2480
2470
2460
2450
2440
2430
2420
Velocity = 2,900 to 7,300 ft/yr
Given: hydraulic conductivity = 61 ft/day
gradient = 0.033
porosity = 0.1 to 0.25
LEGEND
PERMIT LINE
FENCE LINE
UNIMPROVED ROAD
POINT OF COMPLIANCE
SITE COORDINATE SYSTEM MARKER LOCATION IN NORTHING AND EASTING
MW-002 DETECTION MONITOR WELL LOCATION AND NUMBER
MW-603 SUPPLEMENTAL MONITOR WELL LOCATION AND NUMBER
MW-500 VALDOSE ZONE MONITOR WELL LOCATION AND NUMBER
B96-1 CORRECTIVE ACTION BORING LOCATION AND NUMBER
100 50 0 100
SCALE FEET
2 CBC 3/98 ADDED CONCENTRATIONS
1 DKK 1/98 CHANGED PHASE III TO PHASE IV
Rev Drawn Check Appr Date Description
REVISIONS
American Ecology
5333 WESTHEIMER
Suite 1000
Houston, Texas 77056
Reference Drawings
Drawn By: DKK
Checked By: L.IRWIN
Appr. By:
Date: 12/95
Scale: AS SHOWN
Project No.: NV-163
POTENTIOMETRIC SURFACE
UPPER WATER BEARING ZONE
MARCH 1998
HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology
BEATTY, NEVADA
Drawing No.
NV-163-GMS-010



POTENTIOMETRIC SURFACE
LOWER WATER BEARING ZONE
MARCH 1998
HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology
BEATTY, NEVADA
NV-163-GMS-010
American Ecology
5333 WESTHEIMER
Suite 1000
Houston, Texas 77056
Drawn By: DKK
Checked By: L.IRWIN
Date: 12/95
Scale: AS SHOWN
Project No.: NV-163
Drawing No.
Reference Drawings
REVISIONS
2 CBC 3/98 ADDED CONCENTRATIONS
1 DKK 1/98 CHANGED PHASE III TO PHASE IV
Rev Drawn Check Appr Date Description
Velocity = 24 to 61 ft/yr
Given: hydraulic conductivity = 2 ft/day
gradient = 0.0083
porosity = 0.1 to 0.25
LEGEND
PERMIT LINE
FENCE LINE
UNIMPROVED ROAD
POINT OF COMPLIANCE
SITE COORDINATE SYSTEM MARKER LOCATION IN NORTHING AND EASTING
MW-002 DETECTION MONITOR WELL LOCATION AND NUMBER
MW-603 SUPPLEMENTAL MONITOR WELL LOCATION AND NUMBER
MW-500 VADOSE ZONE MONITOR WELL LOCATION AND NUMBER
B96-1 CORRECTIVE ACTION BORING LOCATION AND NUMBER
SCALE FEET
100 50 0 100
MW-313 MW-600 2478.81
1450 FEET TO THE NORTH
EXISTING ROAD
PERIMETER ACCESS ROAD
CELL 12
CELL 11
CELL 10
CELL 9
CELL 8
CELL 7
PRE-RCRA DISPOSAL AREA
LLRW DISPOSAL AREA (CLOSED)
TRENCH 22
TRENCH 21
TRENCH 20
TRENCH 7
TRENCH 14
TRENCH 10
TRENCH 17
TRENCH 16
TRENCH 19
TRENCH 18
TRENCH 1
TRENCH 2
TRENCH 3
TRENCH 4
TRENCH 5
SITE WELL
MW-001
MW-002
MW-301
MW-308
MW-309
MW-310
MW-311
MW-312
MW-313
MW-314
MW-315
MW-315A
MW-316
MW-317
MW-319
MW-323
MW-500
MW-501
MW-601 2445.41
MW-602 2447.28
MW-603 2445.54
MW-604 2445.30
MW-605 2446.90
B96-1
B96-2
2445
2446
2447
E 10,000
E 10,500
E 11,000
E 11,500
E 12,000
E 12,500
N 10,000
N 9,500
N 9,000
N
S
E
W


E 10,000
E 10,500
E 11,000
E 11,500
E 12,000
E 12,500
N 10,000
N 9,500
N 9,000
2496.69
MW-313
MW-600
1450 FEET TO THE NORTH
EXISTING ROAD
MW-301
CELL 12
CELL 11
CELL 10
CELL 9
CELL 8
CELL 7
2492.87
MW-310
2490
2480
2470
2460
2450
2440
2430
2420
TRENCH 1
TRENCH 2
TRENCH 3
TRENCH 4
TRENCH 5
TRENCH 7
TRENCH 10
TRENCH 14
TRENCH 16
TRENCH 18
TRENCH 19
TRENCH 20
TRENCH 21
TRENCH 22
LLRW DISPOSAL AREA (CLOSED)
PRE-RCRA DISPOSAL AREA
2492.78
MW-312B
MW-312
2492.44
B96-1
2494.76
B96-2
2487.12
2473.74
MW-314
MW-602
MW-323
2485.78
MW-316
2470.70
MW-308
2438.58
MW-001
2418.15
MW-002
PERIMETER ACCESS ROAD
2466.27
MW-315
MW-601
MW-603
MW-315A
2467.92
2466.69
MW-311
MW-604
MW-501
MW-500
2464.50
MW-317
MW-605
2467.06
MW-309
Velocity = 3,200 to 8,000 ft/yr
Given: hydraulic conductivity = 61 ft/day (1)
gradient = 0.036
porosity = 0.1 to 0.25 (2)
LEGEND
2490 POTENTIOMETRIC CONTOUR
PERMIT LINE
FENCE LINE
UNIMPROVED ROAD
POINT OF COMPLIANCE
SITE COORDINATE SYSTEM MARKER LOCATION IN NORTHING AND EASTING
POTENTIOMETRIC CONTOUR INTERVAL = 10 FT
MW-002 DETECTION MONITOR WELL LOCATION AND NUMBER
MW-603 SUPPLEMENTAL MONITOR WELL LOCATION AND NUMBER
MW-500 VALDOSE ZONE MONITOR WELL LOCATION AND NUMBER
B96-1 CORRECTIVE ACTION BORING LOCATION AND NUMBER
REFERENCES:
(1) THE MARK GROUP, 1988
(2) CLEBSCH (1962), GRANT (1993)
100 50 0 100
SCALE FEET
Rev Drawn Check Appr Date Description
REVISIONS
American Ecology
5333 WESTHEIMER
Suite 1000
Houston, Texas 77056
Reference Drawings
Drawn By: LAM
Checked By: CAB
Appr. By: PAZ
Date: 3/99
Scale: AS SHOWN
Project No.:
POTENTIOMETRIC SURFACE
UPPER WATER BEARING ZONE
AUGUST 1999
HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology
BEATTY, NEVADA



LEGEND

2447	POTENTIOMETRIC CONTOUR
	PERMIT LINE
	FENCE LINE
	UNIMPROVED ROAD
	POINT OF COMPLIANCE
+	SITE COORDINATE SYSTEM MARKER LOCATION IN NORTHING AND EASTING
MW-002	DETECTION MONITOR WELL LOCATION AND NUMBER
MW-603	SUPPLEMENTAL MONITOR WELL LOCATION AND NUMBER
MW-500	VADOSE ZONE MONITOR WELL LOCATION AND NUMBER
B96-1	CORRECTIVE ACTION BORING LOCATION AND NUMBER

POTENTIOMETRIC CONTOUR INTERVAL = 1 FT

* Well reading affected by site well pumping and is not considered in potentiometric contours.

SCALE 100 50 0 100 FEET

Rev	Drawn	Check	Appr	Date	Description

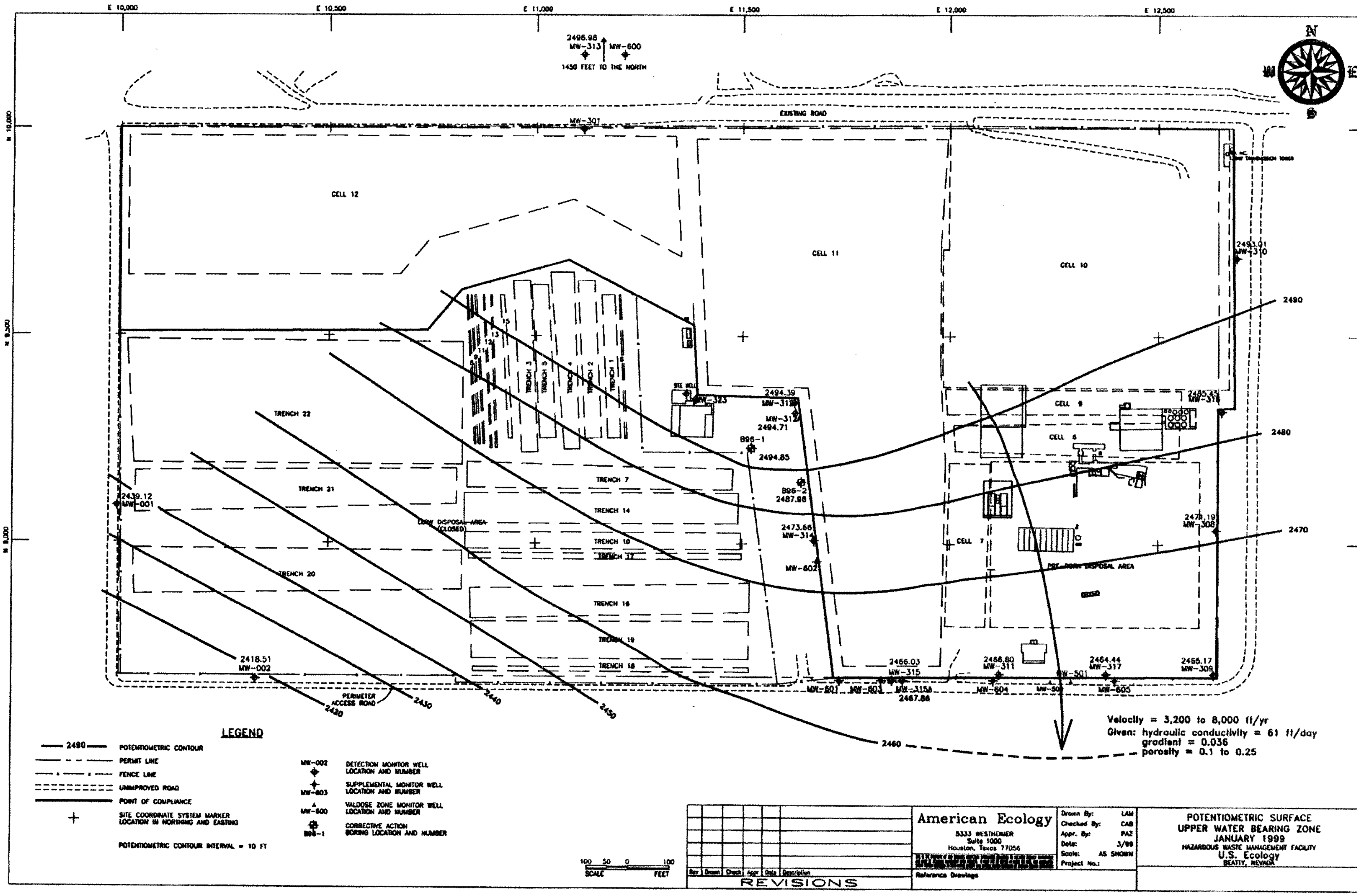
REVISIONS

American Ecology
5333 WESTHEIMER
Suite 1000
Houston, Texas 77056

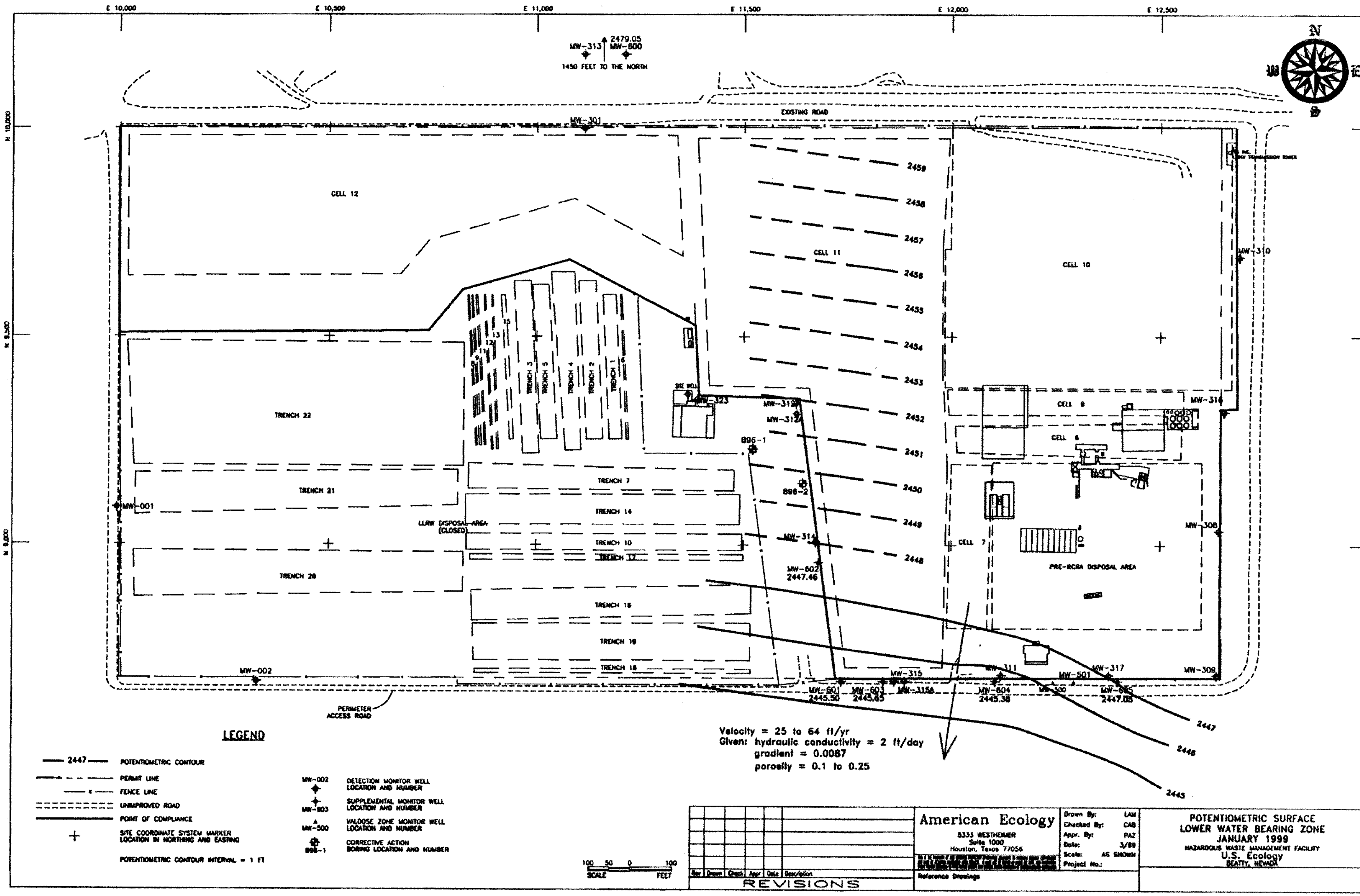
Reference Drawings

Drawn By:	LAM
Checked By:	CAB
Appr. By:	PAZ
Date:	3/99
Scale:	AS SHOWN
Project No.:	

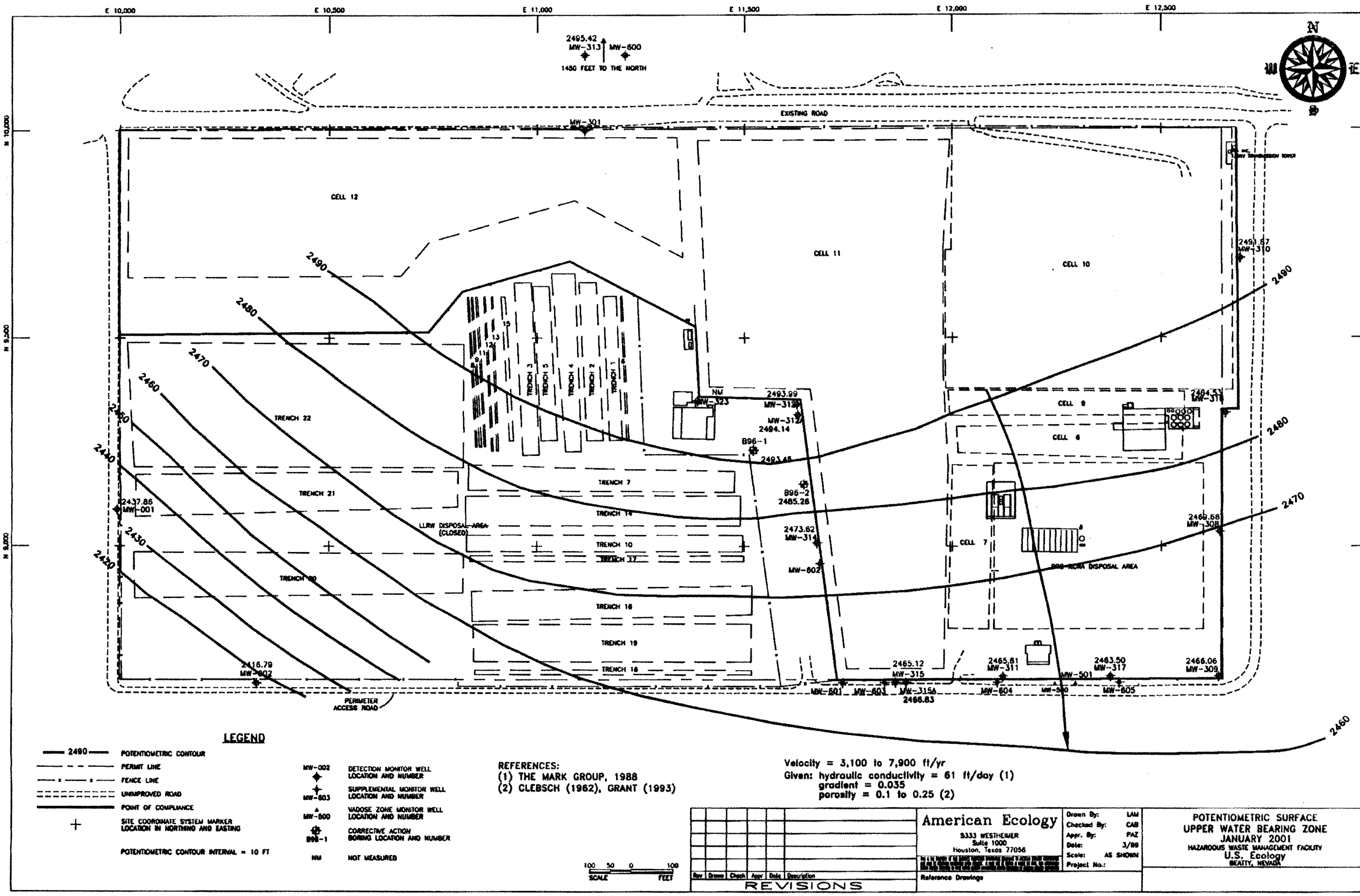
POTENTIOMETRIC SURFACE
LOWER WATER BEARING ZONE
AUGUST 1999
HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology
BEATTY, NEVADA



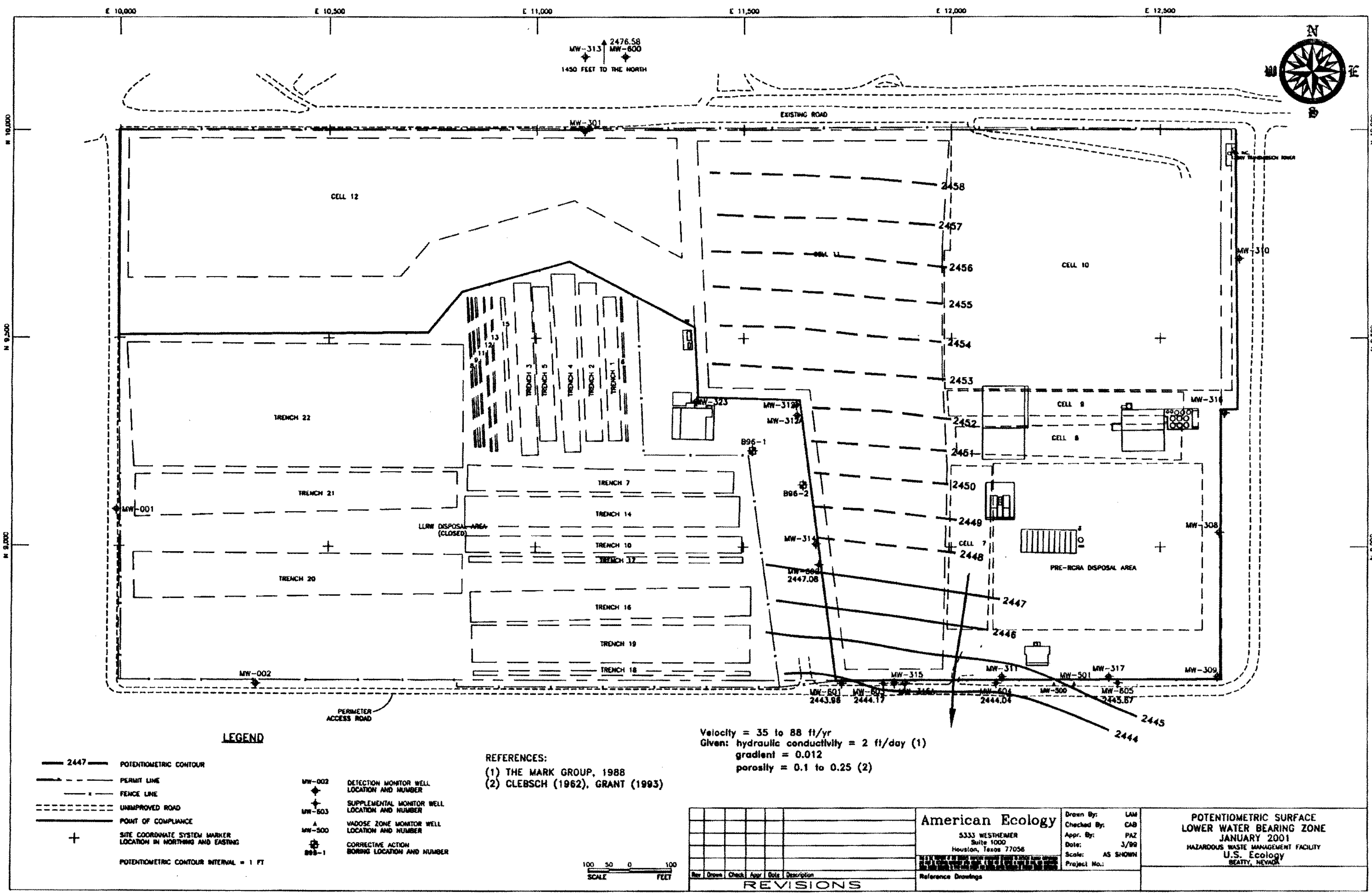
E 10,000
E 10,500
E 11,000
E 11,500
E 12,000
E 12,500
N 10,000
N 9,500
N 9,000
2496.98
MW-313
MW-600
1450 FEET TO THE NORTH
EXISTING ROAD
MW-301
CELL 12
CELL 11
CELL 10
CELL 9
CELL 6
CELL 7
2493.01
MW-310
2485.45
MW-318
2490
2480
2470
2460
2450
2440
2430
2420
TRENCH 1
TRENCH 2
TRENCH 3
TRENCH 4
TRENCH 5
TRENCH 7
TRENCH 14
TRENCH 10
TRENCH 17
TRENCH 16
TRENCH 19
TRENCH 18
TRENCH 20
TRENCH 21
TRENCH 22
SITE WELL
MW-323
2494.39
MW-312
MW-312
2494.71
B96-1
2494.85
B96-2
2487.88
2473.66
MW-314
MW-602
LLRW DISPOSAL AREA (CLOSED)
PRE-RCRA DISPOSAL AREA
2478.19
MW-308
2439.12
MW-001
2418.51
MW-002
PERIMETER ACCESS ROAD
2466.03
MW-315
MW-601
MW-603
MW-315B
2467.86
2456.80
MW-311
MW-604
MW-501
MW-502
2464.44
MW-317
MW-605
2465.17
MW-309
Velocity = 3,200 to 8,000 ft/yr
Given: hydraulic conductivity = 61 ft/day
gradient = 0.036
porosity = 0.1 to 0.25
LEGEND
2490 POTENTIOMETRIC CONTOUR
PERMIT LINE
FENCE LINE
UNIMPROVED ROAD
POINT OF COMPLIANCE
SITE COORDINATE SYSTEM MARKER LOCATION IN NORTHING AND EASTING
POTENTIOMETRIC CONTOUR INTERVAL = 10 FT
MW-002 DETECTION MONITOR WELL LOCATION AND NUMBER
MW-603 SUPPLEMENTAL MONITOR WELL LOCATION AND NUMBER
MW-500 VADOSE ZONE MONITOR WELL LOCATION AND NUMBER
B96-1 CORRECTIVE ACTION BORING LOCATION AND NUMBER
100 50 0 100
SCALE FEET
Rev Drawn Check Appr Date Description
REVISIONS
American Ecology
5333 WESTHEIMER
Suite 1000
Houston, Texas 77056
Reference Drawings
Drawn By: LAM
Checked By: CAB
Appr. By: PAZ
Date: 3/99
Scale: AS SHOWN
Project No.:
POTENTIOMETRIC SURFACE
UPPER WATER BEARING ZONE
JANUARY 1999
HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology
BEATTY, NEVADA

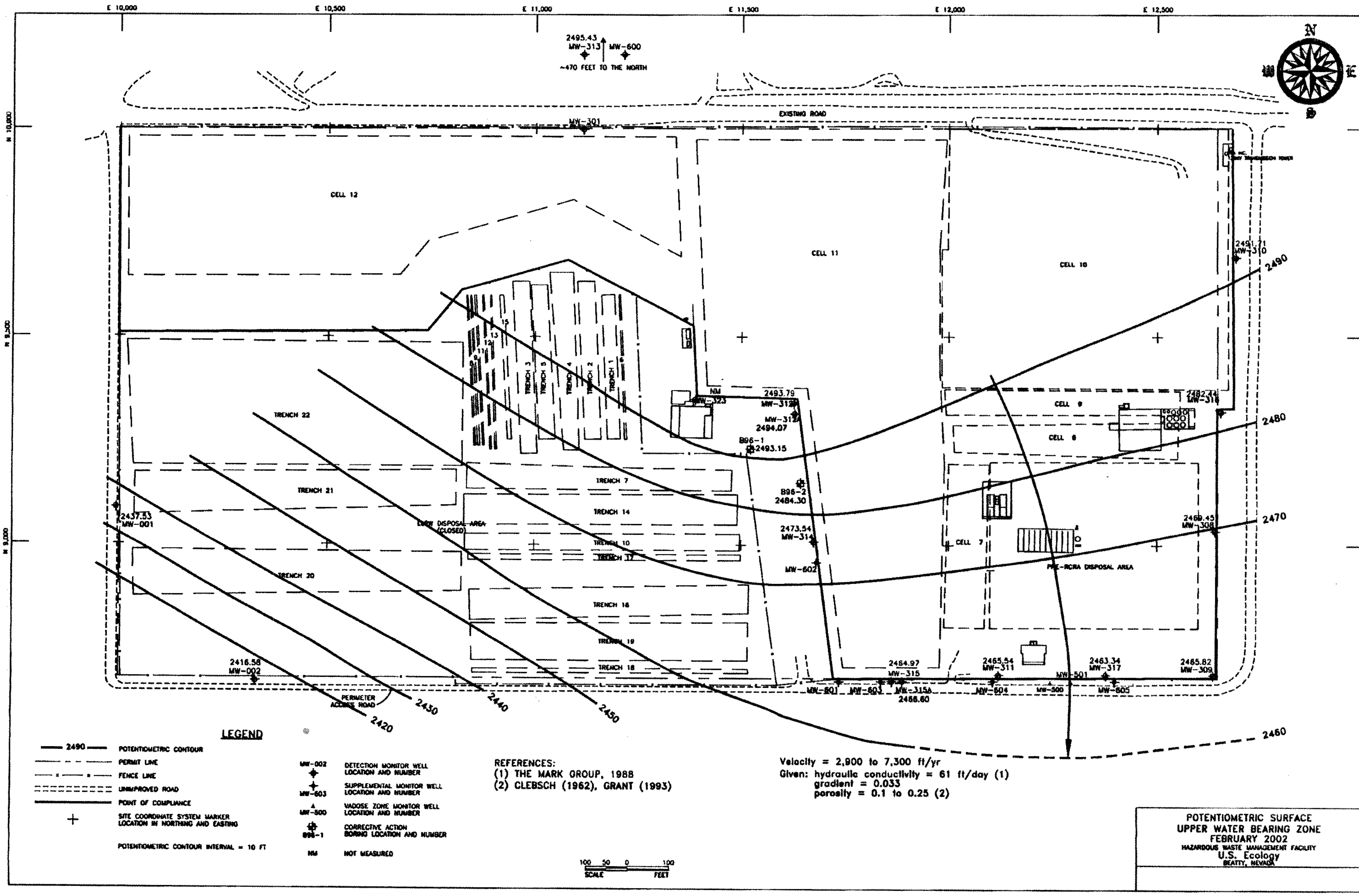


POTENTIOMETRIC SURFACE
LOWER WATER BEARING ZONE
JANUARY 1999
HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology
BEATTY, NEVADA
American Ecology
5333 WESTHEIMER
Suite 1000
Houston, Texas 77056
Drawn By: LAM
Checked By: CAB
Appr. By: PAZ
Date: 3/99
Scale: AS SHOWN
Project No.:
Reference Drawings
REVISIONS
Rev Drawn Check Appr Date Description
Velocity = 25 to 64 ft/yr
Given: hydraulic conductivity = 2 ft/day
gradient = 0.0087
porosity = 0.1 to 0.25
LEGEND
2447 POTENTIOMETRIC CONTOUR
PERMIT LINE
FENCE LINE
UNIMPROVED ROAD
POINT OF COMPLIANCE
SITE COORDINATE SYSTEM MARKER LOCATION IN NORTHING AND EASTING
POTENTIOMETRIC CONTOUR INTERVAL = 1 FT
MW-002 DETECTION MONITOR WELL LOCATION AND NUMBER
MW-603 SUPPLEMENTAL MONITOR WELL LOCATION AND NUMBER
MW-500 VALDOSE ZONE MONITOR WELL LOCATION AND NUMBER
B96-1 CORRECTIVE ACTION BORING LOCATION AND NUMBER
SCALE 100 50 0 100 FEET
E 10,000
E 10,500
E 11,000
E 11,500
E 12,000
E 12,500
N 10,000
N 9,500
N 9,000
MW-313
2479.05
MW-600
1450 FEET TO THE NORTH
EXISTING ROAD
PERIMETER ACCESS ROAD
CELL 12
CELL 11
CELL 10
CELL 9
CELL 8
CELL 7
PRE-RCRA DISPOSAL AREA
LLRW DISPOSAL AREA (CLOSED)
TRENCH 22
TRENCH 21
TRENCH 20
TRENCH 1
TRENCH 2
TRENCH 3
TRENCH 4
TRENCH 5
TRENCH 7
TRENCH 14
TRENCH 10
TRENCH 17
TRENCH 16
TRENCH 19
TRENCH 18
2459
2458
2457
2456
2455
2454
2453
2452
2451
2450
2449
2448
2447
2446
2445
MW-001
MW-002
MW-301
MW-308
MW-309
MW-310
MW-311
MW-312
MW-314
MW-315
MW-315B
MW-316
MW-317
MW-323
MW-500
MW-501
MW-601
2445.50
MW-602
2447.46
MW-603
2445.65
MW-604
2445.38
MW-605
2447.05
B96-1
B96-2
SITE WELL
N
E
S
W



POTENTIOMETRIC SURFACE
UPPER WATER BEARING ZONE
JANUARY 2001
HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology
BEATTY, NEVADA
American Ecology
5333 WESTHEIMER
Suite 1000
Houston, Texas 77056
Drawn By: LAM
Checked By: CAB
Appr. By: PAZ
Date: 3/99
Scale: AS SHOWN
Project No.:
Reference Drawings
Rev Drawn Check Appr Date Description
REVISIONS
Velocity = 3,100 to 7,900 ft/yr
Given: hydraulic conductivity = 61 ft/day (1)
gradient = 0.035
porosity = 0.1 to 0.25 (2)
REFERENCES:
(1) THE MARK GROUP, 1988
(2) CLEBSCH (1962), GRANT (1993)
LEGEND
2490 POTENTIOMETRIC CONTOUR
PERMIT LINE
FENCE LINE
UNIMPROVED ROAD
POINT OF COMPLIANCE
SITE COORDINATE SYSTEM MARKER LOCATION IN NORTHING AND EASTING
POTENTIOMETRIC CONTOUR INTERVAL = 10 FT
MW-002 DETECTION MONITOR WELL LOCATION AND NUMBER
MW-603 SUPPLEMENTAL MONITOR WELL LOCATION AND NUMBER
MW-500 VADOSE ZONE MONITOR WELL LOCATION AND NUMBER
B96-1 CORRECTIVE ACTION BORING LOCATION AND NUMBER
NM NOT MEASURED
100 50 0 100
SCALE FEET
E 10,000
E 10,500
E 11,000
E 11,500
E 12,000
E 12,500
N 10,000
N 9,500
N 9,000
2495.42
MW-313
MW-600
1450 FEET TO THE NORTH
EXISTING ROAD
MW-301
CELL 12
CELL 11
CELL 10
CELL 9
CELL 8
CELL 7
TRENCH 22
TRENCH 21
TRENCH 20
TRENCH 7
TRENCH 14
TRENCH 10
TRENCH 17
TRENCH 16
TRENCH 19
TRENCH 18
TRENCH 1
TRENCH 2
TRENCH 3
TRENCH 4
TRENCH 5
LLRW DISPOSAL AREA (CLOSED)
PCB-RCRA DISPOSAL AREA
PERIMETER ACCESS ROAD
2490
2480
2470
2460
2450
2440
2430
2420
2493.99
MW-312
2494.14
B96-1
2493.45
B96-2
2485.26
2473.62
MW-314
MW-602
NM
MW-323
2491.57
MW-310
2494.53
MW-316
2469.68
MW-308
2466.06
MW-309
2463.50
MW-317
MW-501
MW-605
2465.81
MW-311
MW-604
MW-500
2465.12
MW-315
MW-601
MW-603
MW-315A
2466.83
2437.86
MW-001
2416.79
MW-002
N
E
S
W


E 10,000
E 10,500
E 11,000
E 11,500
E 12,000
E 12,500
N 10,000
N 9,500
N 9,000
MW-313
2476.58
MW-600
1450 FEET TO THE NORTH
EXISTING ROAD
MW-301
CELL 12
CELL 11
CELL 10
CELL 9
CELL 8
CELL 7
TRENCH 22
TRENCH 21
TRENCH 20
TRENCH 1
TRENCH 2
TRENCH 3
TRENCH 4
TRENCH 5
TRENCH 7
TRENCH 14
TRENCH 10
TRENCH 17
TRENCH 16
TRENCH 19
TRENCH 18
LLRW DISPOSAL AREA (CLOSED)
PRE-RCRA DISPOSAL AREA
MW-001
MW-002
MW-323
MW-312
B96-1
B96-2
MW-314
MW-310
MW-316
MW-308
MW-309
MW-317
MW-501
MW-500
MW-505
2445.87
MW-311
MW-504
2444.04
MW-315
MW-502
2444.17
MW-601
2443.98
2447.08
2458
2457
2456
2455
2454
2453
2452
2451
2450
2449
2448
2447
2446
2445
2444
PERIMETER ACCESS ROAD
Velocity = 35 to 88 ft/yr
Given: hydraulic conductivity = 2 ft/day (1)
gradient = 0.012
porosity = 0.1 to 0.25 (2)
REFERENCES:
(1) THE MARK GROUP, 1988
(2) CLEBSCH (1962), GRANT (1993)
LEGEND
2447 POTENTIOMETRIC CONTOUR
PERMIT LINE
FENCE LINE
UNIMPROVED ROAD
POINT OF COMPLIANCE
SITE COORDINATE SYSTEM MARKER LOCATION IN NORTHING AND EASTING
POTENTIOMETRIC CONTOUR INTERVAL = 1 FT
MW-002 DETECTION MONITOR WELL LOCATION AND NUMBER
MW-503 SUPPLEMENTAL MONITOR WELL LOCATION AND NUMBER
MW-500 VADOSE ZONE MONITOR WELL LOCATION AND NUMBER
B96-1 CORRECTIVE ACTION BORING LOCATION AND NUMBER
100 50 0 100
SCALE FEET
Rev Drawn Check Appr Date Description
REVISIONS
American Ecology
5333 WESTHEIMER
Suite 1000
Houston, Texas 77056
Reference Drawings
Drawn By: LAM
Checked By: CAB
Appr. By: PAZ
Date: 3/99
Scale: AS SHOWN
Project No.:
POTENTIOMETRIC SURFACE
LOWER WATER BEARING ZONE
JANUARY 2001
HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology
BEATTY, NEVADA


POTENTIOMETRIC SURFACE
UPPER WATER BEARING ZONE
FEBRUARY 2002
HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology
BEATTY, NEVADA
LEGEND
POTENTIOMETRIC CONTOUR
PERMIT LINE
FENCE LINE
UNIMPROVED ROAD
POINT OF COMPLIANCE
SITE COORDINATE SYSTEM MARKER LOCATION IN NORTHING AND EASTING
POTENTIOMETRIC CONTOUR INTERVAL = 10 FT
DETECTION MONITOR WELL LOCATION AND NUMBER
SUPPLEMENTAL MONITOR WELL LOCATION AND NUMBER
VADOSE ZONE MONITOR WELL LOCATION AND NUMBER
CORRECTIVE ACTION BORING LOCATION AND NUMBER
NM NOT MEASURED
REFERENCES:
(1) THE MARK GROUP, 1988
(2) CLEBSCH (1962), GRANT (1993)
Velocity = 2,900 to 7,300 ft/yr
Given: hydraulic conductivity = 61 ft/day (1)
gradient = 0.033
porosity = 0.1 to 0.25 (2)
SCALE FEET
2495.43 MW-313 MW-600
~470 FEET TO THE NORTH
EXISTING ROAD
CELL 12
CELL 11
CELL 10
CELL 9
CELL 8
CELL 7
PRE-RCRA DISPOSAL AREA
LLRW DISPOSAL AREA (CLOSED)
PERIMETER ACCESS ROAD
TRENCH 1
TRENCH 2
TRENCH 3
TRENCH 4
TRENCH 5
TRENCH 7
TRENCH 10
TRENCH 14
TRENCH 17
TRENCH 18
TRENCH 19
TRENCH 20
TRENCH 21
TRENCH 22
2491.71 MW-310
2482.44 MW-318
2469.45 MW-308
2465.82 MW-309
2463.34 MW-317
2465.54 MW-311
2464.97 MW-315
2466.60 MW-315A
2493.79 MW-312
2494.07
B96-1 2493.15
B96-2 2484.30
2473.54 MW-314
MW-602
MW-323
NM
MW-301
2437.53 MW-001
2416.58 MW-002
MW-501
MW-500
MW-601
MW-603
MW-604
MW-605
2490
2480
2470
2460
2450
2440
2430
2420
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E 12,500
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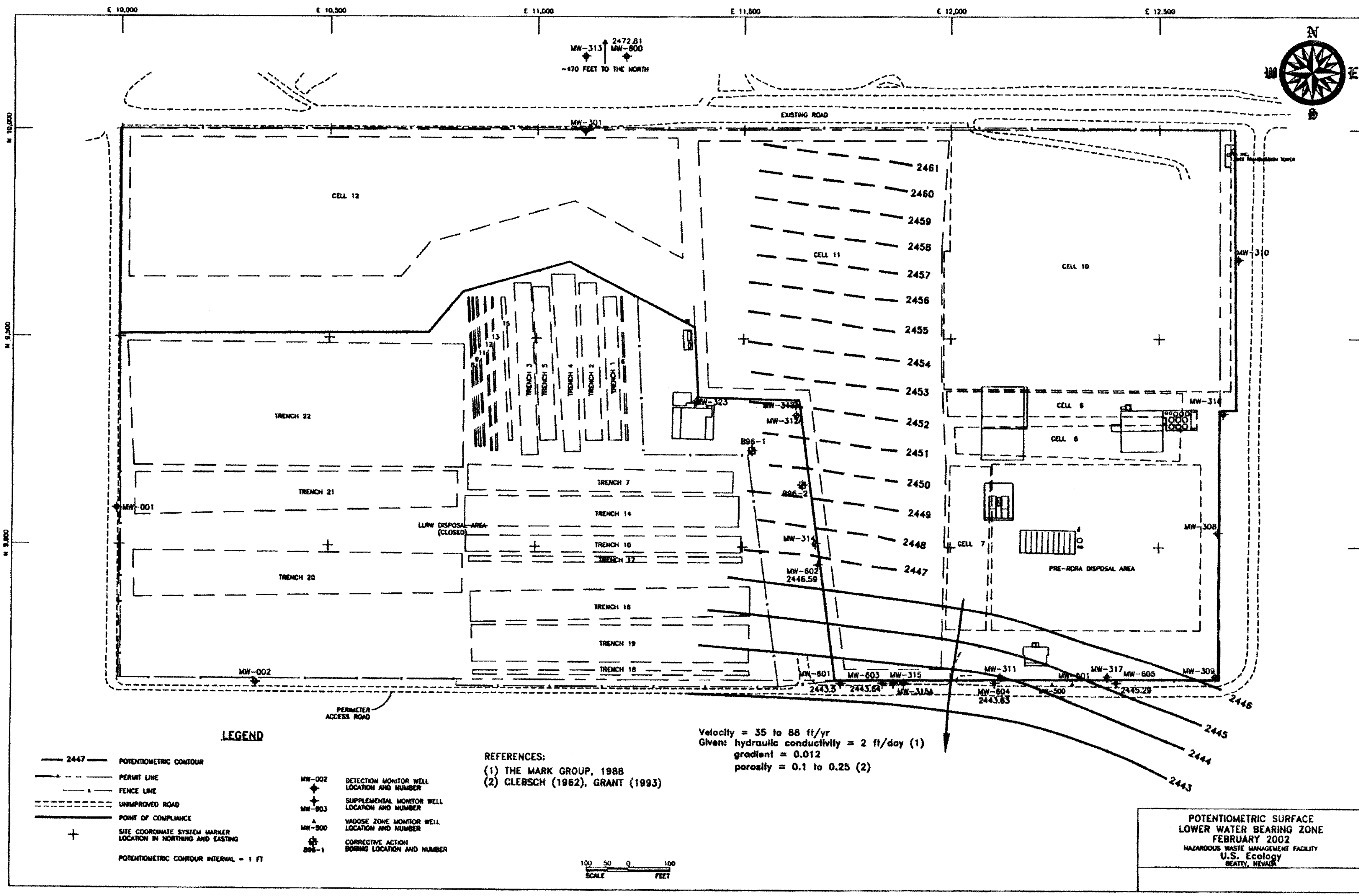
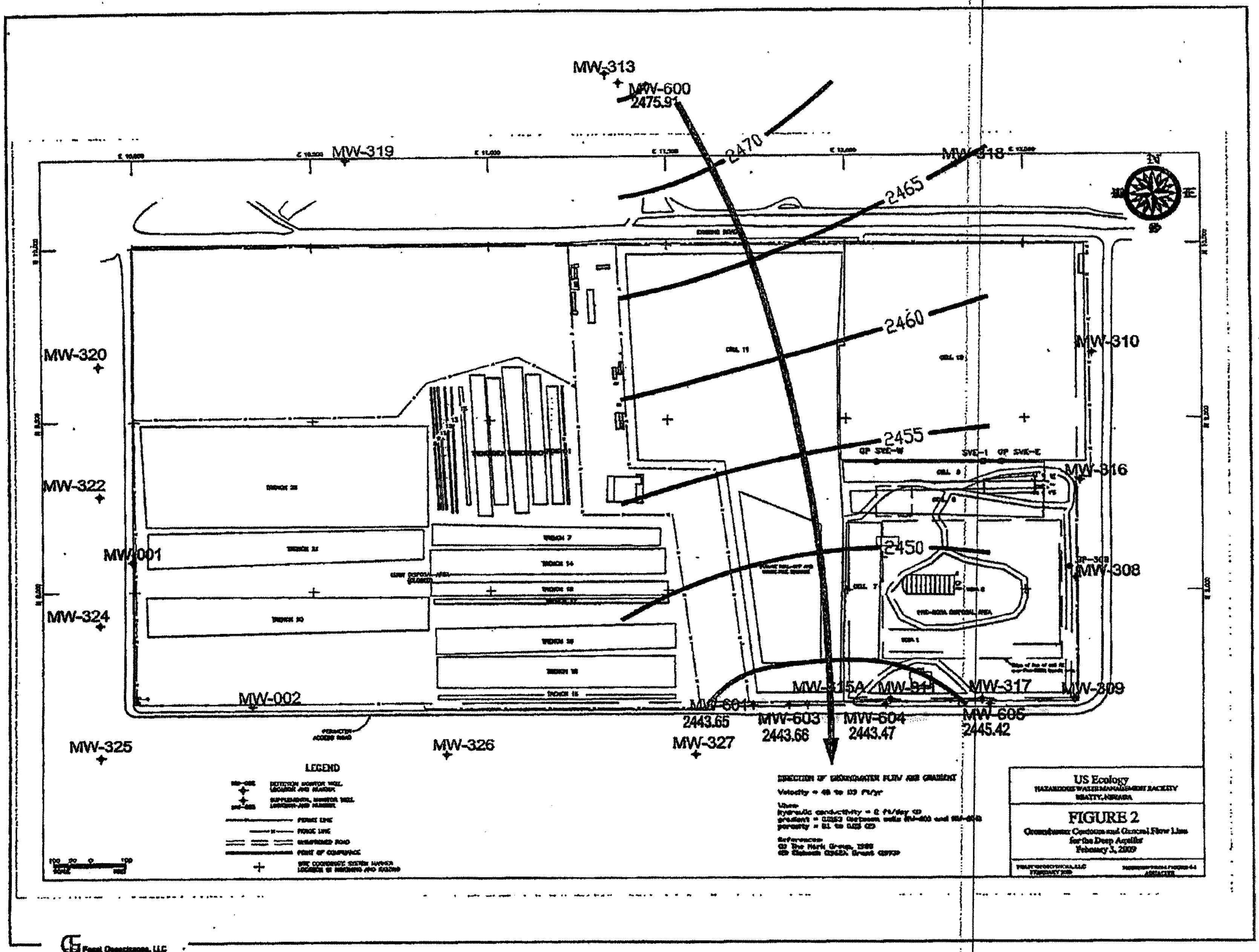
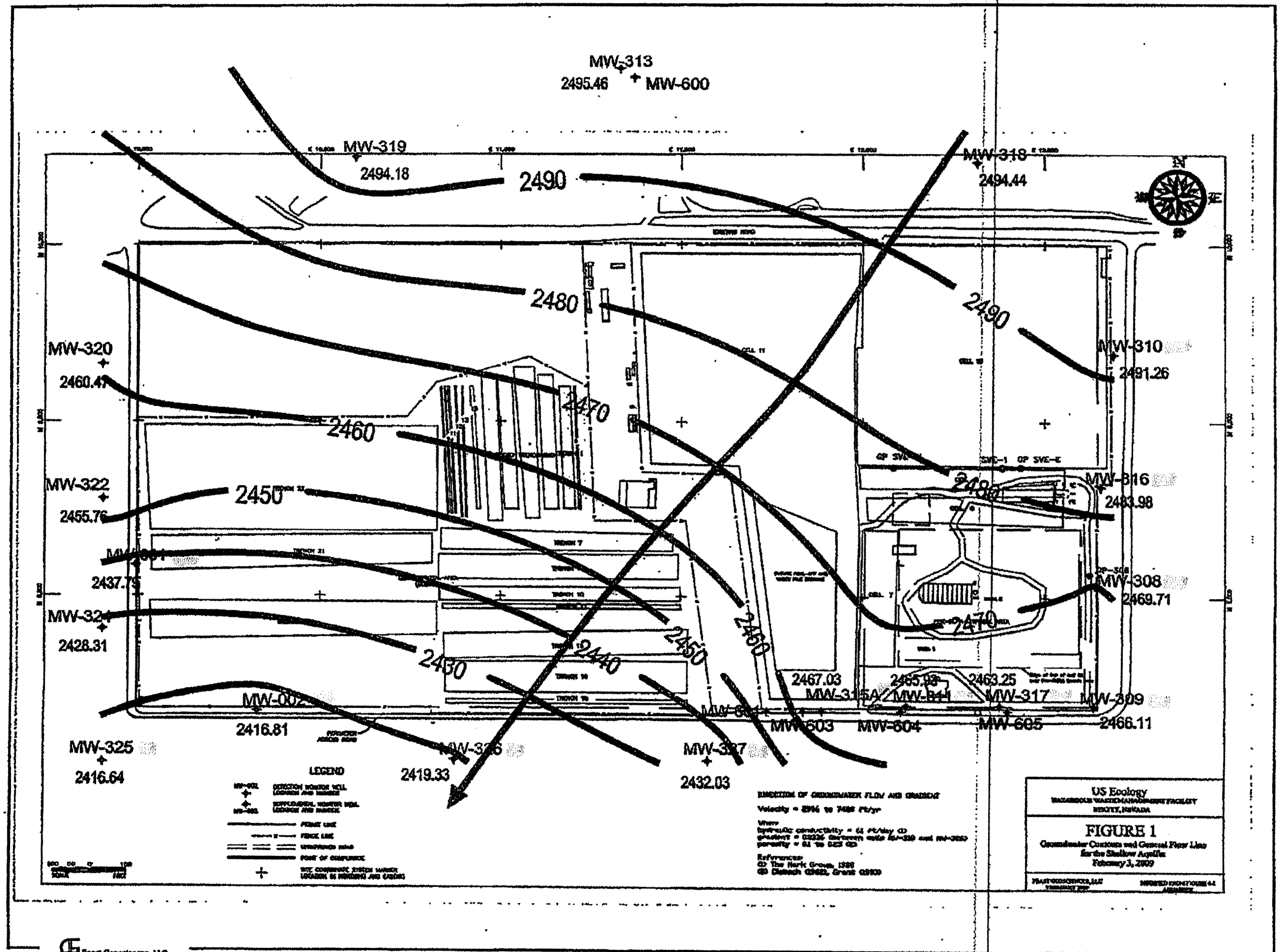
N 9,500
N 9,000



E 10,000
E 10,500
E 11,000
E 11,500
E 12,000
E 12,500
N 10,000
N 9,500
N 9,000
MW-313
2472.81
MW-600
~470 FEET TO THE NORTH
EXISTING ROAD
MW-301
CELL 12
CELL 11
CELL 10
CELL 9
CELL 8
CELL 7
MW-310
MW-316
MW-308
MW-309
MW-317
MW-605
2445.29
MW-501
MW-500
MW-311
MW-604
2443.83
MW-315
MW-315A
MW-603
2443.64
MW-601
2443.5
MW-602
2446.59
MW-314
MW-312
MW-323
B96-1
B96-2
MW-001
MW-002
2461
2460
2459
2458
2457
2456
2455
2454
2453
2452
2451
2450
2449
2448
2447
2446
2445
2444
2443
TRENCH 22
TRENCH 21
TRENCH 20
TRENCH 3
TRENCH 5
TRENCH 4
TRENCH 2
TRENCH 1
TRENCH 7
TRENCH 14
TRENCH 10
TRENCH 11
TRENCH 16
TRENCH 19
TRENCH 18
LLRW DISPOSAL AREA (CLOSED)
PRE-RCRA DISPOSAL AREA
PERIMETER ACCESS ROAD
Velocity = 35 to 88 ft/yr
Given: hydraulic conductivity = 2 ft/day (1)
gradient = 0.012
porosity = 0.1 to 0.25 (2)
LEGEND
2447 POTENTIOMETRIC CONTOUR
PERMIT LINE
FENCE LINE
UNIMPROVED ROAD
POINT OF COMPLIANCE
SITE COORDINATE SYSTEM MARKER LOCATION IN NORTHING AND EASTING
POTENTIOMETRIC CONTOUR INTERVAL = 1 FT
MW-002 DETECTION MONITOR WELL LOCATION AND NUMBER
MW-603 SUPPLEMENTAL MONITOR WELL LOCATION AND NUMBER
MW-500 VADOSE ZONE MONITOR WELL LOCATION AND NUMBER
B96-1 CORRECTIVE ACTION BORING LOCATION AND NUMBER
REFERENCES:
(1) THE MARK GROUP, 1988
(2) CLEBSCH (1962), GRANT (1993)
100 50 0 100
SCALE FEET
POTENTIOMETRIC SURFACE
LOWER WATER BEARING ZONE
FEBRUARY 2002
HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology
BEATTY, NEVADA



MW-313
MW-600
2475.91
2470
2465
2460
2455
2450
MW-319
MW-318
MW-310
MW-316
MW-308
MW-309
MW-317
MW-605
2445.42
MW-315A
MW-604
2443.47
MW-603
2443.66
MW-601
2443.65
MW-327
MW-326
MW-325
MW-002
MW-001
MW-320
MW-322
MW-324
LEGEND
US Ecology
FIGURE 2


MW-313
2495.46
MW-600
MW-319
2494.18
MW-318
2494.44
MW-310
2491.26
MW-316
2483.98
MW-308
2469.71
MW-309
2466.11
MW-320
2460.47
MW-322
2455.76
2437.79
MW-324
2428.31
MW-325
2416.64
MW-002
2416.81
MW-326
2419.33
MW-327
2432.03
MW-603
MW-604
MW-605
MW-317
MW-315A
2467.03
2465.98
2463.25
2490
2480
2470
2460
2450
2440
2430
LEGEND
US Ecology
FIGURE 1
February 3, 2009
Frost Geosciences, LLC