

Attachments to
Environment
Committee Report

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Environment
Committee Report

IRONMENT COMMITTEE
Public Meeting
September 24, 1996
Fitzgerald School Cafeteria
70 Rindge Avenue

Chair of the Environment Committee -

2. John D. Spengler, Ph.D., Harvard School of Public Health and Environmental Health & Engineering. -

Discussion of report by EH & E on environmental contamination at W.R. Grace Site.

3. Edward Weagle, Massachusetts Department of Environmental Protection, Bureau of Waste Site Clean-Up. -

Explanation of regulatory process for the Massachusetts Contingency Plan and its audit process.

4. Sharon Hayes, U.S. Environmental Protection Agency, Site Assessment Manager. -

Overview of how hazardous waste sites are evaluated and selected for inclusion on the National Priorities List.

5. Howard Haywood, Chief of Design & Construction, MBTA, and John Powers, Assistant Director of Design and Construction, MBTA. -

Howard Haywood and John Powers were project managers for the Red Line construction in the Alewife area and the reconstruction of Russell Field. They are available to respond to questions.

**FINAL DRAFT
PUBLIC HEALTH RISK EVALUATION FOR
W.R. GRACE SITE IN
CAMBRIDGE, MASSACHUSETTS**

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LIST OF ABBREVIATIONS & ACRONYMS

CO ₂	carbon dioxide
EH&E	Environmental Health & Engineering, Inc.
EPA	U.S. Environmental Protection Agency
IRIS	Integrated Risk Information System
MADEP	Massachusetts Department of Environmental Protection
MCP	Massachusetts Contingency Plan
MWRA	Massachusetts Water Resources Authority
NTP	National Toxicology Program
OHM	oil or hazardous materials
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
ppb	parts of vapor or gas per billion parts of air by volume
ppm	parts of vapor or gas per million parts of air by volume

1.0 EXECUTIVE SUMMARY

Environmental Health & Engineering, Inc. (EH&E) is pleased to present this summary of our review of public documents and data describing environmental measurements and risk assessments for the W.R. Grace site located at 62 Whittemore Avenue in Cambridge, Massachusetts. The site is a 27-acre, irregularly-shaped parcel of land that is directly east of the Alewife Brook Parkway and Route 2 interchange in Cambridge. Redevelopment of this site to office or retail use as proposed by W.R. Grace, Inc. has been considered. Information considered include reports and data collected by Haley & Aldrich, Inc., consultants to W.R. Grace. Site development is likely to occur in coordination with further remediation of soils contaminated with petroleum products. Details of the soil remediation techniques were not considered but were presumed to be approved by the Massachusetts Department of Environmental Protection (MADEP). Hotel development on the former Liegh Metals site, which now belongs to W.R. Grace, was not considered. Public health issues addressed for this evaluation included potential impacts of airborne compounds generated by excavation and movement of soil during site development, transport of site-related compounds through groundwater and surface water to the site and vicinity, and potential exposures related to the site as it currently exists.

Based in available data there is no reason to consider the W.R. Grace site, as it currently exists, to be a health concern to the neighboring community, which includes residents and recreational users of the Russell Field Facilities. Redevelopment, conducted under proper precautions, should not cause unacceptable health risks from exposures to contaminants present on site. This includes slab-on-grade, as well as below-grade construction. Nevertheless, there are unresolved issues that warrant further investigation. Even if further investigation determines that conditions are other than what has been represented in this and previous assessments, remedial actions are available to safeguard the environment and the community. During construction and remediation on the site, implementation and enforcement of a comprehensive hazardous materials' management plan is required. Public participation in this

management plan should ensure neighbors that all public health risks are thoroughly considered.

The general findings and recommendations of EH&E's review are summarized as follows.

1. Monitoring of groundwater should continue to provide long-term assurance to residents bordering the W.R. Grace site regarding potential changes in the levels of contaminants. The low levels of compounds reported in offsite well 604 near the Alewife Brook do not present a health risk. Results of multi-year monitoring from three wells along Whittemore Avenue indicated that site contaminants have not moved offsite in this northerly direction. However, direct monitoring rather than groundwater modeling can provide the best assurance that contaminants have not migrated toward residential areas.

Groundwater flow may be altered by development, repairs to the MBTA tunnel, variations in surface recharge rates, and other factors. Surveillance of groundwater for evidence of site-related compounds should continue after site development. Selection and use of analytical methods that detect very low levels of contaminants will provide adequate response time to ensure that public health and economic interests are protected.

2. Questions remain regarding how fast and in what directions the groundwater is moving. Quantifying the groundwater transport of site-related contaminants is uncertain based on current assessments. Modeling groundwater flow at this site is complicated by the MBTA tunnels and lack of hydrogeologic information east of the tunnel toward Clifton Street. Additional hydrogeological data and analysis is required. While groundwater movement toward Clifton Street is not expected, we could not confirm this based on the information provided. Some Clifton Street residents attest that basement flooding has occurred more frequently since the MBTA tunnel was built. Additional data (groundwater elevations, permeability) collected east of the MBTA tunnel, along with measurements taken from existing wells, will determine with more certainty direction and speed of hydrogeologic

pressure driven groundwater flow. Following a review, recommendations about the extent and frequency of continued monitoring of groundwater could be reconsidered.

3. EH&E is satisfied that the chemical compounds identified on the site currently do not and will not (with anticipated construction and future site use) constitute a risk to public health. The risk assessments conducted for this site used conservative methods to examine both the cancer and non-cancer risks and determined them to be below levels of concern established by the MADEP. Groundwater monitoring at the site boundary, the planned soil remediation, and the mitigation of construction impacts will further ensure that risks are maintained at acceptably low levels.
4. MADEP audit of the Tier Classification of the site is underway. A change in classification from the current II to a IA, IB, or IC would require varying degrees of State oversight or permitting. At a minimum, the State should review and approve soil remediation activities.

Although the issue concerning the storage of contaminated soil on Russell Field is only marginally related to the proposed development, the city (and/or MBTA) should resolve the remaining uncertainties. This may include sampling of surface or subsurface soils, groundwater, or providing verification from manifest records that contaminated soils were handled appropriately.

2.0 BACKGROUND

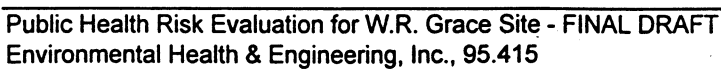
The primary health concerns of the City of Cambridge regarding the proposed development of the W.R. Grace site are based on its former use for chemical manufacturing and the compounds that remain on site as a result of these previous manufacturing activities. (See Figure 1) The site is currently listed with MADEP based on 1984 and 1985 evaluations of subsurface and hydrogeological conditions that indicated the presence of volatile and semi-volatile organic compounds, petroleum products, and metals.

The Dewey and Almy Chemical Company developed the site in 1919 for the manufacture of rubber products used for sealing compounds, drum and pail cover gaskets, and bottle cap gaskets. One of the major products manufactured on site was naphthalene sulfonate (trade name DAXAD), a compound used to facilitate the dispersion of rubber in water. During the period of DAXAD manufacture, several lagoons on the site were used for settling ponds and sources of cooling water. This activity is the presumed major source for the continued presence of naphthalene in soils at the site. Evaluation of the map of the storage areas (Haley & Aldrich 1995) indicates storage of a number of chemical compounds, as well as fuel oils, on the site during the Dewey and Almy operations. Based on the 1988 health risk assessment by Meta Systems, Inc. and a 1994 update by the same company now named Cambridge Environmental, Inc., the compounds detected on site at levels that pose potential health concerns are naphthalene, formaldehyde, fluorene, and several petroleum-based compounds.

EH&E's evaluation of the history and extensive database associated with this site, which was purchased by W.R. Grace in the early 1940s, involved several broad categories of activities.

- Evaluation of the sufficiency and adequacy of measurement data collected by Haley & Aldrich at the W.R. Grace site.

Proposed building footprints overlaid on previous Dewey and Almy Building/use locations



- Evaluation of the 1988 health risk assessment and its 1994 update.
- Evaluation of the groundwater model and the potential for transport of site-related compounds to neighboring properties.
- Evaluation of the hazardous materials management plan.
- Communication with representatives from the City of Cambridge, the community, and the Grace Site Advisory Committee regarding the potential health impacts related to current and future conditions at the site.

3.0 GENERAL FINDINGS

Extensive sampling of soil and groundwater was performed between 1984 and 1988 in anticipation of development plans for the site proposed in the late 1980s. Soil and water samples were analyzed for more than 125 analytes, including volatile organic compounds (VOCs), pesticides, polycyclic aromatic hydrocarbons (PAHs), metals, and polychlorinated biphenyls (PCBs) among others. The data set provided to EH&E had 78 compounds listed as well as total cyanide, total sulfates, total phenol, and grease/oil. According to Haley & Aldrich, the remaining 47 compounds were never detected in any of the samples.

Sixteen of the compounds or metals tested in the soil exceeded reporting levels established by MADEP. Eighteen compounds or metals tested in the groundwater were at concentrations above the MADEP-required reporting levels. The MADEP reporting levels, used here simply as a reference, apply to soils and water at residential sites or sites with unrestricted access. All of these compounds exceeding the stricter reporting levels were included in the 1988 risk assessment. These compounds, plus oil, grease, petroleum hydrocarbons in the soil, and formaldehyde and phenanthrene in the water, were examined statistically. Haley & Aldrich, Cambridge Environmental, Inc., W.R. Grace, and City employees were cooperative in providing us prompt access to data and documents as well as candid responses to our inquiries. The following are EH&E's general findings in support of the recommendations.

1. Considering that the proposed soil remediation and additional boundary line well monitoring takes place, EH&E does not foresee health impacts resulting from contaminants that originated from former industrial use of the site.
2. Data from soil samples, including the duplicates, suggest that the selected analytic methods were adequate to discriminate differences in concentrations between sampling locations and variations attributable to laboratory and sampling procedures. Evaluation of all soil sample duplicates, although limited in number, supports this conclusion.

3. Soil samples in the area of the proposed supermarket and parking lot show that contaminants are not uniformly distributed. Based on the distribution patterns, the locations identified for further remediation are apparent and those locations should be addressed during construction.
4. Soils in the vicinity of the proposed retail development on the eastern side of the parcel have not been surveyed as thoroughly as the rest of the site. While additional samples would be useful, we do not think they are absolutely necessary. Review of site plans and facility history suggests that chemicals were not stored, used, or deposited on this area. Oversight during construction should identify deposits of oil, grease, naphthalene, and perhaps other odorous compounds, if they exist. Only petroleum hydrocarbons appeared somewhat elevated in this area. The risk assessment anticipated a more extensive disruption of soils from the area where chemicals and fuels were stored and used than currently proposed. However, the exposure scenarios used conservative methods to estimate assumed activities onsite and dispersion of materials offsite independent of a specific location. Therefore, results of the risk assessment would apply to the development of a sub-parcel on the eastern side of site, provided contaminants in the disturbed soils were similar to those reported.
5. Between 1984 and the present, 44 monitoring wells were drilled in and around the W.R. Grace property. Information about groundwater elevations and bulk water samples were collected from these sites. There were too few well and surface water duplicate samples to draw conclusions about the analytic precision of these samples. Confidence in the well water methods was assessed by examining variability for those wells over time. Greater variability in concentrations across the property suggests that some wells were located in areas of higher concentrations, which was the intent. Furthermore, the monitoring methods were specific and sensitive enough to identify movement of contaminants offsite. This observation, if substantiated, is at variance with the speed of groundwater transport described in the model. It implies that

downgradient movement of contaminants might continue and warrant continued monitoring.

Nine monitoring wells were selected by Haley & Aldrich for trends monitoring: three were located along Whittemore Avenue to the north of the property, two wells were along the western border, three wells were near the eastern MBTA entrance and in the vicinity of known naphthalene deposits, and one well was across the road west of the property near Alewife Brook. Measurable concentrations of naphthalene were reported at the offsite well, which, from a hydrogeological perspective, indicates that naphthalene is moving from the site toward the Alewife Brook. While in absolute terms the concentrations were low (below MADEP-reporting values), they suggest that site-related contaminants are moving offsite.

6. The groundwater model was not sufficiently described or documented in reports to substantiate the claims that, "the simulated existing groundwater conditions reasonably reflected measured existing groundwater conditions."

Uncertainties about the recharge rate of water from the surface and the influence of the MBTA tunnel and portals need to be resolved before specific inferences can be derived from the current analysis. Changes in site development plans reduces the usefulness of the simplified hydrogeological model used.

The rates at which contaminants were moving offsite can be inferred either from the modeling or the measurements. At this time we have greater confidence that materials have not left the site on the northern boundary (Whittemore Avenue), but this can not be said about the other directions because no direct evidence exists.

7. Overall, we found the risk assessment to be reasonable and conservative. Estimated health risks were below 1 in 100,000 for cancer and below the reference dose or concentration guidelines. Even assuming naphthalene as a possible human carcinogen and summing the impacts of all the PAHs, the likely

risk to workers and neighbors would be small and within acceptable guidelines. The risk assessment considered below grade excavation of soils. When considering that some of the soil with higher amounts of petroleum hydrocarbons to other contaminants will be remediated before construction, risk would be further reduced.

8. The MBTA tunnel is affecting groundwater flow; it is likely that some site contaminants enter the tunnel. Air and water emissions from MBTA facilities at Alewife do not pose health hazards to neighborhoods or future users of the site.
9. Questions related to storage of contaminated soil at Russell Field are separate from the issues specifically related to development of the W.R. Grace site. If modeling or monitoring indicate that groundwater is moving under Russell Field in the direction of homes on Clifton Street, then it would be another matter. Staged groundwater and possible soil tests are recommended to help resolve this issue.

4.0 RECOMMENDATIONS

1. Groundwater well monitoring should continue in order to provide long-term protection of residents bordering the W.R. Grace site regarding possible changes in the concentrations of contaminants in the groundwater. Well B204 and at least two additional wells east of the MBTA tunnel should be included along with the nine previously established wells. Composite samples might be screened for the presence of potential site-related compounds as a less expensive strategy that provides greater spatial coverage.
2. A groundwater model reflecting the proposed development, drainage into the MBTA tunnel, and additional hydrogeological data is required to establish the rate, direction, and variations in flow. As an alternative approach, existing hydrogeological and chemical data along with additional permeability information could be used to assess groundwater flow. Following independent review of the results by a party selected by the City of Cambridge, the recommendation for expanded monitoring of groundwater contaminants could be reconsidered.
3. MADEP audit of the Tier Classification of the site is underway. A change in classification may require additional oversight by the State of Massachusetts. If the current Class II is changed to IA, IB, or IC, at a minimum, the MADEP should review and approve soil remediation activities.
4. While the issue of storage of contaminated soil on Russell Field is only marginally related to the proposed development, the city (and/or MBTA) should resolve the remaining uncertainties. This may include sampling of surface soils or providing verification of manifest records.

5.0 EVALUATION OF THE SUFFICIENCY AND ADEQUACY OF DATA FROM SOIL AND GROUNDWATER SAMPLES

This evaluation examined the patterns of chemical concentration measurements in soil and groundwater samples at the W.R. Grace site in Cambridge, Massachusetts. Specifically, EH&E has:

1. Examined the consistency of the data between samples and their duplicates
2. Summarized concentrations in relation to MADEP soil and groundwater standards
3. Mapped the spatial pattern of chemical concentrations on the site

5.1 THE DATA

The soil samples' data set contains the results of soil analyses collected mainly in 1986 and 1987 with a few preliminary samples from 1984 and 1985. There were 127 sites sampled in and around the W.R. Grace property. Each site was sampled only once, except for the collection of duplicates. However, many of the collected samples were fairly close to others collected at different times.

Groundwater samples were taken from 44 wells in and around the W.R. Grace property from 1984 to 1988 with the bulk of the samples taken in 1986 and 1987. From these wells, 29 were sampled two to four times during this time period. Sampling of nine wells continued through 1994 and each of these was sampled 10 and 15 times. The data set corresponding to the samples collected between 1990 and 1994 was not integrated into the main database. Instead, the data from these nine wells are discussed separately.

Samples collected from 1984 to 1988 were analyzed for 125 analytes and several other types of measurements, such as pH. The data sets (provided by Haley & Aldrich) were examined and found to contain 78 compounds, as well as other summary values. According to Haley & Aldrich the remaining 47 compounds were never detected in any of the samples. From these compounds, 59 were chosen for inclusion in risk assessment by Cambridge Environmental, Inc. and are listed in Table 5.1. The

groundwater samples collected between 1990 and 1994 were analyzed for VOCs and naphthalene only. A subset of these compounds found in the data files were selected for the statistical analysis described here. A further description of the methods for choosing the compounds for analysis is given in Section A.3 of Appendix A.

Table 5.1 Compounds included in the Cambridge Environmental, Inc. risk assessment and those included in statistical analyses discussed in this report

Compound	Risk assessment	Soil analysis		Groundwater
		Duplicate	Distribution	Duplicate and distribution
1,1,1-trichloroethane	1			
1,1-dichloroethene	1			1
1,2-dichloropropane	1			
2,4-dimethylphenol	1			
2-butanone	1			
2-hexanone	1			
4-methyl-2-pentanone	1		1	
Acenaphthene	1		2	
Acenaphthylene	1			
Acetone	1	1		
Anthracene	1			
Antimony	1			
Arsenic	1	1	2	
Barium	1		2	
Benzene	1	1		
Benzo (a) anthracene	1	1	1	1
Benzo (a) pyrene	1	1	1	1
Benzo (b,k) fluoranthene	1	1	1	1
Benzo (ghi) perylene	1		2	1
Beryllium	1		1	
Bis (2-ethylhexyl) phthalate	1			1
Butyl benzyl phthalate	1			
Cadmium	1		1	1
Carbon disulfide	1			
Carbon tetrachloride				1
Chlorobenzene	1			
Chromium	1	1		
Chrysene	1		1	1
Copper	1			
Di-n-butyl phthalate	1			
Di-n-octyl phthalate	1			
Dibenzo (a,h) anthracene	1		1	1
Diethyl phthalate	1		2	1
Ethylbenzene	1			
Fluoranthene	1	1		

Blank means not used, 1 means included in analysis, and 2 indicates compounds less than reporting limits, but larger than half the reporting limits.

Table 5.1 Continued				
Compound	Risk assessment	Soil analysis		Groundwater
		Duplicate	Distribution	Duplicate and distribution
Fluorene	1			
Formaldehyde	1	1	1	1
Indeno (1,2,3-cd) pyrene	1		1	1
Iron	1			
Lead	1	1	1	1
Mercury	1	1		1
Methylene chloride	1	1	1	
n-Nitrosodiphenylamine	1			
Naphthalene	1	1	1	1
Nickel	1	1	1	1
Oil and grease		1	1	
p-Chloro-m-cresol	1			
Pentachlorophenol	1			
Petroleum hydrocarbons		1	1	
Phenanthrene	1		2	1
Phenol	1			
Pyrene	1	1		
Selenium	1			1
Silver	1			
Styrene	1			
Tetrachloroethene	1			
Toluene	1	1		
Total Cyanide	1			
Total Xylenes	1			
Trichloroethene	1		1	
Vinyl Acetate	1			
Zinc	1	1	1	1
Blank means not used, 1 means included in analysis, and 2 indicates compounds less than reporting limits, but larger than half the reporting limits.				

Results of a sample's lab analysis can be placed in four categories:

1. Not available - compounds not analyzed for the sample.
2. Not detected - sample analyzed for compound, but value was below detection limits.
3. Detected, but not quantified - sample analyzed and compound detected, but not in amounts that can be reliably measured.

4. Detected and quantified - sample analyzed and compound detected in amounts that could be reliably measured.

The last three categories separate samples on the basis of the qualitative description of the presence of a compound at a site. Let these categories be represented by the sets A (absent), D (detected), and M (measurable), respectively. The response for samples that fall in the first two categories are non-numeric, but tell us a great deal about the concentration levels of a compound at a site.

5.2 METHODOLOGY

We were interested in determining the reliability of the monitoring data. A comprehensive evaluation would have included a review of laboratory records and chain of custody documentation for the samples. This could not be done because of time and expense involved and due to the fact that many of the samples were analyzed by laboratories no longer in existence. Therefore, we proceeded to examine the statistical behavior of the data.

Duplicate soil and water samples can be used to determine the precision of sampling and analysis methods. A small difference between the reported values of duplicate samples relative to the overall mean concentrations provides confidence that the methods are capable of detecting larger differences across sites and across time. Unfortunately, these analyses can not answer the question of accuracy. Displaying the distribution of concentrations can be used to compare reported values to expected distributional patterns. Plotting data spatially and examining the concentration patterns with knowledge about historic operations, chemical use, fuel storage, spills, settling ponds, and likely groundwater movement can also be useful. These techniques, along with trends analyses of samples collected over time, provide a sense that the sampling and analyses were comprehensive and provide a reasonable database for risk assessment.

5.3 GENERAL FINDINGS

A comprehensive description of the statistical analysis is included in Appendix A. The following is a summary of the general findings.

- The methods used both for field sampling and laboratory analyses are standard.
- The number of analytes evaluated is a comprehensive list that includes pesticides, PCBs, metals, and numerous other organic and inorganic compounds. Of the 125 analytes, only 78 were detected at least once at quantifiable levels. The other 47 were never detected. MADEP established reporting levels for soil, water, and air contamination. Using the most conservative MADEP reporting guidelines set for residential property use, there were 16 compounds or metals in the soil exceeding those levels. Eighteen compounds or metals tested in the groundwater were at concentrations above the MADEP-required reporting levels.
- Our analyses also included these compounds plus oil, grease, and petroleum hydrocarbons in the soil and formaldehyde and phenanthrene in the water.
- For the compounds found in the soil with a sufficient number of duplicates, the precision was 30% or better. The spatial differences between sites were substantially greater than 30%, so spots with higher concentrations are readily identified. This is important in order to have confidence that further soil remediation will be effective in removing soils with the higher concentrations.
- There were a few soil test pits dug in the area of the commercial/retail site proposed for the eastern side of the property. Only petroleum hydrocarbons were found in these samples. This is reasonable, based on historic use of the site.
- The higher concentrations of soil contaminants were reported for subsurface instead of surface samples.

- Unfortunately, there were not a sufficient number of groundwater duplicate samples to draw firm conclusions about precision. As an alternative, the multiple measurements collected at a well were used to calculate the within well variability. By comparing statistical variance of repeated measurements at a well to the variance obtained by contrasting concentrations reported for different wells, a degree of reliability for the overall analytical performance was obtained. We reached the conclusion that, because across well variance greatly exceeded the within-well variance, well data could be interpreted to show trends and spatial differences.
- Based on the above reasoning and examination of the data, we see groundwater contaminants in higher concentrations onsite in locations that reflect historic use.
- Except for small amounts of a few VOCs found in well water samples collected more than ten years ago, there is no contemporary evidence that site-related contaminants have moved offsite in the direction of Whittemore Avenue.
- The same can not be said about well 604 between the Parkway and Alewife Brook. Samples containing naphthalene suggest that site contaminants have or are being transported via groundwater. These values do not constitute a health risk. First, they are found in the groundwater at low levels and second, water and sediment samples found no trace of site-related contaminants.
- Because there is very limited data available for groundwater or soils east of the MBTA tunnel, we were unable to formulate findings relevant to the Clifton Street neighborhood.
- Haley & Aldrich prepared responses to comments and recommendations raised in our previous review in 1987. While Haley & Aldrich provided maps showing sewer and utility connections, there were no additional sampling data in response to the original concern. The plan to analyze samples along existing or historic sewer and utility lines during excavations and only from within the building footprint is not fully responsive to the original concerns. The point of the original comment relates to the possibility that contaminants could be leaving site by traveling both within and

adjacent to sewer and utility lines. It is our understanding that the MWRA has upgraded sewer and storm drains along sections of Whittemore Avenue since 1987. The City should examine construction records to determine the reported condition of the previous system and to establish the extent of repairs/replacement. Further, the location of all the groundwater wells along Whittemore Avenue should be determined with respect to their proximity to sewer and utility lines. If, as we suggested, groundwater monitoring is continued, an alternative set of wells may be more appropriate to safeguard the community.

Appendix A contains a more detailed evaluation of data. We have also included in Appendices A and B graphical presentations of the soil and groundwater well data. Concentrations are shown graphically as cumulative distributions. The reader should note that only values at quantified concentrations are included. Table A.9 shows in the last column the fraction of total samples that had measurable quantities. Table A.11 provides similar information for groundwater. It is from these fractions that the empirical or cumulative distributions were drawn. Where applicable, vertical lines are drawn on the empirical distribution graphs to indicate values used in the risk analyses (RA) and as the MADEP S1 reporting level.

Appendix B provides spatial maps and empirical distribution functions for selected contaminants found in soil and groundwater samples.

6.0 EVALUATION OF THE 1988 AND 1994 HEALTH RISK ASSESSMENTS

EH&E evaluated the appropriateness of the data and risk assessment methods used by Meta Systems, Inc. in their 1988 health risk assessment for the W.R. Grace site and a 1994 update by the same company, now named Cambridge Environmental, Inc. Since 1994, new development plans for this site have been presented and some new toxicological information regarding a few key compounds found on the site have been presented by MADEP and the U.S. Environmental Protection Agency (EPA). Therefore, the present analysis also evaluated the sufficiency of the original risk analysis calculations in light of recent changes in exposure methods, toxicological data, and planned development.

During the course of this review, a number of questions or points of clarification were raised. To address these questions and issues, Dr. Halük Özkaynak of EH&E met with Dr. Edmund Crouch, the scientist at Cambridge Environmental, Inc. who was responsible for the risk assessment performed for the W.R. Grace site. Many technical issues were resolved and an electronic file copy of the available onsite environmental and meteorological data used in the risk assessment was obtained.

In addition to a technical review of the risk assessment documents, we wanted to be responsive to citizens' concerns that were expressed during meetings with the Grace Site Advisory Committee regarding the potential toxicity of onsite contaminants. One such concern was the toxicity of naphthalene. Naphthalene is a white solid that evaporates easily and is found in several consumer products, including moth balls, moth flakes, and toilet deodorant blocks (ATSDR 1995). Fossil fuels, such as petroleum and coal, contain naphthalene and burning tobacco and wood can release naphthalene into the air. Naphthalene has a strong, distinctive odor that individuals can detect in the air at concentrations as low as 85 parts per billion (ppb). Once released into the air, moisture and sunlight can break down naphthalene within a day. MADEP currently lists an allowable ambient level (24-hour exposure) and threshold effects limit (annual average) of 2.72 ppb for naphthalene in outdoor air.

Naphthalene binds weakly to soils and, as a result, it can pass through sandy soils and reach groundwater. This groundwater can then flow into other areas along its flow patterns. However, microorganisms in healthy soils can help break down naphthalene into carbon dioxide (CO₂), thus reducing the amounts of naphthalene that enter groundwater supplies.

The EPA currently categorizes naphthalene in Class D, which indicates that it is not classifiable as to human carcinogenicity due to inadequate evidence. In an October 1995 draft report, the MADEP proposed a relative potency factor for naphthalene based on some recent evidence that inhaled naphthalene produced cancer in animals. Data from a 1992 National Toxicology Program (NTP) report indicated an increased tumor incidence in female mice that inhaled 30 parts per million (ppm) of naphthalene for two years (NTP 1992).

These issues were also discussed with Dr. Crouch, who was very familiar with NTP studies and their extrapolation to human populations. Further information on the most recent listing and carcinogenic potency value of this compound was solicited from Dr. Lauren Zeiss at the California Department of Health Services. In addition, an online toxicity profile search was performed using the EPA's Integrated Risk Information System (IRIS).

Finally, a limited re-analysis of the site-specific data using alternative (e.g., air quality dispersion) modeling techniques and exposure or chemical toxicity values was conducted to determine how sensitive the results of original risk analysis were to modifications to exposures or potency values.

We have organized our findings under several categories.

6.1 EXPOSURE SCENARIOS

1. The potential human exposures considered in the risk assessment included inhalation of dust and vapors both onsite and offsite, ingestion of soil, and groundwater seepage into basements. It should be recognized that these exposures are hypothetical and were most often designed to represent extreme conditions so that the maximal levels of risk could be assessed. The expectation is that actual health risks are substantially below these values.
2. Emissions or volatilization of VOCs from soil have been modeled using conservative assumptions that are consistent with upper bound estimates.
3. The pollution dispersion model (AVR) did not use site-specific meteorology, but assumed uniform winds in all directions. When we used representative meteorology and a recent EPA model (ISCLT), we could demonstrate that the techniques used by Dr. Crouch were quite conservative. The impacts predicted by Dr. Crouch were about ten times greater than using current models and actual Boston meteorology.
4. Excavation, soil storage, and windblown dust impacts have been modeled using reasonable physical models. Emission rates of soil-related contaminants had to be assumed (estimated). Recently, EPA has developed models of fugitive dust generated during construction. The emission rates estimated for W.R. Grace site development should be compared to those derived from the EPA methods. The analysis performed for workers incorporated conservative exposure assumptions and selected high soil concentrations. However, if the basic emission factor currently used by the EPA would result in risk and methodology estimates increasing by a factor of five or more, then previous risk assessments should be reconsidered.

The risk assessments reviewed did not address impacts of particulate emissions resulting from trucking activities over paved or unpaved surfaces. This may not be an important shortcoming, depending on truck routes and construction site dust suppression practice. Proper dust suppression practices during the course of construction should minimize potential dust exposures.

6.2 GROUNDWATER

1. An ingestion route was not considered in the risk assessment because groundwater will not be used as drinking water. In addition, dermal contact with surface water was not considered.
2. Inhalation of naphthalene originating from the groundwater was considered inside homes. The risk assessment assumed that the highest concentrations of naphthalene would be present in groundwater that intruded into basements. This was obviously a very conservative approach, because the highest levels were reported only in water samples from wells that were several hundred meters from the nearest home.

6.3 SOIL

The updated risk assessment estimated the risk to visitors who might ingest small quantities of soil/dust from the site. All values (detect and non-detect) were averaged together to estimate risks. This is a reasonable approach, particularly when considering additional remediation of soils that will take place. Although an upper 95th percentile value of the arithmetic mean could have been used, this factor should not appreciably change the conclusions.

6.4 EXPOSURE GROUPS

Exposure scenarios for most of the critical groups (e.g., neighborhood residents, construction workers, office workers, and transient visitors) have been addressed in the risk assessment. Trespassers during the construction were not considered in the risk analysis. Also, children and adult shopper scenarios might be examined by different age groups because assumptions about ingestion, length of visit, etc. would result in different estimates. This refinement could be addressed without extensive re-analysis or simply addressed by scaling potential impact that might result from using default inhalation and ingestion values and contaminant levels before and after soil remediation.

6.5 EXPOSURE PATHWAYS

Inhalation, soil ingestion, and dermal absorption pathways have all been considered as the primary routes of exposure. However, small exposures might occur due to ingestion of homegrown fruits and vegetables that may be contaminated by deposition of dusts from the site or absorption of groundwater transported offsite. In the unlikely event that contaminants intruded into basements, dermal contact could occur if building occupants touched the water. Similarly, dermal or ingestion uptake might occur if populations come in contact with contaminated surface water. However, although the data are limited, they do not suggest that these pathways would contribute substantially to human health risks.

We mention these omitted pathways for completion. If the risk assessment were to be updated, we encourage the qualitative discussion of these other pathways that present an upper bound to the relative importance. W.R. Grace has stated that during construction, chemical analyses of landscape soil around Jerry's Pond will be conducted. At this time, additional surface and sediment samples might be required by MADEP. Continued trends monitoring of groundwater wells along Whittemore Avenue will provide advanced indications that contaminants may be leaving the site.

6.6 EXPOSURE FACTORS

Risk assessments of this type have to make assumptions about the frequency and duration of dermal contact, inhalation, and ingestion. While the assumptions used appear quite reasonable, suggested current EPA default values, in some cases, are actually higher. It is quite easy to scale the risk since it will be proportional to the amount ingested or the time of dermal contact and assumed proportion absorbed. Using higher values will obviously increase the estimated risk.

6.7 TOXICITY VALUES

The risk assessment used published potency and reference dose values. We find no fault in the application of these values. However, since the first risk assessment in the 1980s, new information has been published on naphthalene. Also, MADEP has drafted guidelines for assessing the several PAH compounds that do not have established cancer potency values. In light of these developments, we have sought clarification about naphthalene and other PAHs.

According to EPA (IRIS) and the State of California, naphthalene is still not classified as a human carcinogen. However, in a review of the EPA/IRIS database in March 1996, the description of naphthalene includes the following note:

NOTE ADDED IN JULY 1995: Subsequent to the verification of this cancer assessment in 1990, the National Toxicology Program completed a two-year cancer bioassay (1991); its results suggest that naphthalene may be more appropriately classified as a possible human carcinogen (Group C under current EPA guidelines). The NTP concluded, "Under the conditions of these 2-year studies, there was no evidence of carcinogenic activity of naphthalene in male B6C3F1 mice exposed by inhalation to concentrations of 10 or 30 ppm for 6 hours daily, 5 days per week, for 103 weeks. There was some evidence of carcinogenic activity of naphthalene in female B6C3F1 mice, as pulmonary alveolar/bronchiolar adenomas."

Naphthalene, a chemical on this site, was treated in the Health Risk Assessments of 1988 and 1994 as a non-carcinogen based on contemporary evidence. To address concerns regarding a potential reclassification of naphthalene to Group C, possible human carcinogen, the relative potency factor for naphthalene proposed in the MADEP document concerning risk assessment for PAHs (October 2, 1995) was used by us to calculate human risk levels. Our evaluation indicated that the projected lifetime cancer risks for residents, mall visitors, and workers would still be below the 1 in 100,000 target limit set by MADEP.

There is inconsistent treatment of naphthalene at this time. Naphthalene is still not classified as a human carcinogen by EPA and the California Department of Health. It is not listed among the California Proposition 65 compounds. As of October 1995 MADEP

considered naphthalene as a potential carcinogen based on evidence of lung cancer in one gender of one animal species only. They use a conservative mouse-to-man extrapolation method to estimate potency in humans.

The existing risk assessments have adequately considered both the cancer and non-cancer risks from other PAHs. Recent revisions or modification to relative toxicity of PAHs should not affect the previous predictions that indicated a small contribution of the analyzed PAHs to total risks.

6.8 CONCLUSIONS

Estimated lifetime cancer risks of less than 1 in 100,000 and a total hazard index of less than 1 (*i.e.*, total exposures are below the reference concentrations or assumed safe limits for non-cancer effects) are projected. These projections are below the MADEP guidelines and other agency criteria for acceptability.

Analysis was done by a competent and experienced individual using available data and mostly new methods to predict concentrations. Methods were developed to predict concentrations and exposures prior to detailed guidance from EPA and MADEP. In general, however, either realistic or conservative assumptions were made to estimate exposures and risks.

It is usually desirable to update a risk assessment when new concentrations, exposures, or toxicity data are made available. In this case, given the conservativeness of the existing risk assessment methods and based on what we already know, it is unlikely that the predicted risks would change appreciably if updates were conducted. Recent proposed revisions or new information on naphthalene and PAH toxicity values are unlikely to increase either the cancer or non-cancer risk estimates above the acceptable limits.

New development plans for the site differ from the earlier version and include an area near the northeast corner of the site where there is limited soil and groundwater data. In absence of soil concentration data for this area, we took the upper (95th percentile) bound estimate based on the site-wide concentrations. Using this approach, the

projected risks (e.g., from naphthalene) could increase somewhat (by 40%) but not beyond the accepted MADEP target limits.

7.0 EVALUATION OF HYDROGEOLOGIC DATA

Hydrogeologic data collected at this site were assessed for quality and adequacy. Analytical methods selected for the water analysis at the site were EPA methods commonly used at hazardous waste sites. The quality of these data could be partially assessed as discussed earlier. General issues relating to environmental data are discussed in this section before considering the groundwater model in more detail.

Review of the series of long-term monitoring reports was completed. Based upon the review of this data, the following observations and recommendations are made.

Water and sediment data were collected primarily during the springtime when surface water levels would have been highest due to runoff. A better measure of worst case conditions could have been made during the summer or fall when conditions are drier. In addition, only one location at Jerry's Pond had been monitored on a regular basis. This may not adequately represent conditions at Jerry's Pond and, therefore, may affect scoring for Tier Classification, as discussed later.

Groundwater monitoring data indicated that flow patterns and direction displayed some variation over time at the site. Flow patterns to the east of the site, in the vicinity of the MBTA tunnel and Russell Field, have not been well characterized; this is the area where the greatest degree of variability was observed. No monitoring points were located east of the tunnel, which reportedly has a significant impact on flow.

The April 1988 Environmental Data Report (Volume 7 of 7) (Haley & Aldrich 1988) was reviewed to assess the groundwater modeling conducted at the site. Observations are general at this time and concerns might be resolved by discussions with the modelers and/or review of primary data. More specific comments would require a detailed analysis of site data and possibly additional field testing.

The model selected for evaluation of the previously planned development seems appropriate. The boundary conditions and orientation of the model were consistent with

site conditions. Grid spacing was sufficient for the project objectives and was within the model's limitations. Use of a steady-state, two-dimensional simulation, although a simplification, was nevertheless appropriate for assessing the impact of the proposed foundations of the original development plan. However, sensitivity analysis of the initial boundary conditions was not performed, as far as we could discern. Therefore, the influence of boundary conditions' assumptions could not be evaluated, and their impact on groundwater flow patterns could not be assessed.

The documents provided did not present sufficient information supporting model assumptions and applications to allow independent reassessment. For example, information that indicates how values for certain model parameters were determined was generally not provided in the documentation, nor was information provided on the error criterion for model closure.

Parameters that are of primary concern include the permeabilities assigned to the subway tunnel and the passageway nodes and the surface recharge rates. Since the sensitivity analyses indicated that the model was most sensitive to these parameters, justification for the values assigned should be provided. We have no current understanding of how the subway tunnel and passageway node permeabilities were calculated. In addition, our opinion is that the recharge rates seem much lower than would be expected for the site area.

Information contained in the well construction logs and methods used during the in-situ permeability tests could possibly be used to evaluate the representativeness of aquifer permeabilities used as model input. Given the descriptions of the aquifer material, the permeability used appears within the typical ranges commonly observed for sandy outwash material. Current methods generally employ a different analytical technique than Hvorslev's method (which was used) to estimate aquifer permeability from slug test data. Evaluation and re-analysis at this level of detail was not undertaken.

Without an understanding of how adjustments to the saturated thickness, permeability, and recharge rates were made from measured data, EH&E can form no opinion as to how accurately data represent site conditions during model calibration. We agree that

the comparison of the measured historical groundwater conditions with simulated conditions indicates only reasonable similarities, with notable differences in the upgradient area of the site. However, we believe that the simulated existing groundwater conditions do not reasonably reflect measured existing groundwater conditions. Finally, in order to support model verification, a mass balance calculation is typically reported. In the absence of these data, we can not form an opinion as to the accuracy of the calibration and verification runs.

In our opinion, comparison of the simulated future groundwater contour plan with the existing groundwater contour plan showed significant differences in the rate and direction of groundwater flow. We believe that, because the conclusion derived from the groundwater modeling was based on previous development plans, they can not be used to evaluate conditions under the current development proposal. We can not say with confidence that it is unlikely that groundwater flow directions or water table elevations will be significantly altered in the site vicinity or north of the development as a result of the newly proposed construction. However, if the new construction does not include significant alteration of the subsurface or recharge patterns, impacts to flow patterns and rates may not be as significant. Detailed analysis of construction plans would be necessary to assess potential impacts to groundwater flow. In addition, changes in groundwater flow directions and gradients that could result from the repair of the MBTA tunnel are potentially significant.

Additional characterization of site hydrogeology is necessary to resolve these questions. Installation of additional wells east of the MBTA tunnel, groundwater monitoring in this area, and additional assessment of groundwater flow rates across the site are recommended.

8.0 RELATED ISSUES

While the majority of EH&E's effort was involved with the review of the numerous documents previously prepared by Haley & Aldrich, several related items were mentioned at the citizen meetings and in written correspondences. We could not address all of these points, in fact the City, Haley & Aldrich, and others were more appropriate responders. However, we did consider the Tier Classification, MBTA Tunnel, Russell Field, and the recent data on naphthalene (previously discussed).

8.1 TIER CLASSIFICATION

We support the decision of MADEP to conduct an audit of the Tier Classification process for this site. We believe that the interests of the City, neighborhood, and the developer would be better served if site construction and further remediation were subject to some additional oversight by MADEP.

The following observations are offered to assist the audit process.

8.1.1 Surface Soil and Sediment

Surface soil in the zero- to six-inch zone reportedly had been sampled at 14 locations on the site (J1, J2, and SS1 through SS12). Sediment reportedly had been sampled at five locations in Jerry's Pond (Jerry's Pond, J3, and SD11 through SD13), two locations in Alewife Brook (SD6 and SD8), and one other location of apparent sediment accumulation (SD14). It has been assumed that the applicable reporting category for the site is RCS-1 due to the proximity of Russell Field Park, residences, and Jerry's Pond. Exceedances of the RCS-1 concentrations have been noted at locations SS1 through SS3, SS5, SS6, SS9, SS10, SS12, SD4, SD6, and SD8.

The Numerical Ranking System indicated that areas where surface soil or sediment concentrations of oil or hazardous materials (OHM) exceeded applicable reportable concentrations constituted a potential exposure pathway for soil (and sediment) as

defined in MADEP CMR 40.1512(1). The Tier Classification and Numerical Ranking submitted for the site indicates that the OHM is located beneath paved surfaces and at depths greater than six inches (due to pre-construction paving or re-grading that occurred subsequent to the collection of these data), thereby constituting evidence of contamination for soil (and sediment) as defined in MADEP regulations. Additional documentation of the regrading and paving was requested, but was not received at the time this report was prepared. The significance of this point is that if site conditions actually constitute a Potential Exposure Pathway rather than Evidence of Contamination, the Numerical Ranking Score would be increased by 85 points.

It was also noted that some of the greater exceedances of RCS-1 concentrations in subsurface soils in the test pit programs completed at the site were at locations where no surface soil samples were obtained. This may not be an issue if the remediation and construction plans include replacing top soil with clean material or covering the surface with a foundation and/or parking area.

The site-wide database should be reviewed to assess that samples of surface soil and sediment (*i.e.*, zero to six inch) were collected at a representative number of locations on the site, based upon site history and current knowledge of the nature, extent, and distribution of contamination.

A comparison of the locations where the RCS-1 exceedances noted were observed should be made with actual site conditions to verify that all these locations had been re-graded or paved over, including sediment sample locations. It should be determined if MADEP definitions refer to the sediment above and/or below water surfaces. We have been unable to obtain information from MADEP regarding this issue at the time this report was prepared.

8.1.2 Private Water Supply Well

A letter from a resident in the site vicinity, Mr. Edward Norberg, to Secretary Trudy Coxé of the Executive Office of Environmental Affairs, dated February 7, 1996, indicates that Mr. Norberg has a private water supply well for agricultural/residential (non-ingested)

use at his property. Subsequent conversations with Mr. Wesley Stimpson of Haley & Aldrich and receipt of a letter written by Haley & Aldrich to MADEP regarding this issue indicated that Mr. Norberg does not use this well at all and, in fact, does not have a pump in the well. This may be a non-issue as long as the well is never activated.

The Numerical Ranking System indicates that when a private *drinking* water well is located within 500 feet of any portion of a disposal site where OHM has been identified in groundwater at concentrations equal to or exceeding applicable risk-based concentrations promulgated in MADEP regulations, this constitutes a Potential Exposure Pathway for groundwater as defined in the regulations. Such exceedances were reported in the Numerical Ranking Score determined for the site. However, the Numerical Ranking indicated that no *drinking* water wells were known to exist in the site vicinity at the time the Numerical Ranking Score was determined, thereby constituting Evidence of Contamination in groundwater. Please note that Haley & Aldrich indicated that, based on prior experience in Massachusetts, an unpermitted well, as the Norberg well is reported to be, is not eligible for consideration in Numerical Ranking in the Massachusetts Contingency Plan (MCP). MADEP must make a firm determination on this matter. The significance of this point is that if site conditions actually constitute a Potential Exposure Pathway rather than Evidence of Contamination, the Numerical Ranking Score would be increased by 80 points.

8.1.3 Surface Water

The Numerical Ranking indicated that OHM has been identified in site surface water at concentrations constituting Evidence of Contamination. Part of the basis for the score provided for this section appears to be that the surface water indicating the presence of OHM is not used for drinking, boating, or swimming. MADEP regulations indicate that conditions constitute a Potential Exposure Pathway for surface water if it is known to be used for drinking, swimming, boating, or fishing. Information provided in historical reports for the site indicates that Jerry's Pond was used for swimming, boating, and fishing. It is not clear whether the locations where OHM was observed were used for any of these purposes. However, information provided in Section VI of the Numerical Ranking indicated that a Long-Term Monitoring Report, dated 1994, provided data

supporting the conclusion that surface water and sediment contamination do not exist in Jerry's Pond. However, the Long-Term Monitoring Report provides information at one location at Jerry's Pond once a year (springtime). These data may not adequately characterize conditions at Jerry's Pond. The significance of this point is that, if site conditions actually constitute a Potential Exposure Pathway rather than Evidence of Contamination, the Numerical Ranking Score would be increased by 80 points.

8.1.4 Disposal Site Characteristics

State regulations set forth methods for determination of scores in many categories. The sum of all the categories is the final Tier Classification score. It appears that the methods used to determine the OHM Toxicity Score (CMR 40.1511, Section III.A.) and the OHM Mobility and Persistence Score (CMR 40.1511, Section III.C.) do not include use of the methods defined and required by in the regulations, specifically, the Human Health-Based Toxicity Value Matrix (CMR 40.1513(3)) or the OHM Mobility and Persistence Factors (CMR 40.1514(4)) for site-related OHM are not found in the listed Human Toxicity Values (CMR 40.1513(2)) and Mobility and Persistence Scores (CMR 40.1514(2)) and (3)), respectively. The significance of these points is that it is possible that use of these methods could slightly increase the total site ranking and could potentially change the Tier Classification. However, the outcome would be uncertain until the procedures are completed.

8.1.5 Ecological Population

As with the Disposal Site Characteristics Scoring, a method defined in and required by the regulations was not used for the ecological population scoring. It appears that the methods used to determine the Environmental Toxicity Score did not include use of the Environmental Toxicity Value Matrix for site-related OHM not found in the listed Environmental Toxicity Values. The significance of this point is that it is possible that use of this method could slightly increase the total site ranking. However, the final outcome would be uncertain until the procedures are completed.

8.1.6 Mitigating Disposal Site-Specific Conditions

The first mitigating condition referenced in the Numerical Ranking indicated that, since no surface water or sediment contamination existed in Jerry's Pond, the score for the presence of a Fish Habitat under Ecological Population was reduced by 10 points.

The second mitigating condition referenced in the Numerical Ranking indicated that, since no surface water contamination existed in Alewife Brook and since there was no opportunity for surficial contamination from the site to impact Alewife Brook Reservation, the score for the presence of a Protected Open Space under Ecological Population was reduced by 10 points. Regional groundwater flow from the site toward the Reservation had been shown. Further, naphthalene and some VOCs had been reported for well 604, adjacent to Alewife Brook. The potential for site impact on Alewife Brook Reservation exists. However, EH&E does not believe that the numerical ranking should be changed because of lack of supportive evidence in surface and sediment samples.

8.2 HAZARDOUS MATERIALS MANAGEMENT AND REMEDIAL ACTION

In accordance with the MCP, this site must be remediated within five years of Tier Classification, that is, by the year 2000, with or without redevelopment of the site for any use. Remedial action plans have not yet been developed by Haley & Aldrich, but they will likely be incorporated into any redevelopment project. If the proposed shopping center is built on the site, limited soil excavation will be required for development and additional soils will be excavated for remediation. Management of hazardous materials will be necessary to minimize impacts to the surrounding community and onsite workers during remediation and construction.

Under the MCP, rigorous health and safety and contingency planning must be completed prior to the initiation of remediation and construction. Environmental oversight will be required during any construction that occurs concurrently with remediation. It is recommended that the City of Cambridge thoroughly review all plans governing hazardous materials management, remedial action, health and safety, and emergency contingencies at the site, when these documents become available. This

review will help ensure both the short-term and long-term site risks are minimized and that thorough remedial action is completed at the site.

8.3 MBTA TUNNEL

In February EH&E gained access to the MBTA tunnels at Alewife Station. Visual inspection of several hundred meters of tunnel both east and west of the passenger platform were made. It was obvious from the damage to the concrete retaining walls and ceiling that water seepage had been occurring for some time. The tunnel walls on both sides were wet and seeping water in numerous spots along the entire section.

A 1992 report by Stone & Webster, Inc. for the MBTA characterized the health risks for employees at this station. Drainage into the tunnel by groundwater was identified as the primary route for low level exposures to VOCs. The Stone & Webster, Inc. report referred to the 13-year history of investigations that had been carried out in an attempt to explain the reported objectionable odors and to resolve the health and safety fears of the employees. EH&E's review did not include monitoring nor could EH&E review the consultant reports referred to in the Stone & Webster, Inc. document, which were not provided, with the exception of the W.R. Grace reports prepared by Haley & Aldrich.

Presented here is EH&E's perspective. Based on the similarity between chemical compounds found in tunnel aqueous samples and those reported for soil and well water samples at the site, it is likely that the site is the origin. However, because oil and grease are used on switches and trains, and because various cleaning solvents are used on the trains and in the Alewife station, multiple sources for the contaminants are likely. A limited number of air measurements made in 1985 in the tunnel indicate low airborne concentrations of several compounds. During the tunnel inspection, we did not detect chemical odors in the air or when smelling the discolored surfaces. However, other individuals reported a chemical odor from the pump room on a previous visit.

Inspections by others, as recounted by Stone & Webster, Inc., reported that both the sewer sump and drain sump vented through a common vent, which could be responsible for sewer smells from the track drainage and floor drain system.

The relevance of the MBTA to the proposed development has to be put into perspective. The MBTA drainage system and air exhaust system would be the only avenues for contaminant exposure to the community. Routine and continuous monitoring of the Parkway Pond, where the subway pump empties, has not revealed contaminants, according to Haley & Aldrich, Inc. Limited air sampling in the tunnel conducted by GZA reported low concentrations of a few VOCs. VOCs volatilizing from the seeping groundwater would be greatly diluted both in the high volume airflow through the tunnels and upon dispersion in the outdoor air. As a result, this would not be an important exposure pathway.

The tunnels may have significantly altered the groundwater movement in the vicinity of the proposed development. The combined impact of development, paved surface areas, and new surface water drains needs to be assessed. It is conceivable that, as groundwater flow into the tunnels is reduced, aqueous concentrations of site contaminants could actually increase. Although this would have insignificant impact on the neighborhood, it could be important for MBTA employees.

8.4 RUSSELL FIELD

Environmental data is not currently available for the Russell Field area. This information is important from two perspectives.

First, groundwater quality and flow data in this area would provide a more complete understanding of potential groundwater impacts from the W.R. Grace site onto properties to the east (as discussed in Section 7.0). Based upon the available information, it appears that this area is largely uncharacterized.

Second, there are community concerns about past activities at Russell Field. Specifically, it has been reported by community members and in file documentation that contaminated excavate soil was stored on portions of the Russell Field property during excavation of the MBTA tunnel. Detailed information on the methods of excavation, materials handling, storage, and disposal has not been available for review. No

information on the chemical nature of contamination in the excavate has been available. In addition, records of the reported offsite disposal (hazardous waste manifests), which are required by Federal and State regulations, have not been available for review.

Given the many areas of uncertainty, it is recommended that an environmental investigation of this area be conducted. This should include characterization of soils and groundwater. It is estimated that a minimum of four to five wells would be necessary east of the tunnel to characterize flow in this area; actual locations should be selected based upon field conditions and a review of boring logs from the investigation of the W.R. Grace site. Permeability testing is recommended at selected representative wells. It is reported that clean fill was placed on top of existing materials at Russell Field. This should be verified by analyzing pooled soil samples obtained for the top few inches. In addition, subsurface soil should be characterized to assess any potential impacts of storage of contaminated excavate. While subsurface soils do not generally pose a direct exposure hazard (unless excavated), they can provide a source of contamination to groundwater. Therefore, there are two options: either analyze bulk water samples from new wells located between Russell Field and Clifton Street houses, or collect soil core samples down to the level of the original grade.

9.0 REFERENCES

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APPENDIX A

EVALUATION OF SOIL AND GROUNDWATER SAMPLES

EVALUATION OF SOIL AND GROUNDWATER SAMPLES

This evaluation examined the patterns of chemical concentration measurements in soil and groundwater samples at the W.R. Grace site in Cambridge, Massachusetts. Specifically, EH&E has:

1. Examined the consistency of the data between samples and their duplicates
2. Summarized concentrations in relation to MADEP soil and groundwater standards
3. Mapped the spatial pattern of chemical concentrations on the site

A.1 THE DATA

The soil samples' data set contains the results of soil analyses collected mainly in 1986 and 1987 with a few preliminary samples from 1984 and 1985. There were 127 sites sampled in and around the W.R. Grace property. Each site was sampled only once, except for the collection of duplicates. However, many of the collected samples were fairly close to others collected at different times.

Groundwater samples were taken from 44 wells in and around the W.R. Grace property from 1984 to 1988 with the bulk of the samples taken in 1986 and 1987. From these wells, 29 were sampled two to four times during this time period. Sampling of nine wells continued through 1994 and each of these was sampled 10 and 15 times. The data set corresponding to the samples collected between 1990 and 1994 was not integrated into the main database. Instead, the data from these nine wells are discussed separately.

Samples collected from 1984 to 1988 were analyzed for 125 analytes and several other types of measurements, such as pH. The data sets (provided by Haley & Aldrich) were examined and found to contain 78 compounds as well as other summary values. According to Haley & Aldrich the remaining 47 compounds, were never detected in any of the samples. From these compounds 59 were chosen for inclusion in risk assessment by Cambridge Environmental, Inc. and are listed in Table A.1. The groundwater samples collected between 1990 and 1994 were analyzed for VOCs and naphthalene only. A subset of these compounds found in the data files were selected for the

statistical analysis described here. A further description of the methods for choosing the compounds for analysis is given in Section A.3.

Table A.1 Compounds included in the Cambridge Environmental, Inc. risk assessment and those included in statistical analyses discussed in this report

Compound	Risk assessment	Soil analysis		Groundwater
		Duplicate	Distribution	Duplicate and distribution
1,1,1-trichloroethane	1			
1,1-dichloroethene	1			1
1,2-dichloropropane	1			
2,4-dimethylphenol	1			
2-butanone	1			
2-hexanone	1			
4-methyl-2-pentanone	1		1	
Acenaphthene	1		2	
Acenaphthylene	1			
Acetone	1	1		
Anthracene	1			
Antimony	1			
Arsenic	1	1	2	
Barium	1		2	
Benzene	1	1		
Benzo (a) anthracene	1	1	1	1
Benzo (a) pyrene	1	1	1	1
Benzo (b,k) fluoranthene	1	1	1	1
Benzo (ghi) perylene	1		2	1
Beryllium	1		1	
Bis (2-ethylhexyl) phthalate	1			1
Butyl benzyl phthalate	1			
Cadmium	1		1	1
Carbon disulfide	1			
Carbon tetrachloride				1
Chlorobenzene	1			
Chromium	1	1		
Chrysene	1		1	1
Copper	1			
Di-n-butyl phthalate	1			
Di-n-octyl phthalate	1			
Dibenzo (a,h) anthracene	1		1	1
Diethyl phthalate	1		2	1
Ethylbenzene	1			
Fluoranthene	1	1		

Blank means not used, 1 means included in analysis, and 2 indicates compounds less than reporting limits, but larger than half the reporting limits.

Table A.1 Continued				
Compound	Risk assessment	Soil analysis		Groundwater
		Duplicate	Distribution	Duplicate and distribution
Fluorene	1			
Formaldehyde	1	1	1	1
Indeno (1,2,3-cd) pyrene	1		1	1
Iron	1			
Lead	1	1	1	1
Mercury	1	1		1
Methylene chloride	1	1	1	
n-Nitrosodiphenylamine	1			
Naphthalene	1	1	1	1
Nickel	1	1	1	1
Oil and grease		1	1	
p-Chloro-m-cresol	1			
Pentachlorophenol	1			
Petroleum hydrocarbons		1	1	
Phenanthrene	1		2	1
Phenol	1			
Pyrene	1	1		
Selenium	1			1
Silver	1			
Styrene	1			
Tetrachloroethene	1			
Toluene	1	1		
Total Cyanide	1			
Total Xylenes	1			
Trichloroethene	1		1	
Vinyl Acetate	1			
Zinc	1	1	1	1
Blank means not used, 1 means included in analysis, and 2 indicates compounds less than reporting limits, but larger than half the reporting limits.				

Results of a sample's lab analysis can be placed in four categories:

1. Not available - compounds not analyzed for the sample.
2. Not detected - sample analyzed for compound, but value was below detection limits.
3. Detected, but not quantified - sample analyzed and compound detected, but not in amounts that can be reliably measured.

4. Detected and quantified - sample analyzed and compound detected in amounts that could be reliably measured.

The last three categories separate samples on the basis of the qualitative description of the presence of a compound at a site. Let these categories be represented by the sets A (absent), D (detected), and M (measurable), respectively. The response for samples that fall in the first two categories are non-numeric, but tell us a great deal about the concentration levels of a compound at a site.

A.2 THE MODEL

The model used for this type of mixed data can be described as follows. Let $X(s)$ be the true concentration level at a site. Given a random sample of the study area, define the probability that $X(s)$ is in one of the three categories as:

$$p_A = P(\text{non-detect})$$

$$p_D = P(\text{detected, but not quantified})$$

$$p_M = P(\text{detected and quantified})$$

Given that a sample is in one of these categories, the probability distribution of the true concentration level for samples within the category needs to be determined. The distribution of the sample depends on the category. Define the conditional cumulative distributions for the three categories to be F_A , F_D , and F_M respectively.

Estimates of the distributions for the non-detect and present categories are not possible since we can not get any measurements. We can assume without much loss of generality that the distribution F_A is Uniform on $[0, x_D]$, where x_D is the detection limits of the method of sample analysis and F_D is Uniform on $[x_D, x_M]$, where x_M is the limit of the method of sample analysis that produces reliable numerical results. The cumulative distribution F_M is estimated from the samples, but it is assumed $F_M(x) = 0$, for $x < x_M$. Now the distribution of $X(s)$ can be written as:

$$F(X(s) < x) = p_A F_A(x) + p_D F_D(x) + p_M F_M(x).$$

A.3 THE ANALYSIS

The statistical analysis of the soil and groundwater data from 1984 to 1988 is composed of three parts: duplicate analysis, univariate distribution estimation, and spatial mapping of concentrations. A brief discussion of the nature of the analysis and choice of compounds studied is given here.

There were 78 chemical compounds analyzed for at least one site. Subsets of these chemicals were chosen for duplicate and distribution analyses. Sixteen compounds that had a high number of samples with detectable concentrations were chosen for duplicate analysis for the soil samples. For distribution estimation, compounds were chosen if any samples had concentration values higher than the MADEP standards for groundwater (GW2) and soil (S1). Other compounds included were oil and grease and petroleum hydrocarbons for soil samples and phenanthrene and formaldehyde for groundwater samples. A total of 18 and 20 compounds were included in the soil and groundwater analyses, respectively. There was considerable overlap between compounds included in analyses of soil and groundwater distributions. A secondary list was developed for compounds that had maximum observed values less than the MADEP standards, but greater than half of the MADEP standards. For 47 of the 78 compounds studied, no samples had concentrations greater than half the MADEP standard reporting categories GW2 and S1. Table A.1 contains a list of the compounds included in the statistical analyses and in the Cambridge Environmental, Inc. risk assessment for the site.

Analysis of the duplicate sample data was conducted to determine the validity of the samples themselves. Two main questions were:

1. Do data from the duplicates indicate any sampling bias?
2. Is the variability between duplicates at a site relatively small compared to the variability in concentration levels between sites?

Only soil samples with 15 duplicates had a large enough sample size for true duplicate analysis to be performed. The number of duplicate samples for groundwater and surface water were eight and three, respectively.

Duplicate analysis, in which groundwater samples collected over time from the same site were treated as replicates, was conducted. Even for this strategy, only 13 compounds had enough replicates to perform the analysis. To overcome possible non-normality, analyses were also carried out on log transformed data.

Univariate distribution estimation included estimates of probability samples belonging to the three categories *A*, *D*, and *M*. Empirical distribution functions are given for the distribution of concentration values (*i.e.*, the empirical distribution function for F_M). Other relevant statistics, such as mean and variance, were also computed. Spatial distribution of concentration levels were also supplied.

A.4 DUPLICATE ANALYSIS

Duplicate samples were field duplicates and not lab duplicates. In this situation, duplicates were not necessarily expected to generate nearly identical results, particularly for soil samples, because soil composition can naturally vary even within a few inches. It is really a test to see how representative a sample may be of the neighboring area, particularly compared to the variability across the entire study site.

The number of soil, groundwater, and surface water samples that had duplicates was small. Maximum possible sample sizes were 15, 8, and 3, respectively. For many compounds, actual sample sizes were typically smaller because samples were not analyzed or did not have detectable levels for one of the samples in the duplicates. The number of soil duplicate pairs was just large enough to carry out a few basic analyses.

One assumption about the collection of field duplicates was that the samples were randomly selected at the site. To investigate this assumption let $d = X(s) - X_d(s)$, where X_d is the duplicate sample at the site. Table A.2 states the frequency that d is less than

zero for each compound. Table A.3 gives the mean of d for each compound. If duplicates were taken randomly, the frequency in both tables should be around 50%. Looking over all compounds listed in Table A.2, the variability in these frequencies is in line with what occurs if samples were selected at random. The results show no indication of non-random sampling behavior.

Table A.2 Percent of differences less than zero for soil duplicate samples			
Compound	n	# $d < 0$	%($\#d < 0$)
Methylene chloride	5	2	0.40
Acetone	1	1	1.00
Benzene	1	1	1.00
Toluene	0	-	-
Fluoranthene	2	1	0.50
Naphthalene	6	5	0.83
Benzo (a) anthracene	2	2	1.00
Benzo (a) pyrene	1	1	1.00
Benzo (b,k) fluoranthene	2	2	1.00
Pyrene	3	2	0.67
Arsenic	15	5	0.33
Chromium	15	9	0.60
Mercury	9	3	0.33
Nickel	15	7	0.47
Lead	15	7	0.47
Zinc	14	5	0.36
Formaldehyde	7	5	0.71
Oil and grease	12	8	0.67
Petroleum hydrocarbons	14	8	0.57

Table A.3 Paired differences analysis for duplicate soil samples						
Compound	Mean difference	Std. dev.(d)	Std. err. (d)	n	Mean rel diff.	Std. dev. rel. diff.
Methylene chloride	10.00	21.7	9.7	5	0.20	0.19
Acetone	-40.00	-	-	1	0.19	-
Benzene	-20.00	-	-	1	0.09	-
Toluene	-	-	-	0	-	-
Fluoranthene	11,120.00	19,629.3	13,880.0	2	1.07	0.21
Naphthalene	-1,532.83	6,126.3	2,501.0	6	0.21	0.22
Benzo (a) anthracene	-1,705.00	2,100.1	1,485.0	2	0.42	0.44
Benzo (a) pyrene	-2,835.00	-	-	1	0.97	-
Benzo (b,k) fluoranthene	-5,950.00	7,396.3	5,230.0	2	0.59	0.72
Pyrene	1,780.00	13,821.0	7,979.6	3	0.98	0.19
Arsenic	-0.52	3.0	0.8	15	0.20	0.14
Chromium	-0.71	2.5	0.6	15	0.10	0.09
Mercury	0.00	0.1	0.02	9	0.22	0.22
Nickel	4.77	20.5	5.3	15	0.17	0.30
Lead	-3.23	26.5	6.8	15	0.24	0.35
Zinc	-74.26	214.6	57.4	14	0.18	0.16
Formaldehyde	-48.09	118.3	44.7	7	0.40	0.49
Oil and grease	6,093.17	23,440.0	6,766.5	12	0.53	0.35
Petroleum hydrocarbons	-331.93	809.6	216.4	14	0.34	0.36

Besides mean difference, Table A.3 gives estimates of variability in measured differences, both in absolute terms and relative terms. The mean relative difference is the mean of the coefficient of variation for all duplicate pairs for a compound. The coefficient of variation for a particular pair can be written as $v_i = \sqrt{2}|x_i - x_{ir}|/(x_i + x_{ir})$. Then the mean relative difference is the mean of v_i over all duplicate pairs, etc. Absolute mean difference and its standard deviation show no indication that the mean difference is not zero. The decision on whether the variability within duplicates is high is a subjective one and left at the reader's discretion. The mean relative difference indicates that, for most of the compounds, the standard deviation was usually less than 30-40% of the mean. The largest mean relative errors also had very small sample sizes and were not reliable estimates. Of those compounds with larger sample sizes, formaldehyde and oil and grease had the highest mean relative difference and precision may be of concern for them.

Next, the duplicate pairs were identified by whether both pairs fell in the same detection category. This is a useful test for those compounds that have a high percentage of samples with no measurable concentrations. Clearly, if one sample shows no detectable amounts of a compound and the area is fairly homogeneous, the duplicate sample should also show no detectable amounts. Table A.4 gives the total sample size, the correct number of matches, and the percent correct. All results were over 67% and 15 of the 19 compounds matched on more than 80% of the samples. Metals had very high rates, while the other compounds had lower rates. Note that due to small sample sizes just one mismatch more or less causes about a 6% or 7% change in the correct categorization rate. These results were fairly subjective, but indicated that field samples were representative of the neighboring area, at least on a qualitative level.

Table A.4 Qualitative evaluation of soil duplicate samples based on detection category			
Compound	Total samples	# Correct matches	% Correct
Methylene chloride	14	13	0.93
Acetone	14	11	0.79
Benzene	14	13	0.93
Toluene	14	11	0.79
Fluoranthene	15	11	0.73
Naphthalene	15	13	0.87
Benzo (a) anthracene	15	12	0.80
Benzo (a) pyrene	15	10	0.67
Benzo (b,k) fluoranthene	15	12	0.80
Pyrene	15	13	0.87
Arsenic	15	15	1.00
Chromium	15	15	1.00
Mercury	15	14	0.93
Nickel	15	15	1.00
Lead	15	15	1.00
Zinc	14	14	1.00
Formaldehyde	14	13	0.93
Oil and grease	14	13	0.93
Petroleum hydrocarbons	14	14	1.00

For those duplicate pairs that had measurable concentrations in both samples, a simple analysis of variance was used to compare the variability between duplicate samples and the variability between sampling locations. Small variability within duplicates compared to variability between locations was another indication that samples were fairly

representative of the neighboring area. Let σ_w^2 and σ_b^2 be the within duplicates and between sampling location variances. Table A.5 contains estimates of these variances for all compounds with a suitable sample size. The ratio of variances for within duplicates and between sites can be used to get relative size of variances. Smaller p -values indicate the strength of the hypothesis when the ratios of the two variances is not equal to one, a p -value less than 0.05 is frequently used as a cut-off point. For compounds with a reasonable sample size, only nickel, formaldehyde, and oil and grease show within variability as large as between site variability. However, deletion of a questionable value for one of the duplicates for nickel changes its p -value to 2×10^{-11} . This analysis indicates that for compounds with a reasonable sample size, all but formaldehyde and oil and grease showed a much greater variation between sites than within a site. For many reasons, most notably non-normality and possible lack of independence of samples, it is not recommended to use the p -values given in the table as a true test statistic. However, they may still be used to judge relative variability. Results were carried out on log transformed data and results were qualitatively the same.

Table A.5 Soil - Comparison of within duplicates and between duplicate variances

Compound	<i>n</i>	σ_w^2	σ_b^2	<i>p</i> -value
Methylene chloride	5	237.80	7,488.35	0.0001
Acetone	1	800.00	-	-
Benzene	1	200.00	-	-
Toluene	0	-	-	-
Fluoranthene	2	1.58E+08	1.53E+08	0.43
Naphthalene	6	1.68E+07	4.058E+08	0.001
Benzo (a) anthracene	2	2.56E+06	2.58E+06	0.42
Benzo (a) pyrene	1	4.02E+06	-	-
Benzo (b,k) fluoranthene	2	3.14E+07	532,900	0.90
Pyrene	3	6.53E+07	3.71E+07	0.62
Arsenic	15	4.388787	51.35	0.0000
Chromium	15	3.056	37.28	0.0000
Mercury	9	0.00167	0.0222	0.0004
Nickel*	15	208.0623	206.65	0.5
Lead	15	332.7477	26,635.6	0.0000
Zinc	14	2.41E+04	2.41E+06	0.0000
Formaldehyde	7	8,344.165	7,191.3	0.56
Oil and grease	12	2.7E+08	2.42E+08	0.56
Petroleum hydrocarbons	14	3.59E+05	1.31E+07	0.0000

* - *p*-value would be 3×10^{-6} if site SIT3 TP15 S2 is deleted

Repeated measurements over time were used as replicates for groundwater in place of standard duplicate analysis to try and get an estimate of relative variability within and between sites. The results of this analysis is given in Tables A.6 and A.7 for the 10 compounds with enough samples for this analysis. Again, small *p*-values indicated that variability over time at a particular well was small compared to the variability between wells. The large *p*-values were not surprising for many of the compounds because of the small sample sizes involved. Except for naphthalene, there was general agreement in tests for untransformed and log transformed data. For naphthalene, the log transformed results were more appropriate. Most compounds with reasonable sample sizes indicated concentration levels varied across the property.

Table A.6 Comparison of variation in concentrations between sites and within sites for groundwater well samples-log transformed data

Compound	site d.f.	err. d.f.	MS(site)	MS(w/in)	p-value
Naphthalene	17	17	9.55	1.42	0.00
Benzo (b,k) fluoranthene	6	1	0.84	0.00	0.01
Chrysene	5	1	0.82	0.08	0.24
Phenanthrene	5	3	0.36	0.30	0.47
Cadmium	9	3	4.34	0.77	0.09
Nickel	14	3	1.43	1.07	0.46
Lead	14	2	1.31	0.87	0.47
Selenium	4	1	1.34	6.80	0.91
Zinc	35	18	4.31	1.60	0.01
Formaldehyde	14	6	4.60	0.81	0.02

Table A.7 Number of samples, means, and standard deviations for samples with a measurable concentration of the compound for soil and groundwater samples

Compound	Soil Sample Summary				Groundwater Summary			
	n	Mean	St. Dev.	Units	n	Mean	St. Dev.	Units
Methylene chloride	38	86.78	71.83	ppb	-	-	-	
1,1-dichloroethene	-	-	-		3	5.47	3.92	ppb
Trichloroethene	1	1,200.00	-	ppb	-	-	-	
Carbon tetrachloride	-	-	-		2	22.50	13.44	ppb
4- methyl-2-pentanone	4	333.00	579.92	ppb	-	-	-	
Naphthalene	43	11,265.8	24,985.8	ppb	35	2,838.21	5,596.53	ppb
Benzo (a) anthracene	35	4,404.46	8,704.15	ppb	5	8.00	4.98	ppb
Benzo (a) pyrene	20	3,140.75	5,490.82	ppb	4	17.10	18.04	ppb
Benzo (b,k) fluoranthene	41	9,073.00	29,079.4	ppb	8	13.68	13.07	ppb
Chrysene	15	4,734.67	6,649.04	ppb	7	9.30	11.97	ppb
Benzo (ghi) perylene	-	-	-		2	46.30	56.71	ppb
Phenanthrene	-	-	-		9	22.32	11.15	ppb
Dibenzo (a,h) anthracene	17	2,367.59	6,194.62	ppb	1	4.4	-	ppb
Indeno (1,2,3-cd) pyrene	27	6,008.74	18,753.5	ppb	3	30.47	38.57	ppb
Bis (2-ethylhexyl) phthalate	-	-	-		7	162.37	185.30	ppb
Beryllium	39	0.51	0.45	ppm	1	31	-	ppb
Cadmium	71	2.82	7.12	ppm	13	59.43	151.67	ppb
Mercury	-	-	-		2	0.75	0.64	ppb
Nickel	102	18.08	63.24	ppm	18	107.00	200.41	ppb
Lead	98	190.22	555.50	ppm	17	110.47	123.31	ppb
Selenium	-	-	-		6	113.33	158.20	ppb
Zinc	99	441.31	1,330.23	ppm	54	906.37	1,945.53	ppb
Formaldehyde	40	14.36	44.65	ppm	21	0.55	1.01	ppm
Oil and grease	70	7,871.39	14,237.6	ppm	-	-	-	
Petroleum hydrocarbons	74	789.69	1,321.12	ppm	-	-	-	

A.5 ANALYSIS OF RANGE OF COMPOUND CONCENTRATION LEVELS

As described previously, a complete description of the range or distribution of concentrations for each compound consists of two parts:

1. Estimating the probability that a sample has a detectable concentration of a compound.
2. For those samples with measurable amounts of a compound estimating the distribution or range of concentrations present.

Table A.8 gives estimates of the means and standard deviations for those compounds with a measurable quantity studied from the soil and groundwater samples. Tables A.8 and A.9 contain the probability of non-detect, detecting at non-measurable amounts, and detecting at measurable amounts of a compound for soil and groundwater samples, respectively. Most soil samples detected at least some amount of elemental compounds, while other compounds studied occurred in less than 40% of the samples. In descending order, zinc, naphthalene, formaldehyde, nickel, and lead were the most frequently occurring compounds in the groundwater samples. Nickel and lead were present in 25% of the samples. The overall mean can roughly be calculated as the probability a sample has a measurable concentration times the mean of those samples with a measurable concentration. This overall or grand mean is what is used in the Cambridge Environmental, Inc. risk assessment for soil analyses. Tables A.10 and A.11 contain the quintiles and maximum observed values for soil and groundwater samples respectively. For comparison these tables also contain the MADEP S1 and GW2 standards, respectively.

Table A.8 Comparison of variation in concentrations between sites and within sites for groundwater well samples-untransformed data

Compound	Site d.f.	Err. d.f.	MS(site)	MS(w/in)	P-value
Naphthalene	17	17	2.33E+07	3.93E+07	0.85
Benzo (b,k) fluoranthene	6	1	199.45	0.01	0.00
Chrysene	5	1	171.85	0.85	0.05
Phenanthrene	5	3	84.52	190.89	0.80
Cadmium	9	3	30,433.91	718.22	0.01
Nickel	14	3	21,267.21	128,358.3	0.99
Lead	14	2	16,287.16	7,625.00	0.36
Selenium	4	1	12,270.83	76,050.00	0.93
Zinc	35	18	5.58E+06	2.87E+05	0.00
Formaldehyde	14	6	1.31	0.37	0.06

MS(site) is variance between sites and MS(w/in) is variance within sites. P-value is for *F*-test. Results for log transformed data and untransformed data.

Table A.9 Soil samples - Summary of categorization of samples into non-detect, detect (detected, but concentration not quantified), and measurable (detected and concentration quantified)

Compound	Total n	Probability of		Measurable
		Non-detect	Detect	
Methylene chloride	101	0.62	0.00	0.38
Trichloroethene	101	0.98	0.01	0.01
4-methyl-2-pentanone	102	0.95	0.01	0.04
Naphthalene	117	0.50	0.14	0.37
Benzo (a) anthracene	112	0.48	0.21	0.31
Benzo (a) pyrene	112	0.62	0.21	0.18
Benzo (b,k) fluoranthene	112	0.42	0.21	0.37
Chrysene	112	0.64	0.22	0.13
Dibenzo (a,h) anthracene	112	0.72	0.13	0.15
Indeno (1,2,3-cd) pyrene	112	0.57	0.19	0.24
Beryllium	103	0.62	0.00	0.38
Cadmium	103	0.31	0.00	0.69
Nickel	103	0.01	0.00	0.99
Lead	103	0.05	0.00	0.95
Zinc	100	0.01	0.00	0.99
Formaldehyde	88	0.55	0.00	0.45
Oil and grease	78	0.10	0.00	0.90
Petroleum hydrocarbons	77	0.04	0.00	0.96

Table A.10 Comparison of the distribution of soil concentrations to the MADEP Reporting Standard

		Quantiles for the following percentiles of F_N						MADEP S -1
Compound	n	20th	40th	60th	80th	90th	Max.	Standard
Methylene chloride	38	19	47	76	160	200	250	100
Trichloroethene	1	1,200	1,200	1,200	1,200	1,200	1,200	400
4-methyl-2-pentanone	4	3	19	19	110	1,200	1,200	500
Naphthalene	43	680	1,640	4,800	14,000	20,000	150,000	4,000
Benzo (a) anthracene	35	610	980	1,480	4,000	8,700	41,000	700
Benzo (a) pyrene	20	570	660	1,100	3,000	6,700	24,000	700
Benzo (b,k) fluoranthene	41	480	950	1,630	8,740	13,000	182,900	700
Chrysene	15	800	940	2,900	7,200	10,000	26,000	7,000
Dibenzo (a,h) anthracene	17	151	331	500	1,410	2,000	25,700	700
Indeno (1,2,3-cd) pyrene	27	417	600	1,100	3,600	6,700	97,500	700
Beryllium	39	0.26	0.34	0.45	0.6	0.82	2.8	0.7
Cadmium	71	0.6	0.91	1.3	2.3	3.3	54	30
Nickel	102	6.1	7.8	10	14	19	640	300
Lead	98	8.5	22.9	78	260	351	4,900	300
Zinc	99	18.4	42	110	440	801	11,975	2,500
Formaldehyde	40	0.6	1.1	1.8	3.5	5.1	220	100
Oil and grease	70	527	1,580	4,950	9,930	18,700	81,700	-
Petroleum hydrocarbons	74	10	94	384	1,109	2,118	7,950	-

F_M computed from empirical distribution function. Reporting limits are given by the City of Cambridge

Table A.11 Groundwater - Estimated probabilities for three categories non-detect, detect, and measurable for a sampling visit

Compound	# Sampling visits	Probability of no detect	Probability of detect	Measurable
1,1-dichloroethene	101	0.97	0.00	0.03
Carbon tetrachloride	101	0.98	0.00	0.02
Naphthalene	94	0.56	0.06	0.37
Benzo (a) anthracene	94	0.90	0.04	0.05
Benzo (a) pyrene	94	0.88	0.07	0.04
Benzo (b,k) fluoranthene	94	0.85	0.06	0.09
Chrysene	94	0.87	0.05	0.07
Benzo (ghi) perylene	94	0.95	0.03	0.02
Phenanthrene	94	0.88	0.02	0.10
Dibenzo (a,h) anthracene	94	0.98	0.01	0.01
Indeno (1,2,3-cd) pyrene	94	0.93	0.04	0.03
Bis (2-ethylhexyl) phthalate	59	0.83	0.05	0.12
Diethyl phthalate	94	0.99	0.00	0.01
Cadmium	70	0.81	0.00	0.19
Mercury	70	0.97	0.00	0.03
Nickel	70	0.74	0.00	0.26
Lead	70	0.76	0.00	0.24
Selenium	67	0.91	0.00	0.09
Zinc	58	0.07	0.00	0.93
Formaldehyde	60	0.65	0.00	0.35

See Table A.12 for the probability that a well had at least one detect

Samples with measurable concentration levels can be used to estimate the frequency that concentration levels occurred at sampling locations. For groundwater, the average over time is used for wells with multiple samples. These estimates, called empirical distribution functions, are plotted in Figures A.1 through A.4 for soil and groundwater samples for naphthalene and formaldehyde.

Naphthalene ppb in soil

Whittemore Ave.

western Grace border

← N

Legend:

- No detect = +
- Present = P
- Conc. < 680 = 1
- Conc. < 1640 = 2
- Conc. < 4800 = 3
- Conc. < 14000 = 4
- Conc. < 150000 = 5

DEP S-1

Empirical Distn Function

RA

Conc. of Naphthalene ppb in soil

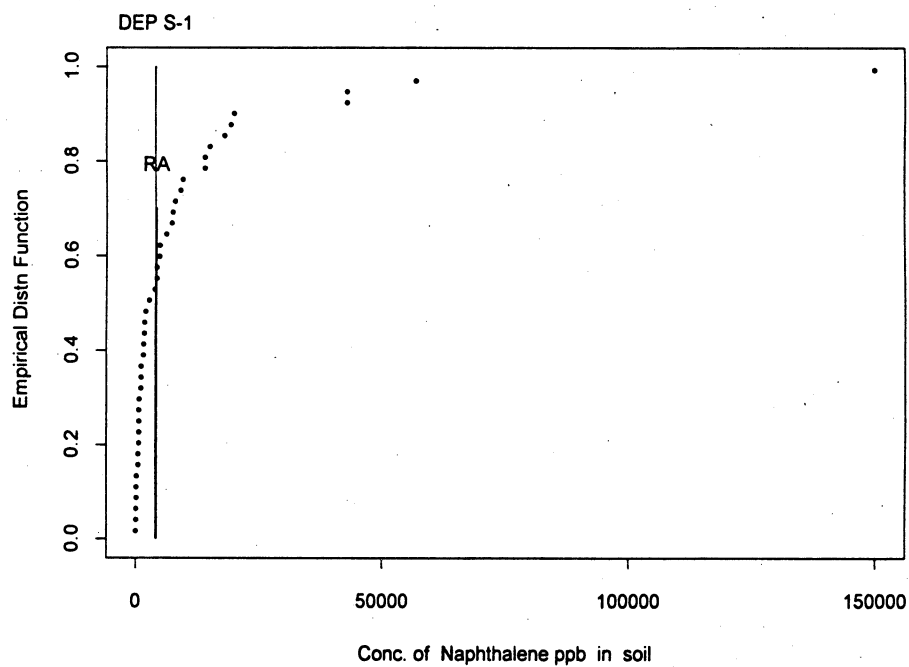


Figure A.2 Spatial Map and Empirical Distribution Function for Formaldehyde in Soil

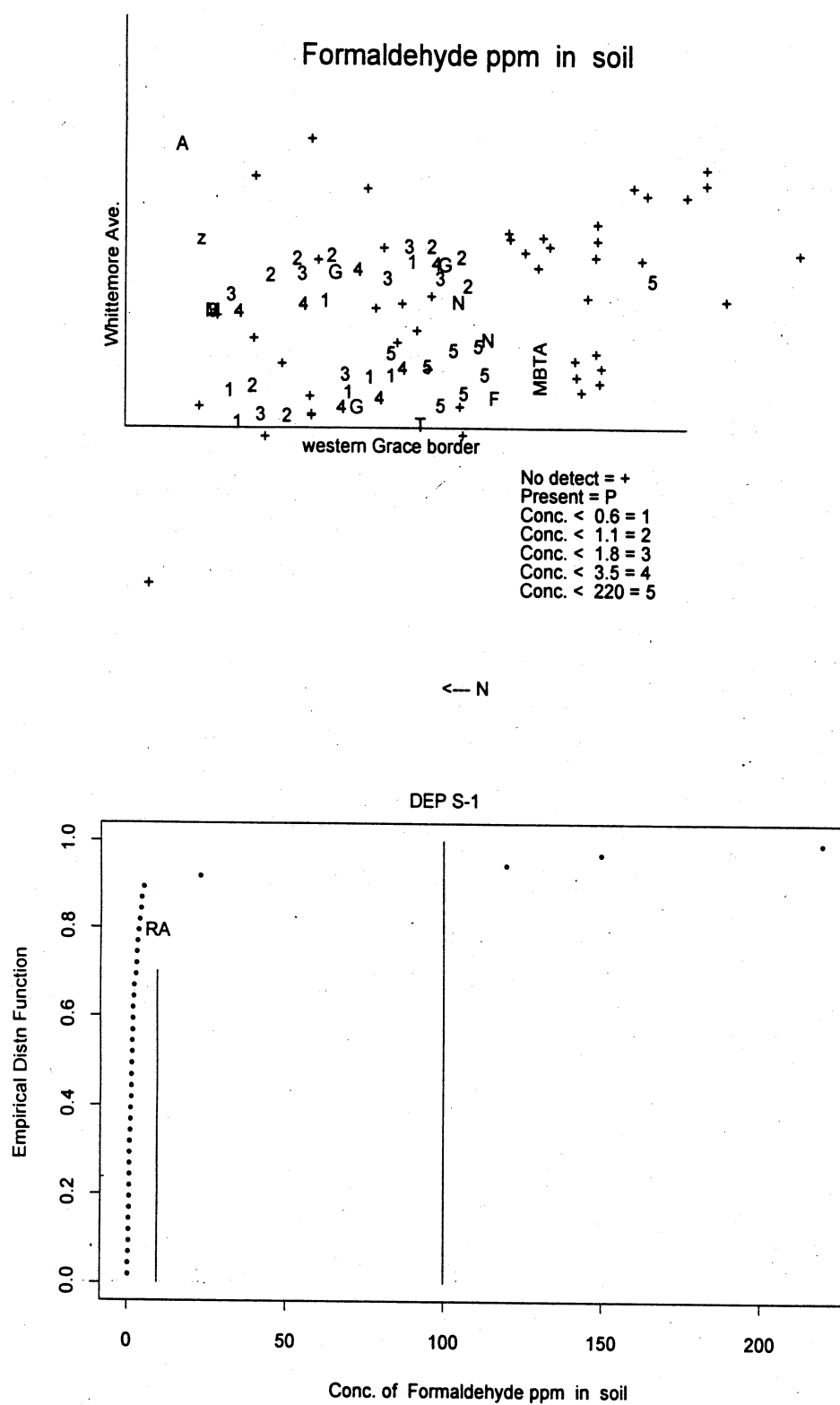


Figure A.3 Spatial Map and Empirical Distribution Function for Naphthalene in Groundwater

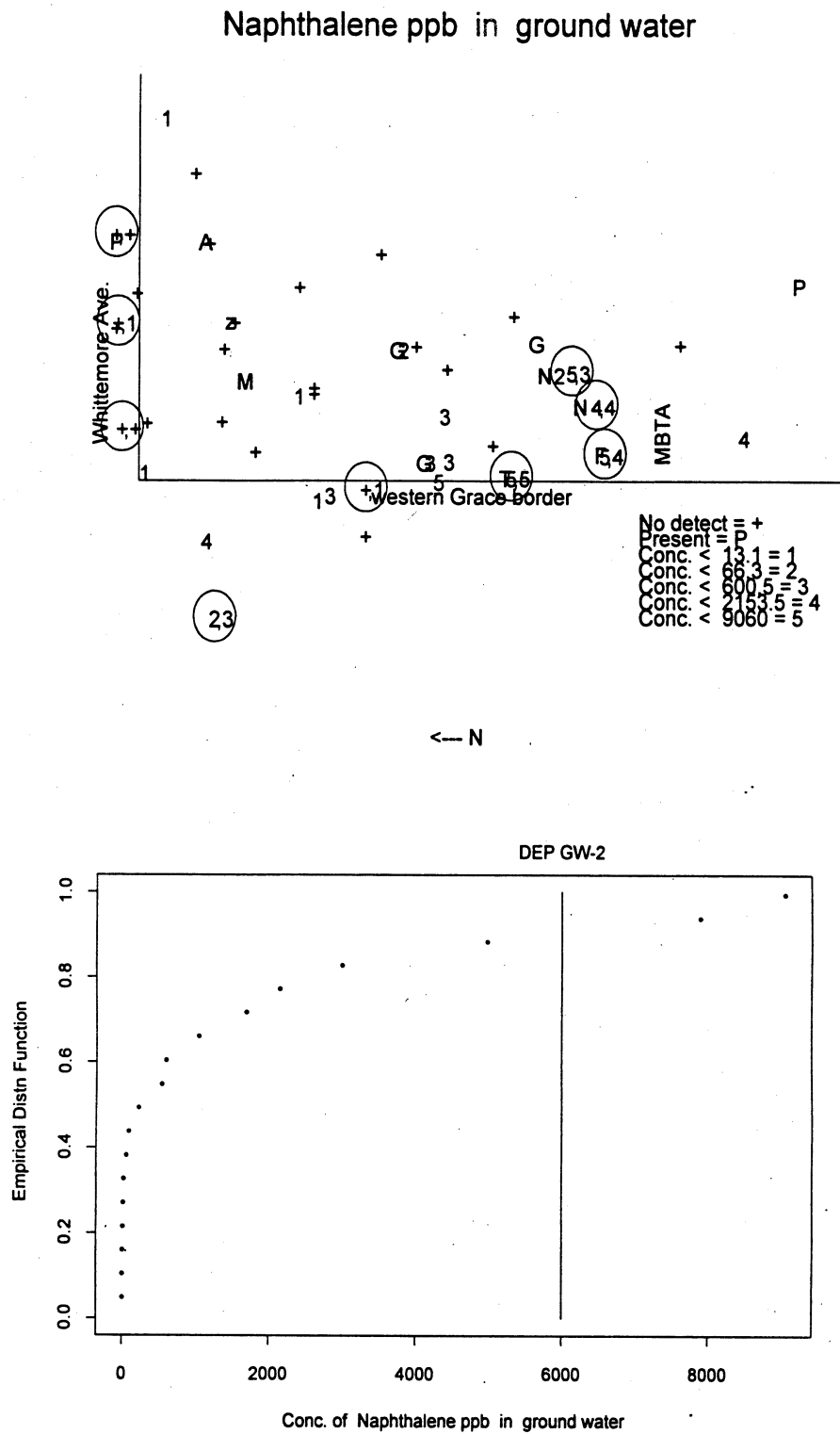
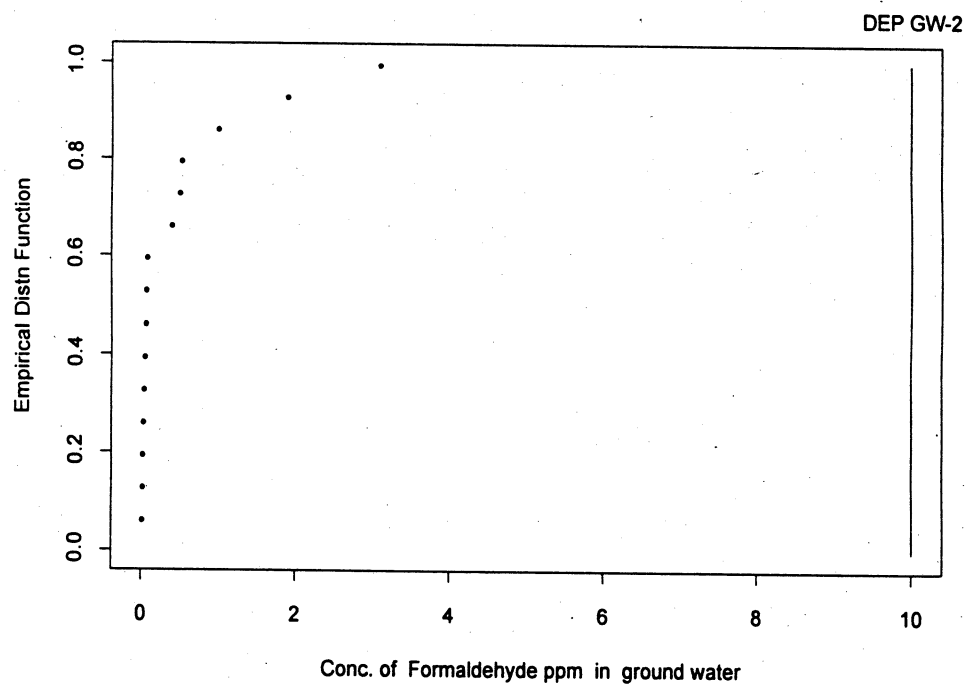
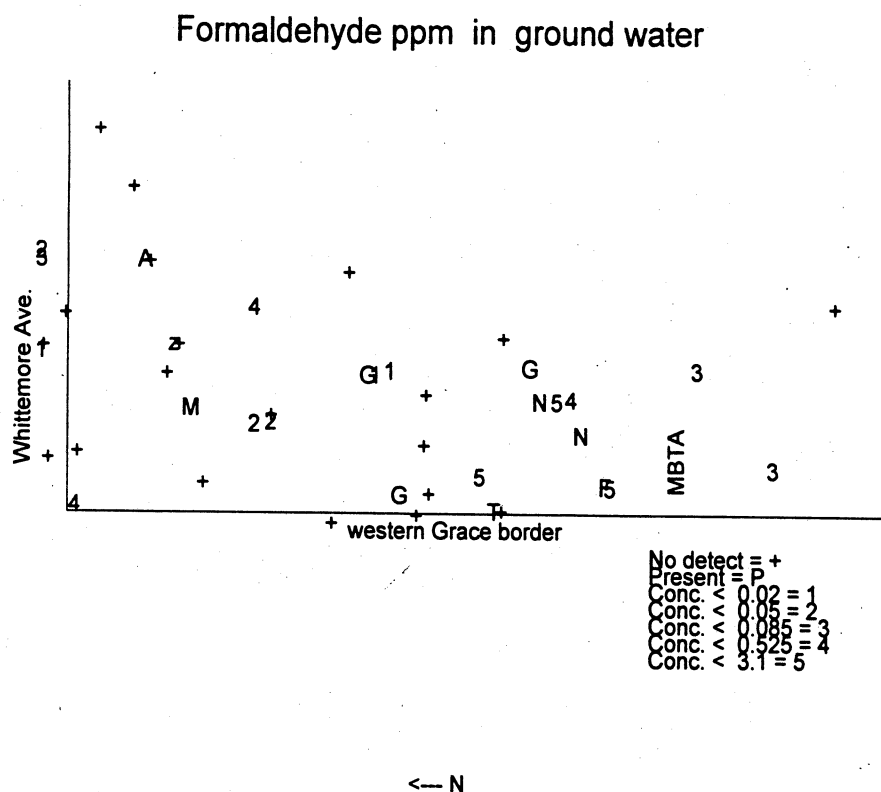


Figure A.4 Spatial Map and Empirical Distribution Function for Formaldehyde in Groundwater



A.6 SPATIAL AND TEMPORAL ANALYSES

Spatial maps of the concentration levels for groundwater and soil samples have been generated. Figures A.1 through A.4 show the maps for soil and groundwater samples for naphthalene and formaldehyde. The characters on the map represent the following: + is a non-detect, P is a detect, 1-5 indicate whether the measurable concentration value observed at the site is less than or between the 20th, 40th, 60th, 80th, or 100th percentile concentrations observed. Locations of storage facilities are also given. The codes for these are: A = acetone, M = methanol, F = formaldehyde, G = fuel, N = naphthalene, z = zinc, and T is for tanks that held a number of different compounds.

A simple representation of time trends is given in Figure A.3 for naphthalene in groundwater. The nine wells that were sampled from 1984 to 1994 are circled in Figure A.3. Inside these circles are a pair of numbers separated by a comma. The meaning of these numbers is the same as the others on the plot; however, the first number represents the mean of samples from 1984 to 1987 and the second number represents the mean of samples from 1990 to 1994. No samples were taken in 1988 and 1989. The two wells changed from non-detect to a 1, but this change was less than indicated. This is because there were only one or two samples at these wells in 1984-1987, but nine samples in 1990-1994, of which only two or three samples had detectable levels. If the earlier period had been sampled as frequently as the latter period, it is possible low concentration levels may have occurred.

The probability of at least one detection in repeated groundwater samples of the same wells can be used to indicate differences between wells. It is assumed that the probability of detection is equally likely at any well at any time. From this assumption, the expected probability a well had at least one detection can be computed using the estimate of the probability that a sample had a detectable level of a compound. If the observed probabilities were considerably less than the expected probabilities given in Table A.12, this indicated that samples with detectable concentrations were being observed at certain wells rather than randomly over the W.R. Grace property. This was another indication that concentration levels of these compounds were different across the W.R. Grace property.

Analysis of concentrations that were analyzed for VOCs and naphthalene over time were only available for nine well sites along the north and west borders of the W.R. Grace property from approximately 1985 to 1994. A total of 90 well samples were spread out fairly evenly among the nine well sites. Five compounds, benzene, ethyl benzene, naphthalene, methylene chloride, and total xylenes, had 26, 27, 49, 10, and 10 detects out of the 90 possible visits; all the rest had less than 10. Only naphthalene had observations above MADEP GW2 standards and the maximum concentrations observed for the other compounds were less than 10% of MADEP GW2 standards.

Naphthalene was consistently present in four of the nine sites: B212, B707, B708, and B604. Except B604, which is outside the W. R. Grace property (near the rotary), all sites were close to previous storage sites on the property. None of the sites showed any apparent time trends in concentration levels of naphthalene. It is possible there was an increase over time at well B604. However, one outlier and too few observations preclude a definite assessment. The fact that well B904 is between B604 and the others and showed no detectable concentration levels further weakens any migration hypothesis for naphthalene from the W.R. Grace property. The increase in concentration levels was slight, roughly 20 ppb per year and the maximum concentration level, 950 ppb at well B604, was considerably less than the MADEP GW2 standards (6,000 ppb).

Benzene and ethyl benzene also had a fair number of detects, but were scattered over many sites. Sites B212 and B604 had more detects than other sites, but detection was not consistent from one time to the next. No samples were above MADEP GW2 standards and there was an indication that concentrations were decreasing over time.

In summary, results from soil samples including duplicates indicate that the analytical methods were adequate to determine concentration differences among sites. However, this finding applies only to a few compounds due to the limited number of available data.

Table A.12 Comparison of the distribution of groundwater concentrations to the MADEP Reporting Standard

Compound	20th	40th	60th	80th	90th	Max.	MADEP GW2
Naphthalene (ppb)	13.1	66.3	600.5	2,153.5	4,983.33	9,060	6,000
Benzo (b,k) fluoranthene	3.9	8.7	10.6	21.9	21.9	42.4	7
Chrysene	3.25	4.8	5.7	6.5	6.5	36.3	3
Phenanthrene	5.9	19	23	27.67	27.67	29	50
Bis (2-ethylhexyl) phthalate	6.6	61	74	400	400	460	30
Cadmium	0.85	2.7	10	28	36.6667	560	10
Nickel	13	24	34	61	120	342.5	80
Lead	29	50	60	195	290	430	30
Zinc	48	130	380	850	2,900	9,600	900
Formaldehyde (ppm)	0.02	0.05	0.085	0.525	1.9	3.1	10

Only compounds with at least six sites with measurable concentrations are included. The mean value for each site does not include non-detects in estimates. Last column is the MADEP GW2 standards.

Table A.13 Comparison of observed and estimated probability of measuring a compound at a groundwater well site

Compounds	# Sites	Observed	Expected
1,1-dichloroethene	44	0.07	0.07
Carbon tetrachloride	44	0.05	0.04
Naphthalene	43	0.42	0.67
Benzo (a) anthracene	43	0.12	0.19
Benzo (a) pyrene	43	0.09	0.23
Benzo (b,k) fluoranthene	43	0.16	0.29
Chrysene	43	0.14	0.25
Benzo (ghi) perylene	43	0.05	0.11
Phenanthrene	43	0.14	0.23
Dibenzo (a,h) anthracene	43	0.02	0.05
Indeno (1,2,3-cd) pyrene	43	0.07	0.15
Bis (2-ethylhexyl) phthalate	36	0.19	0.25
Diethyl phthalate	43	0.02	0.02
Cadmium	38	0.26	0.30
Mercury	38	0.05	0.05
Nickel	38	0.39	0.40
Lead	38	0.39	0.38
Selenium	38	0.13	0.15
Zinc	37	0.97	0.96
Formaldehyde	35	0.43	0.49

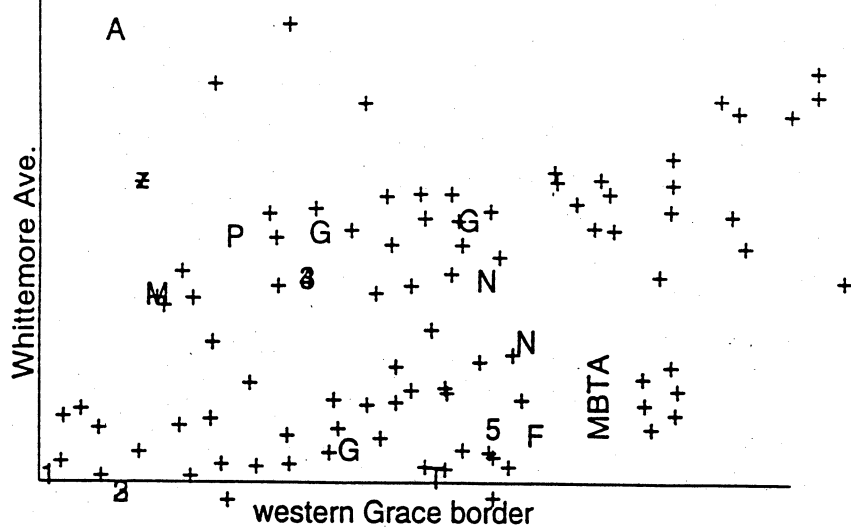
First column is the number of wells that had at least one sample over time sampled for the compound. Second column is the observed probability that a well had at least one detect. The last column is the expected probabilities based on random distribution, when observed was less than expected indicating non-random spatial distribution of compound across the site.

APPENDIX B

SUPPLEMENTAL INFORMATION

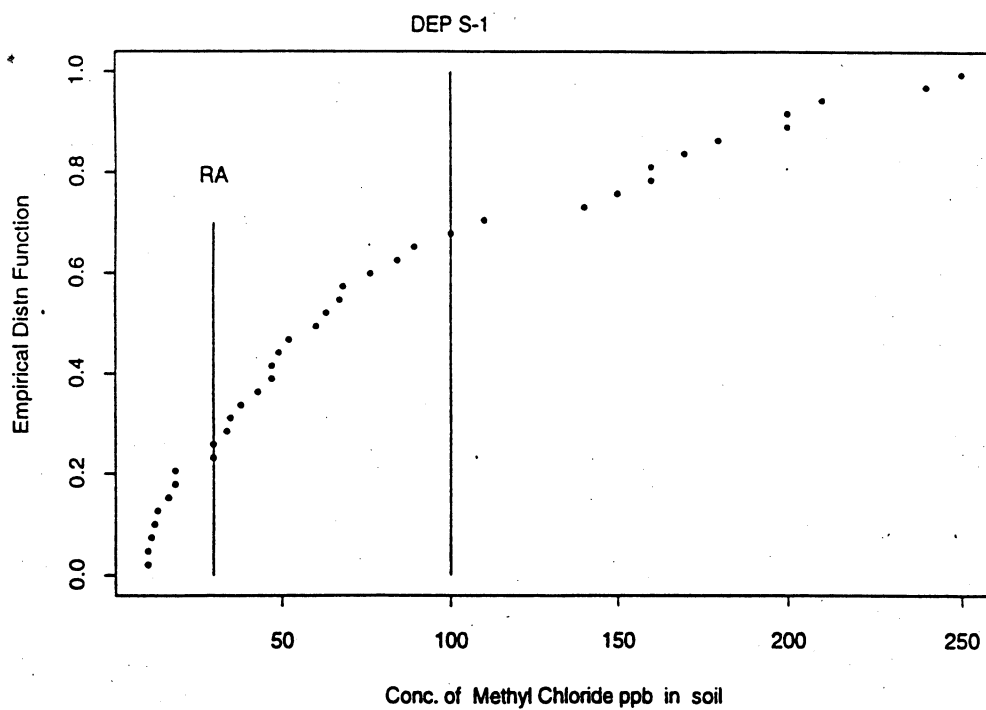
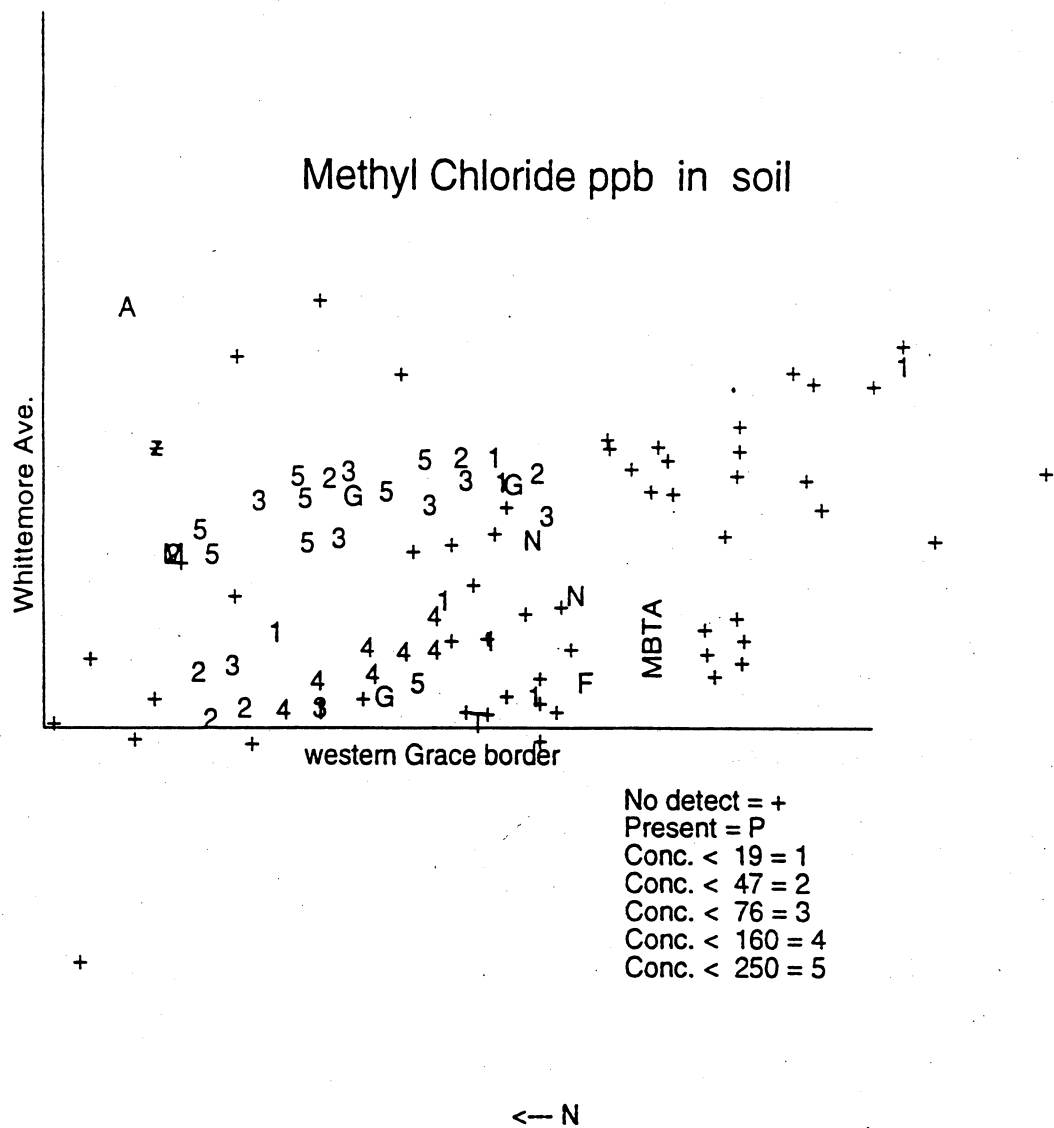
**SOIL AND GROUNDWATER DATA: SPATIAL AND
DISTRIBUTIONAL DISPLAYS**

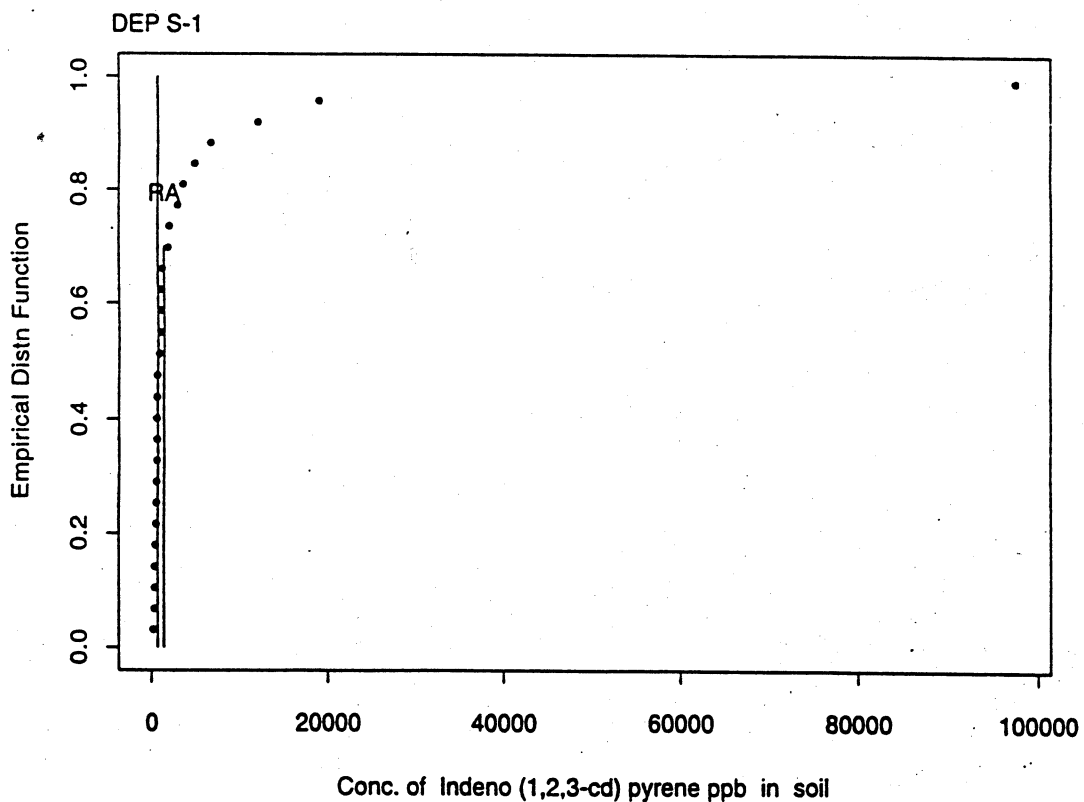
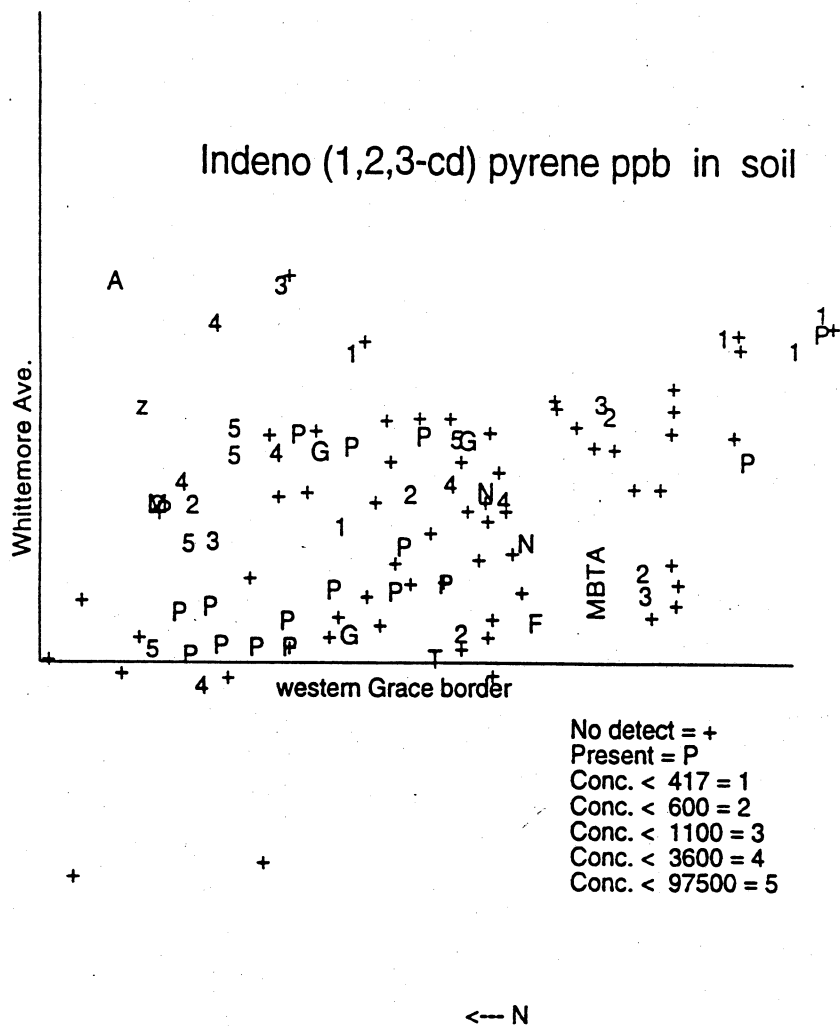
4-Methyl-2-Pentanone ppb in soil



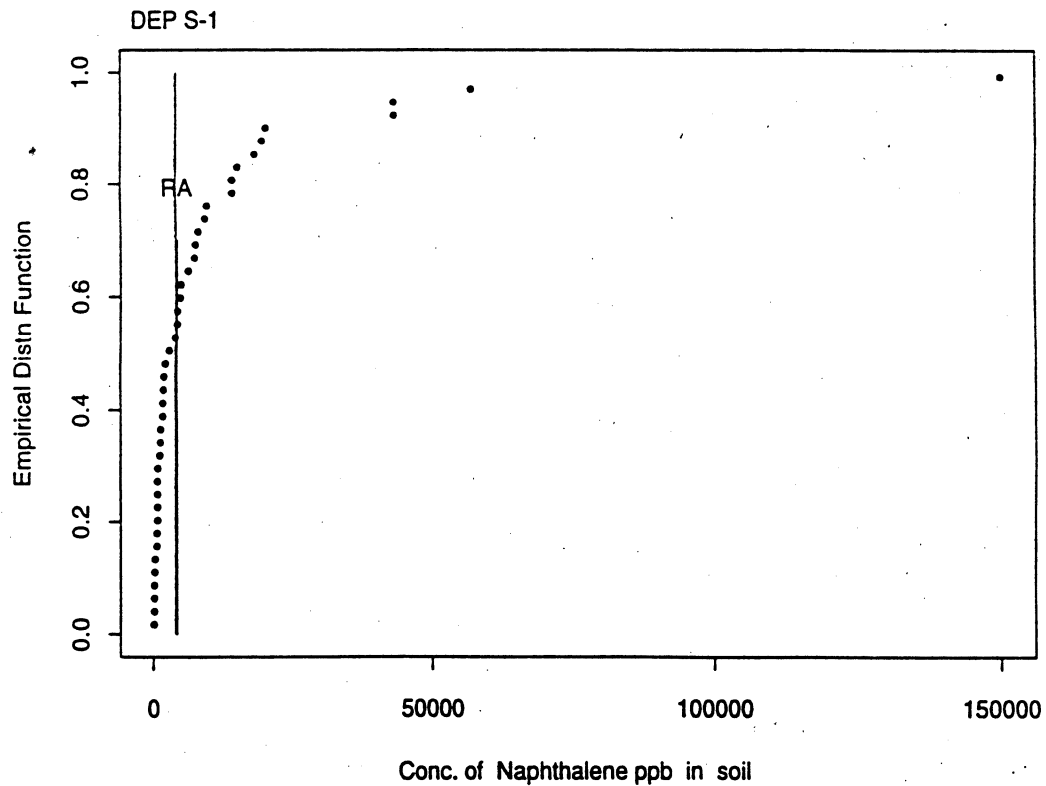
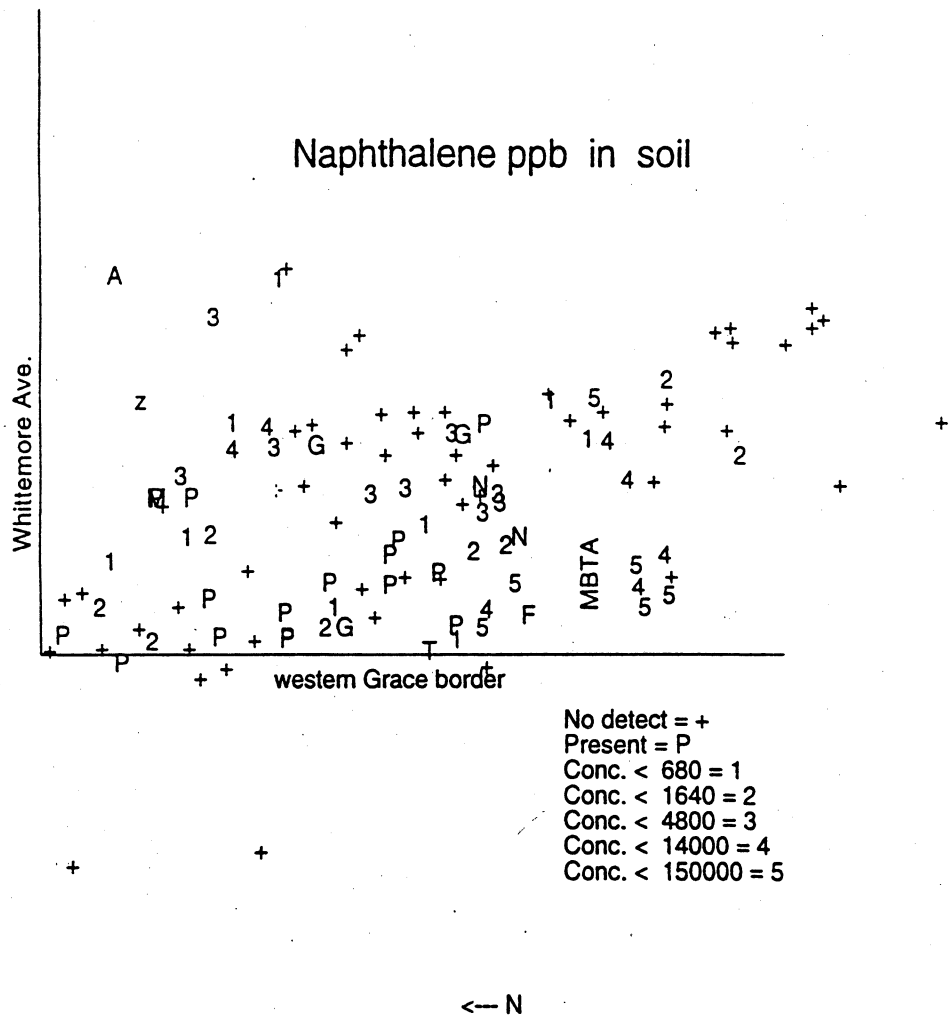
No detect = +
 Present = P
 Conc. < 3 = 1
 Conc. < 19 = 2
 Conc. < 19 = 3
 Conc. < 110 = 4
 Conc. < 1200 = 5

← N





Naphthalene ppb in soil



Benzo (a) anthracene ppb in soil

Whittemore Ave.

A

4

z

4 P P+ G P + P + SG +

5 5 4 P + + 3 2 N 1

5 2 3 3 1 2 P P P 5 + G + T I 3 P F

MBTA

2 3 P

++ ++ 1 P⁴

P

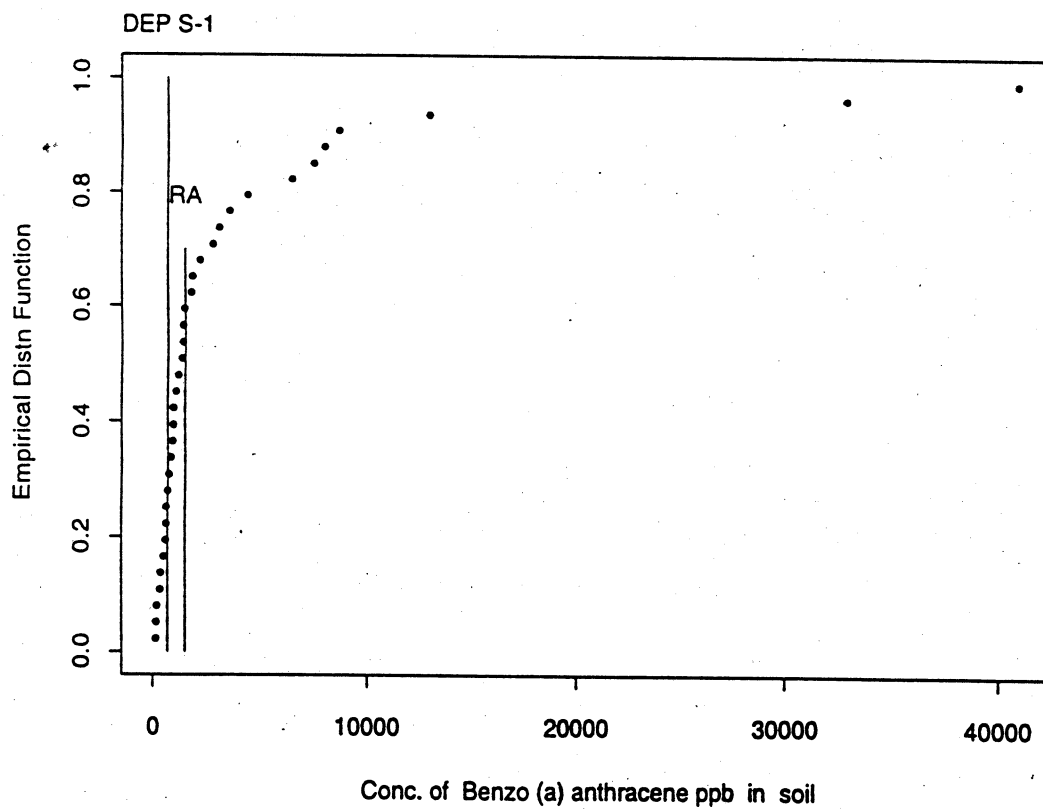
+

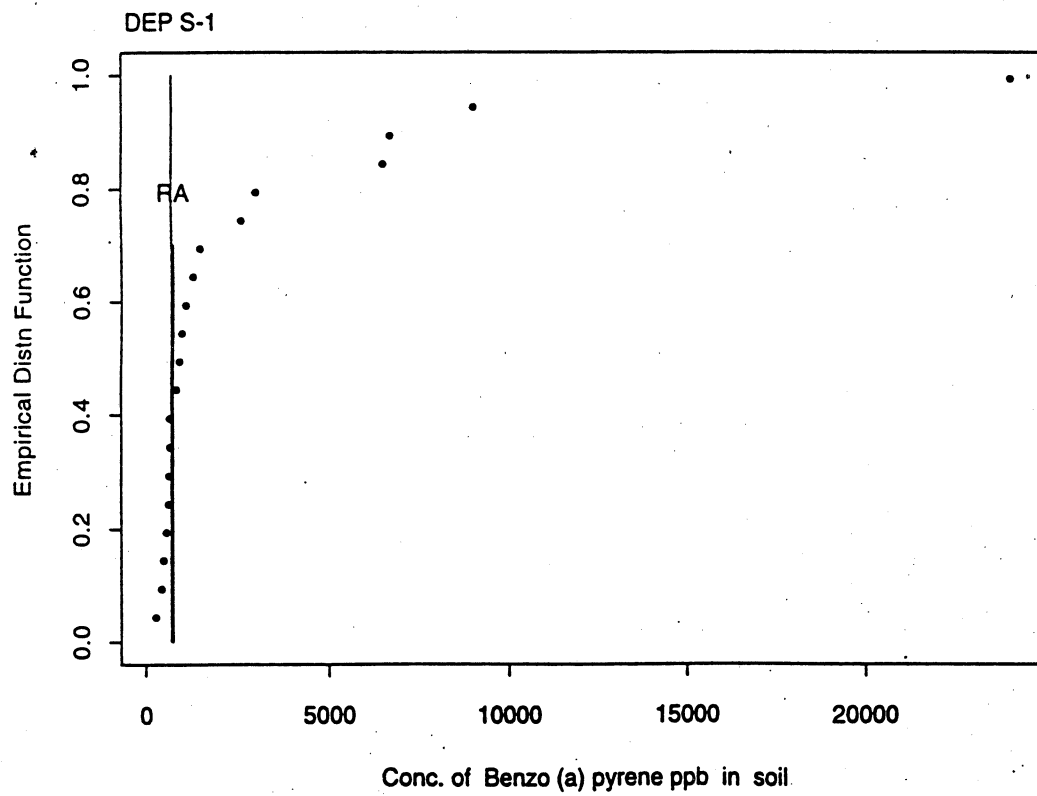
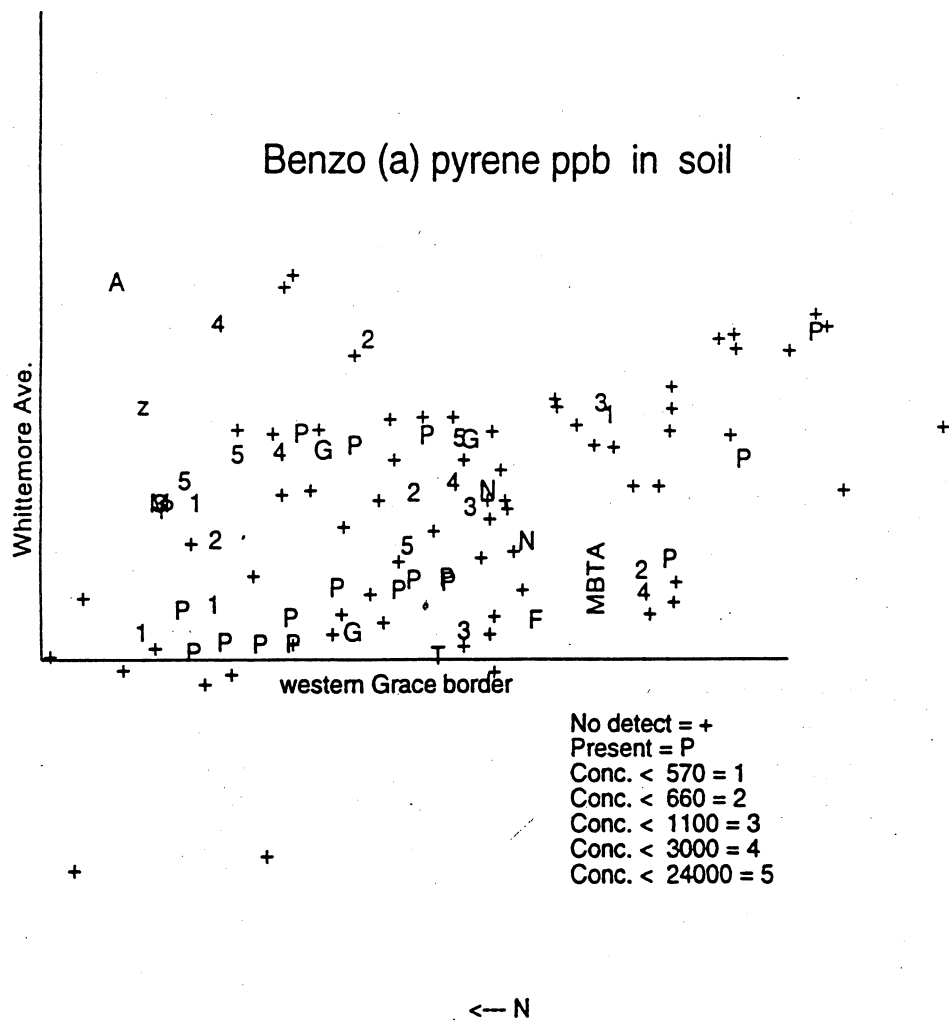
western Grace border

3

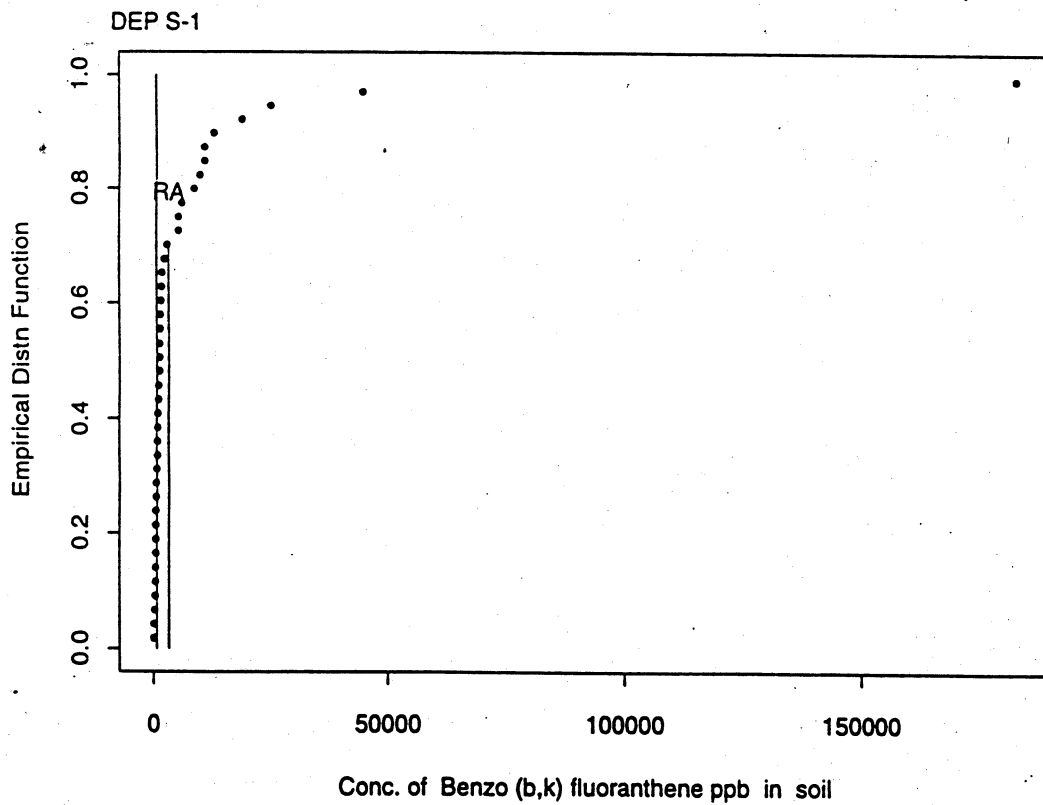
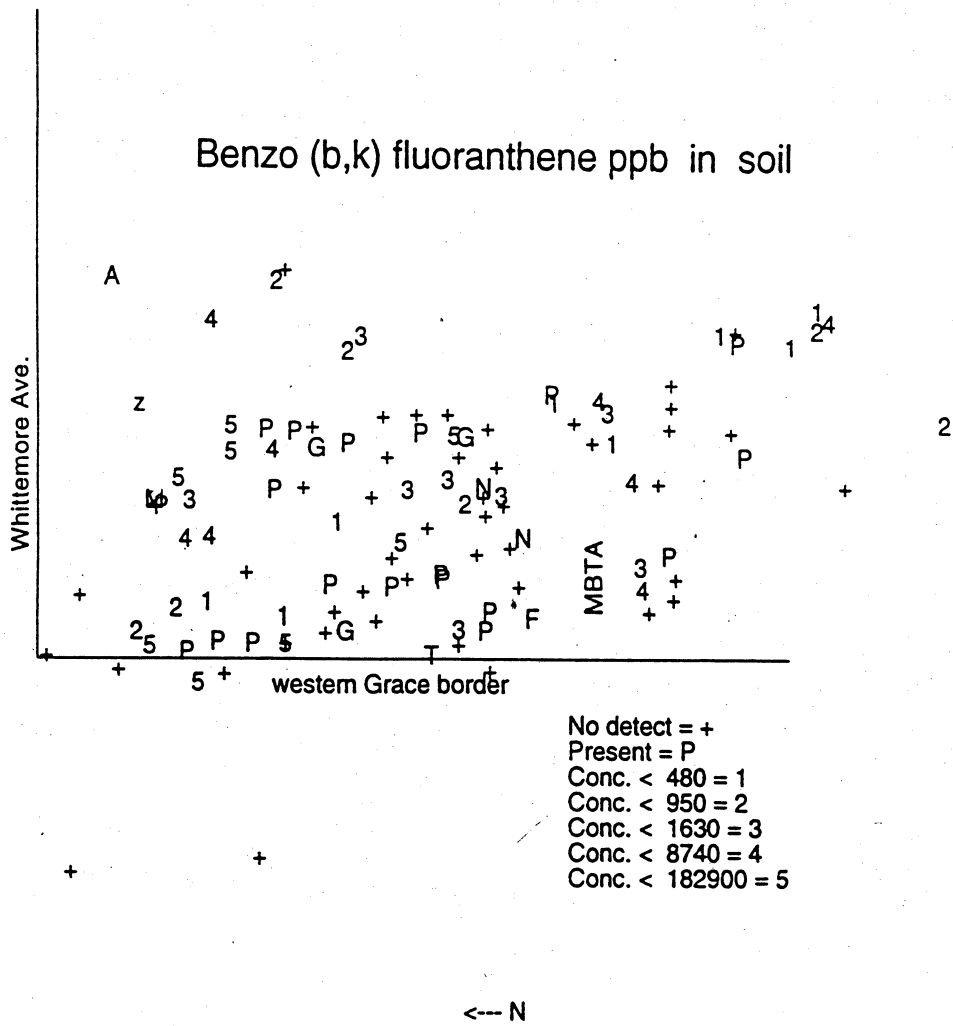
<-- N

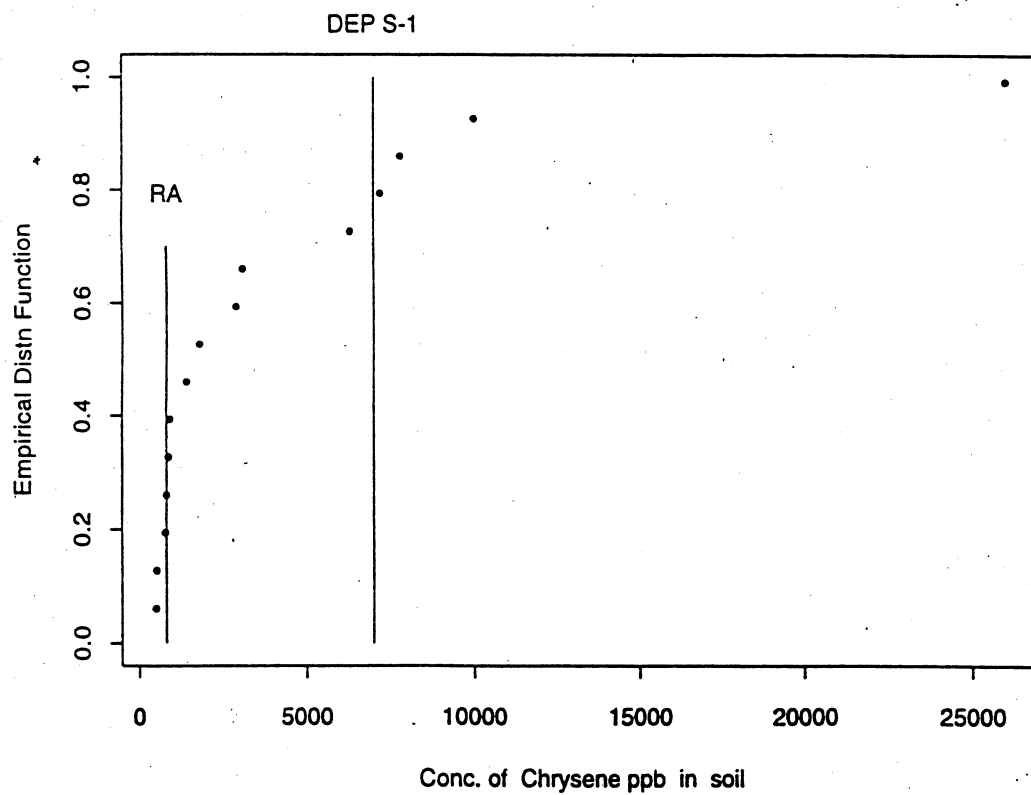
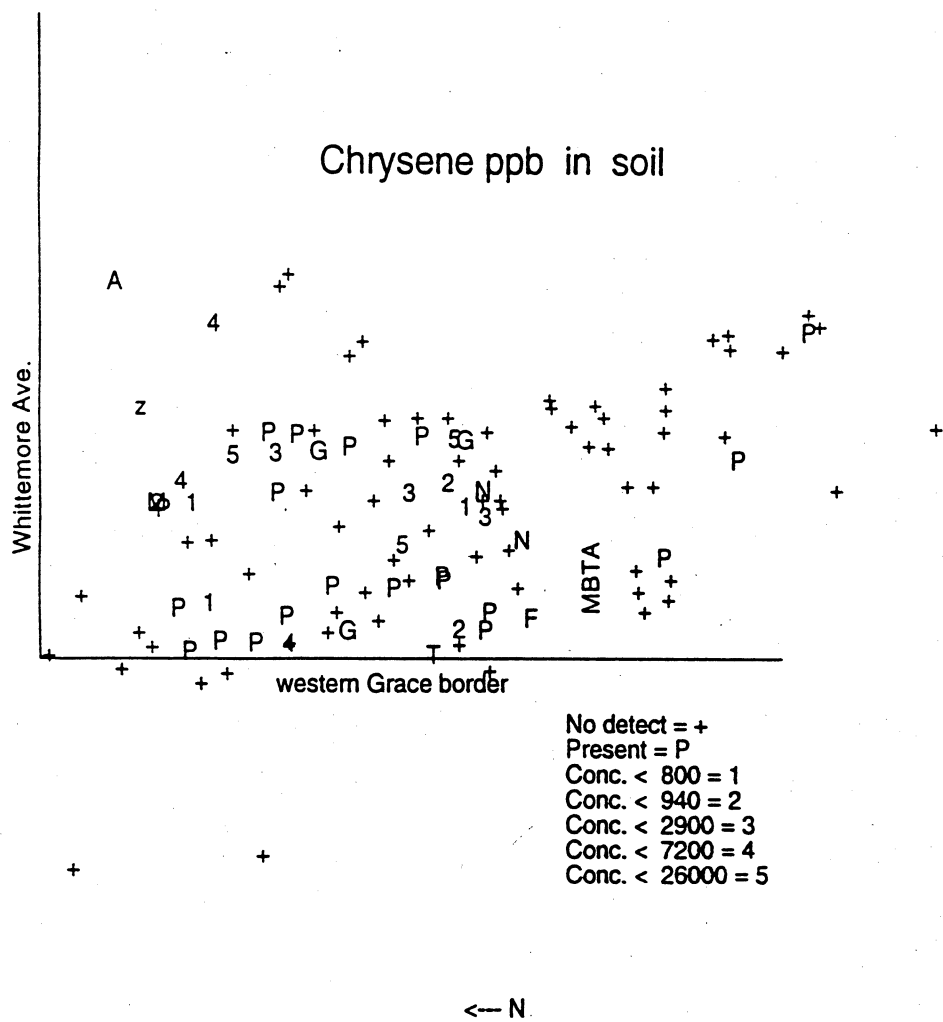
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- Conc. < 1480 = 3
- Conc. < 4400 = 4
- Conc. < 41000 = 5

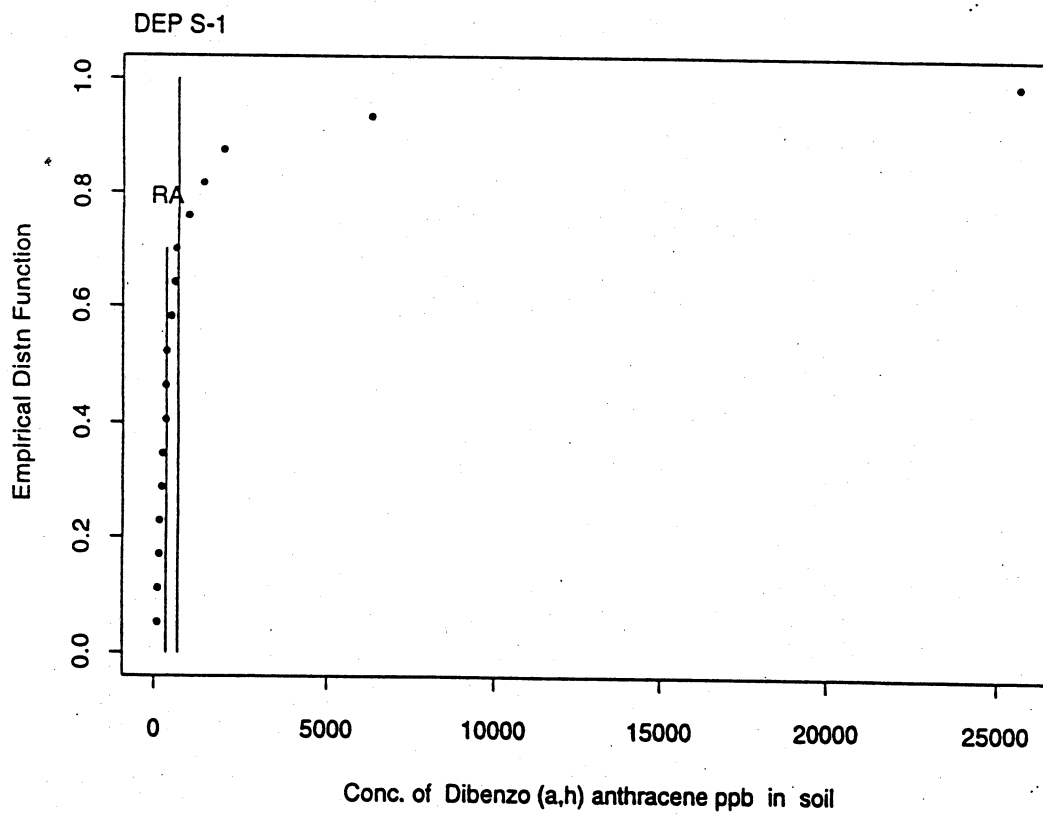
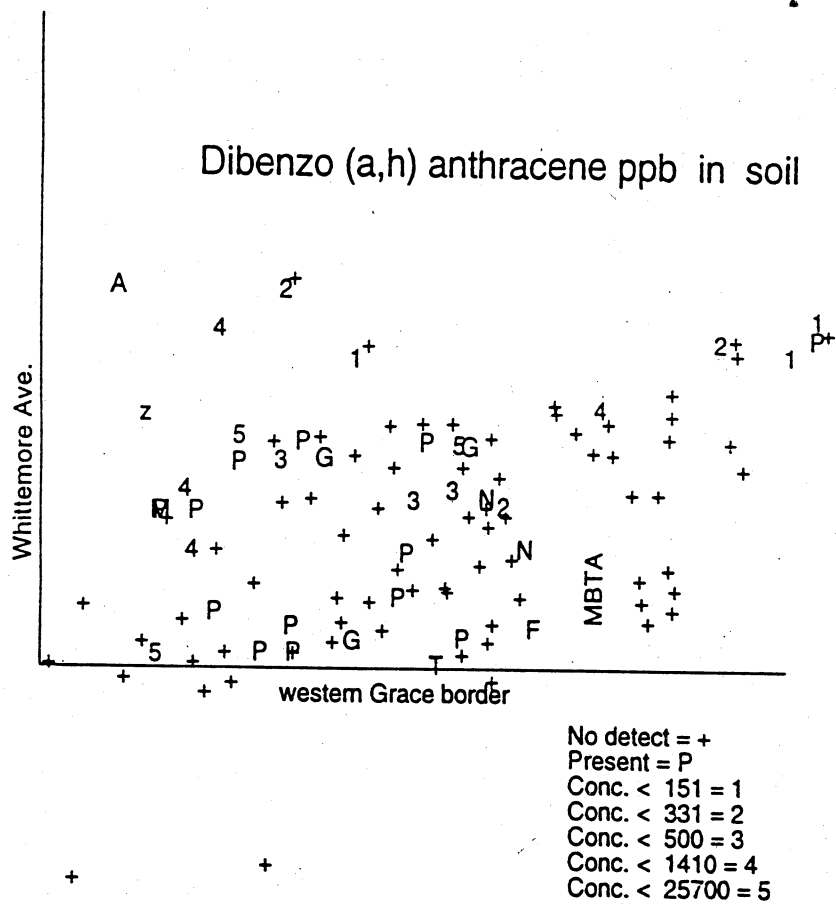


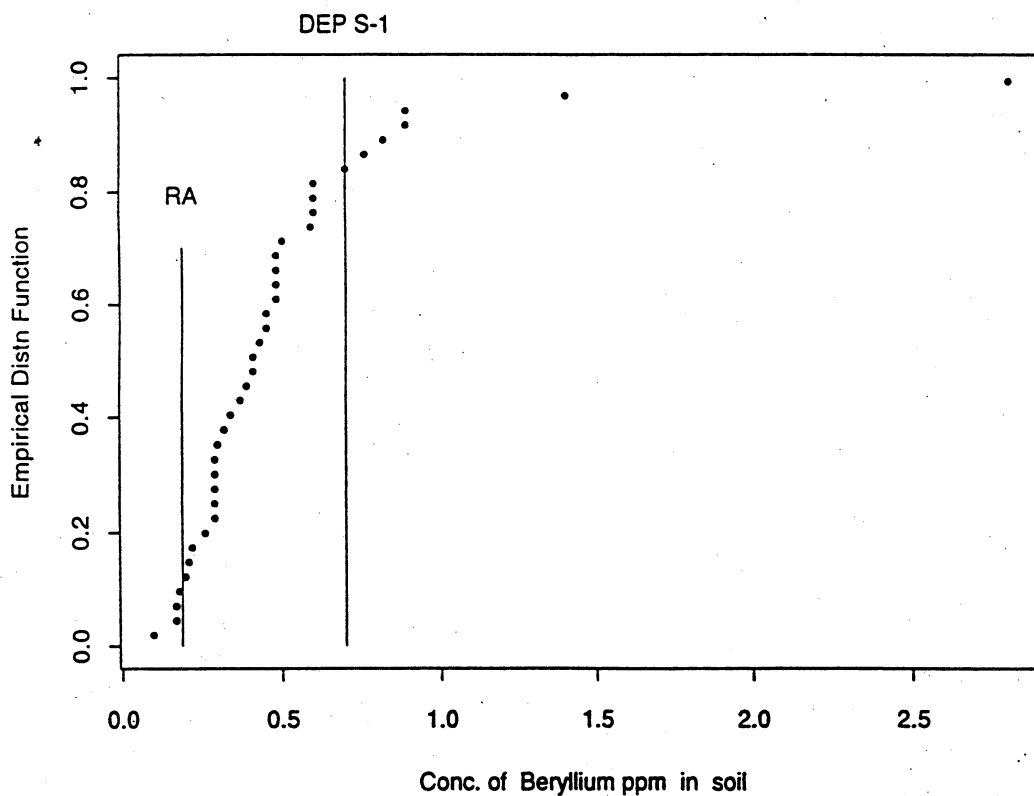
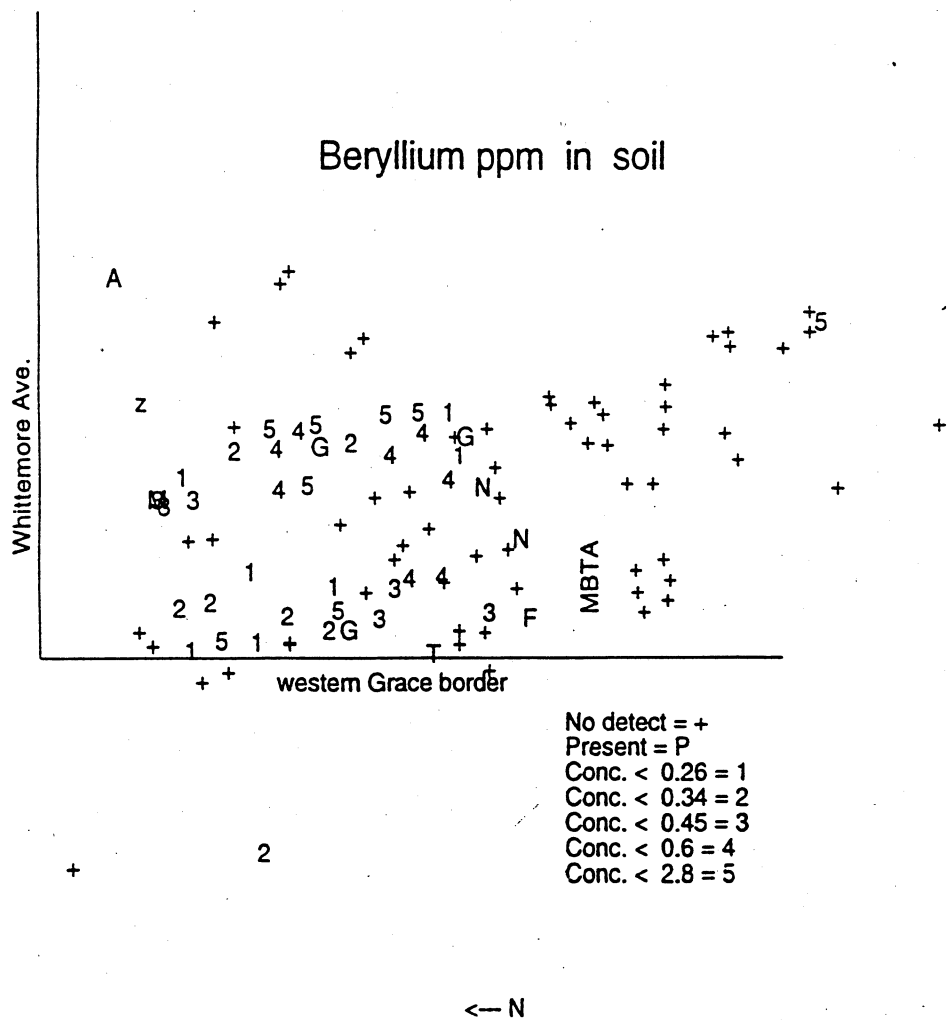


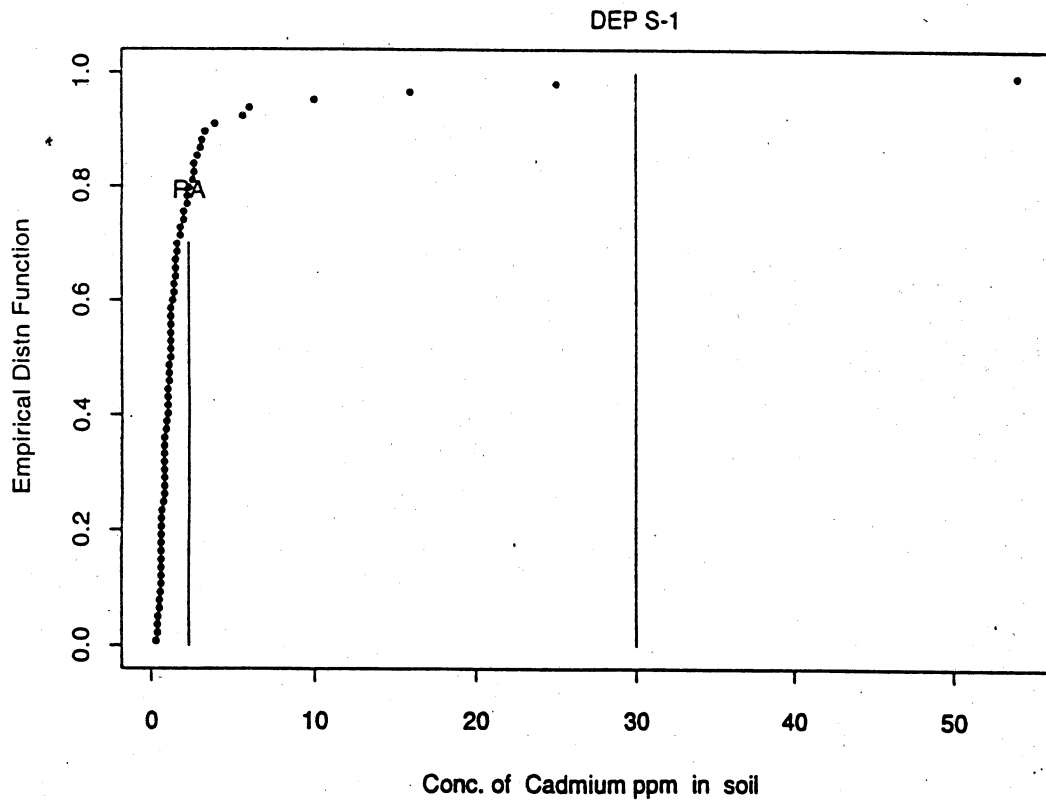
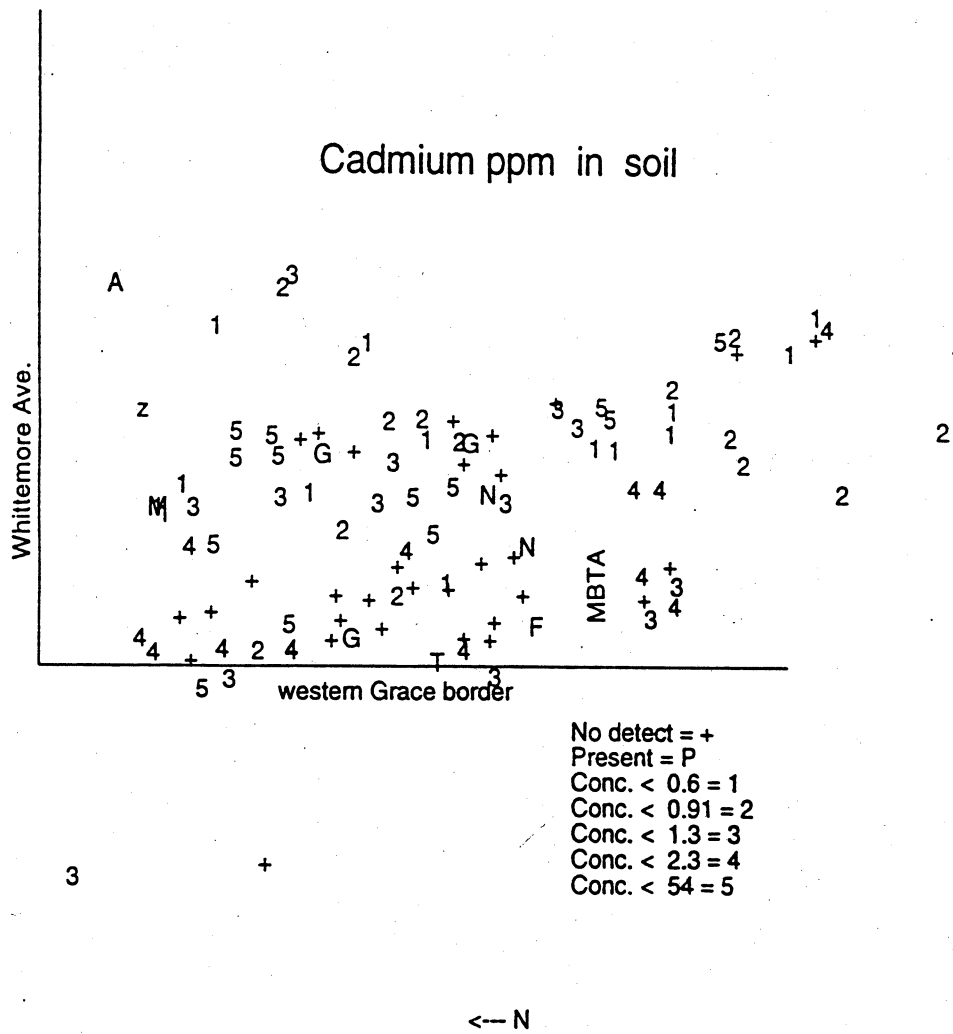
Benzo (b,k) fluoranthene ppb in soil

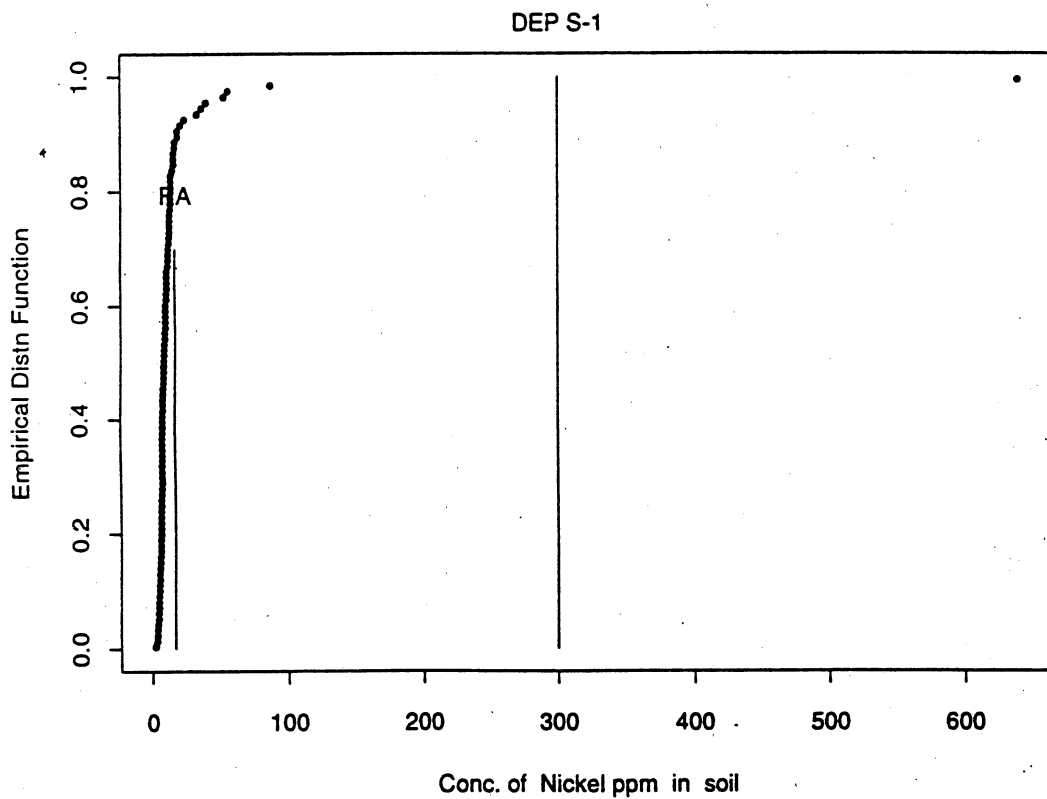
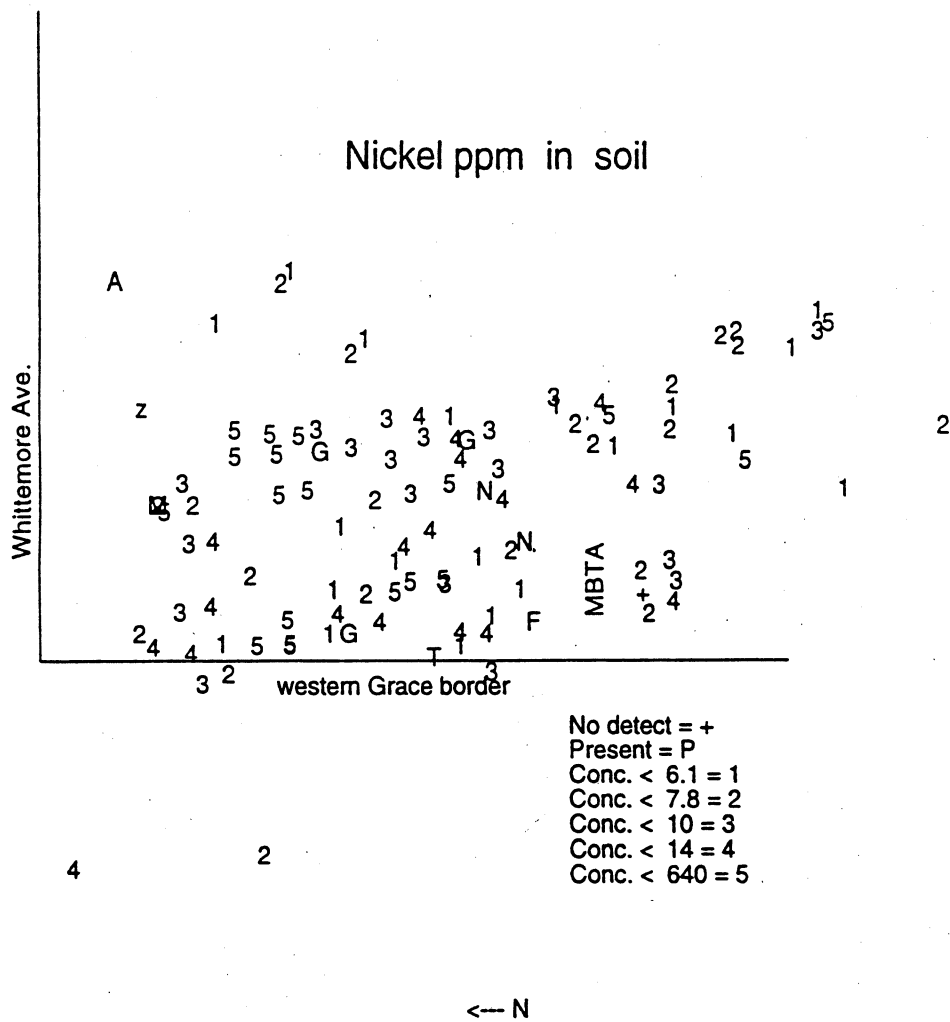


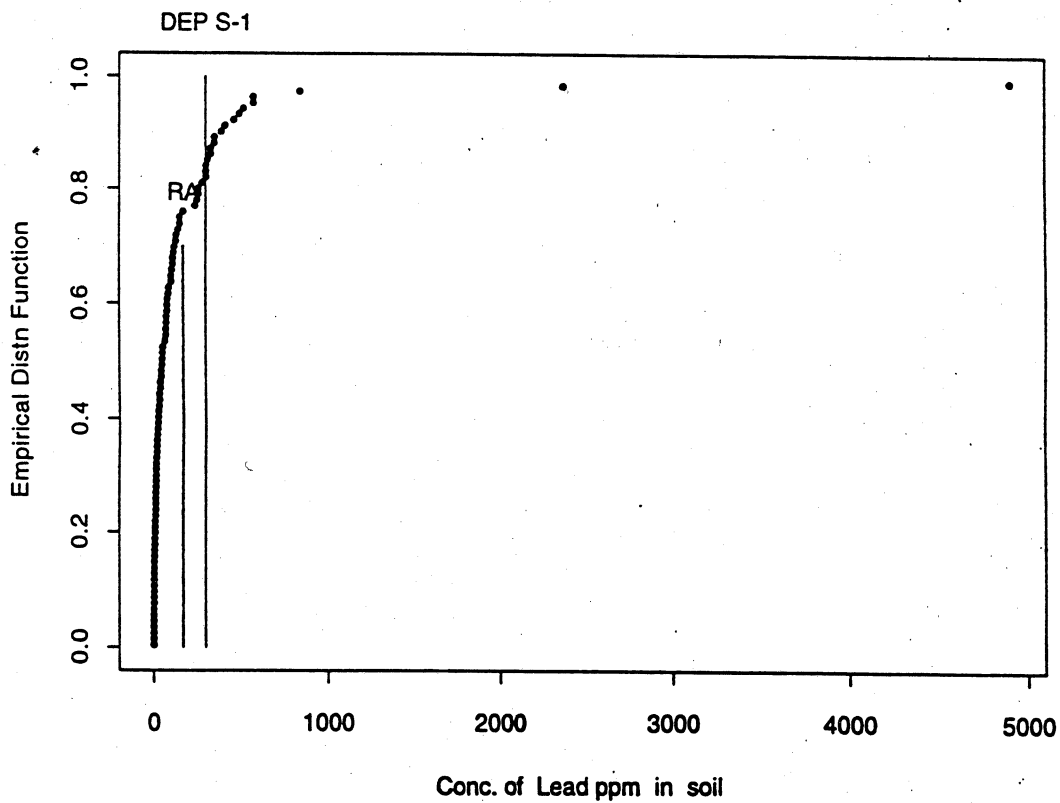
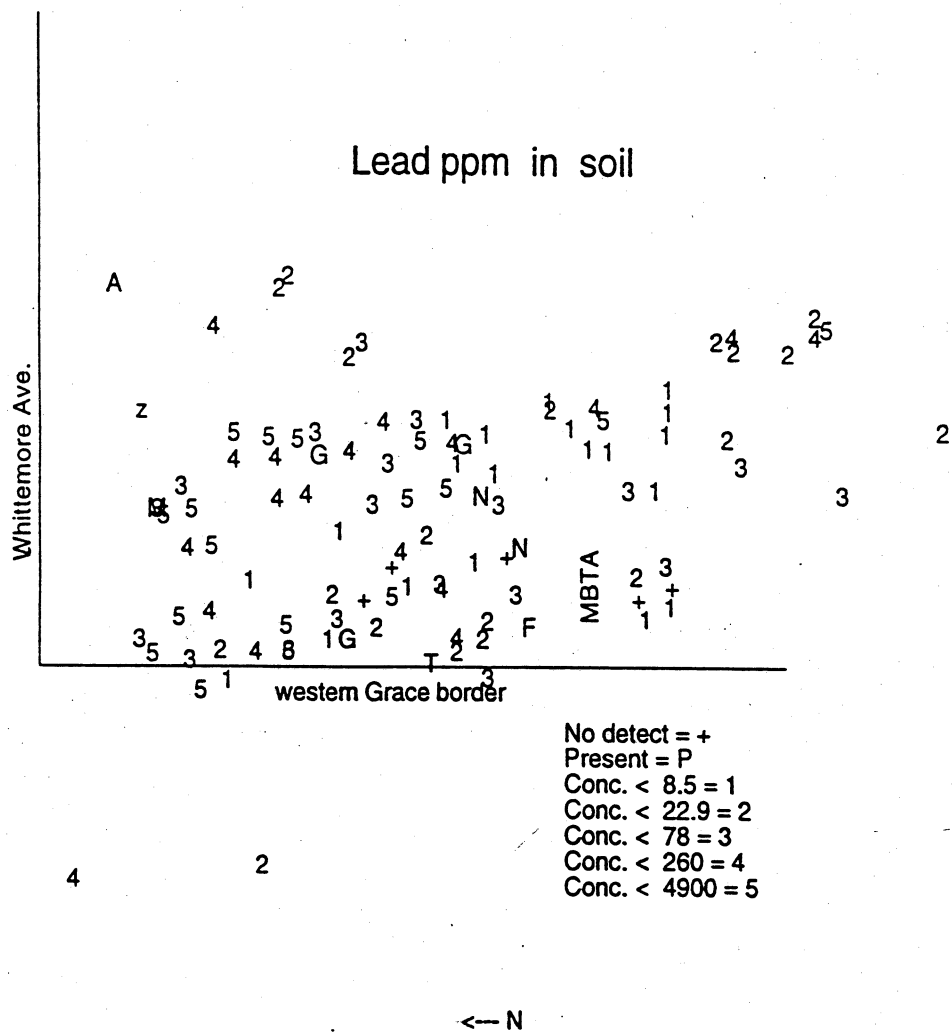


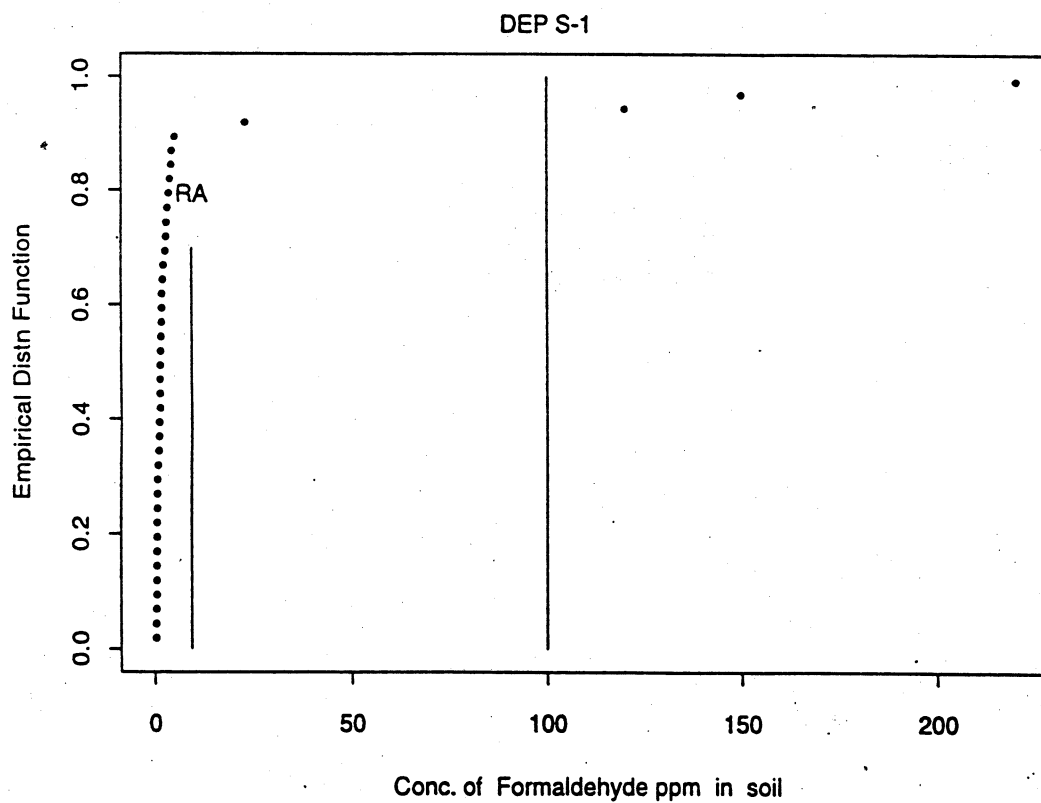
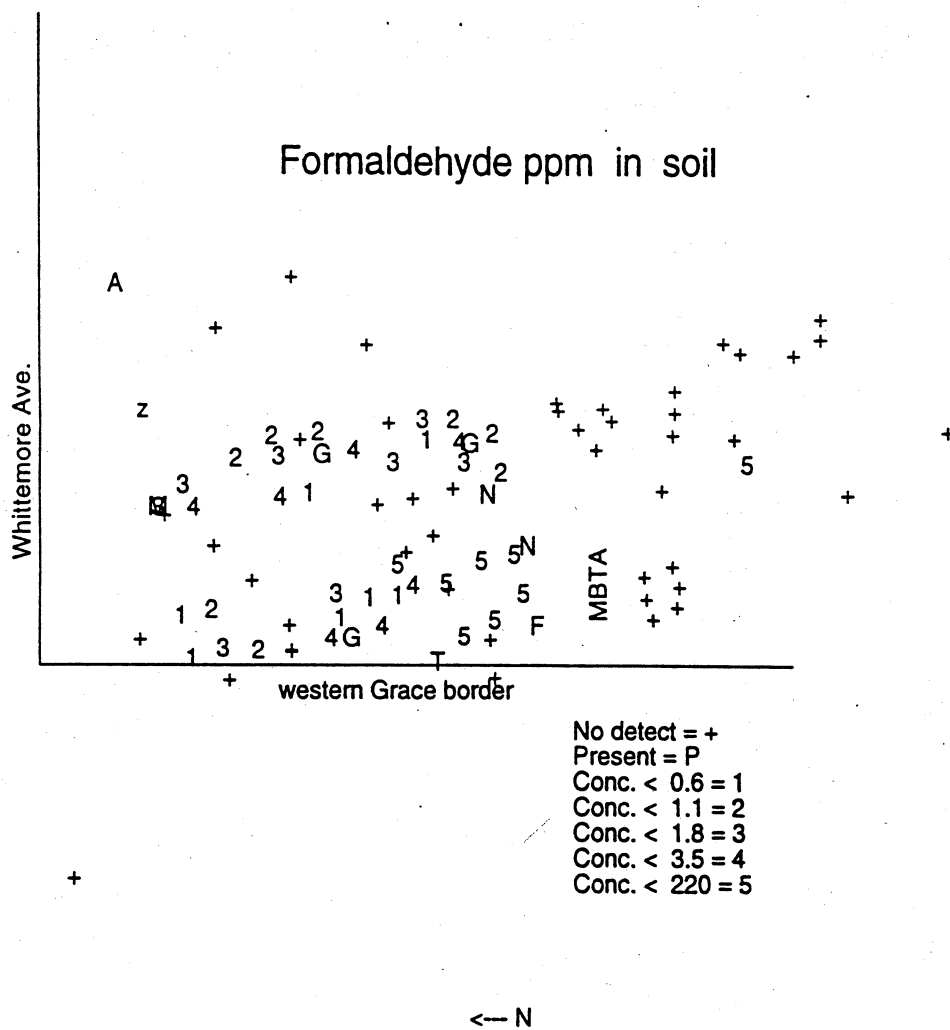


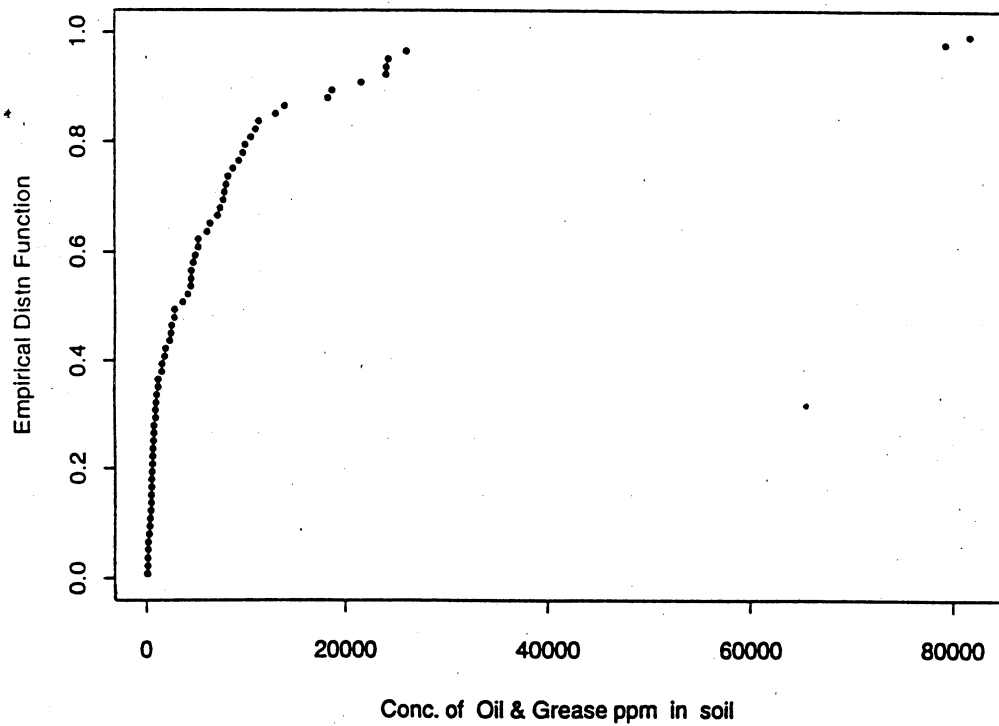
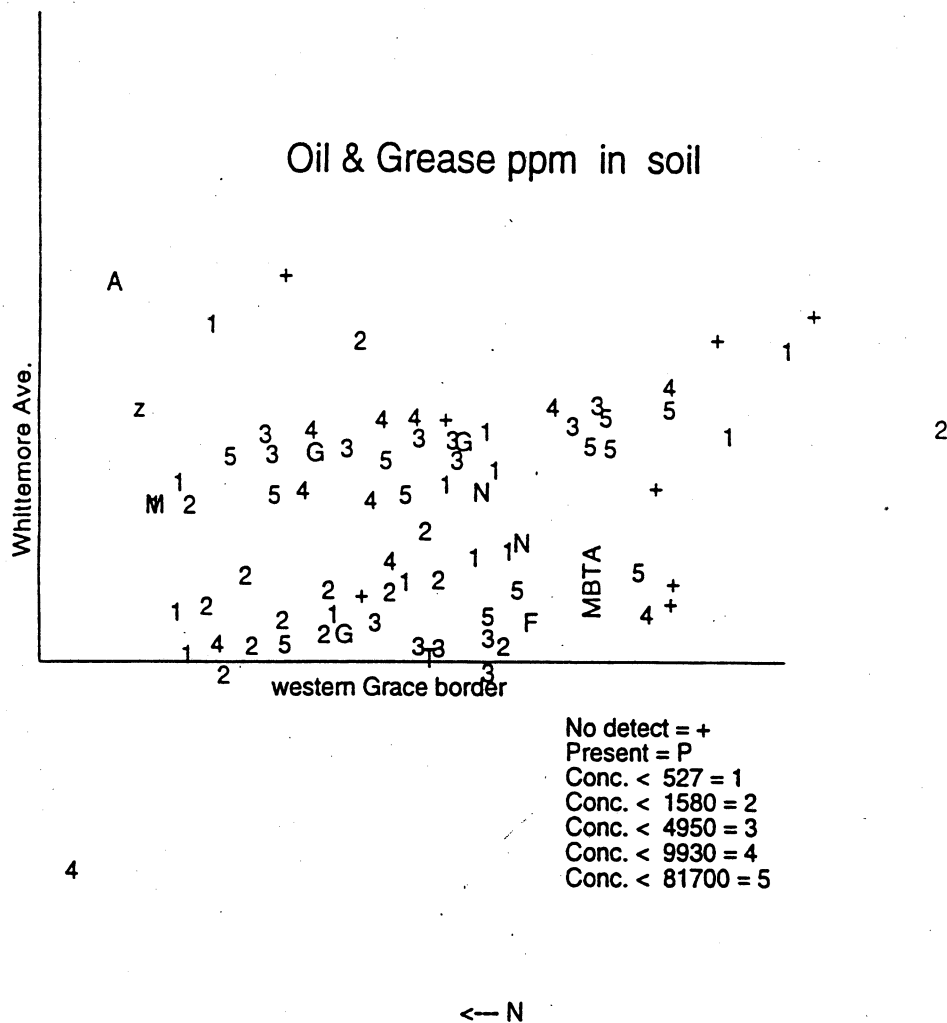




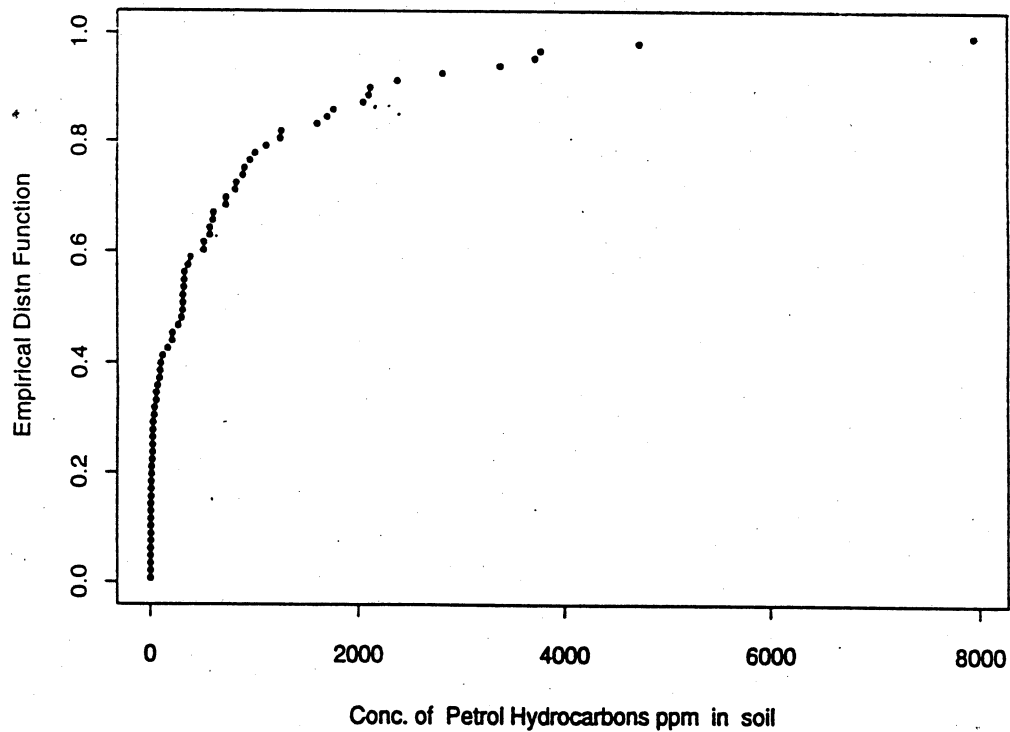
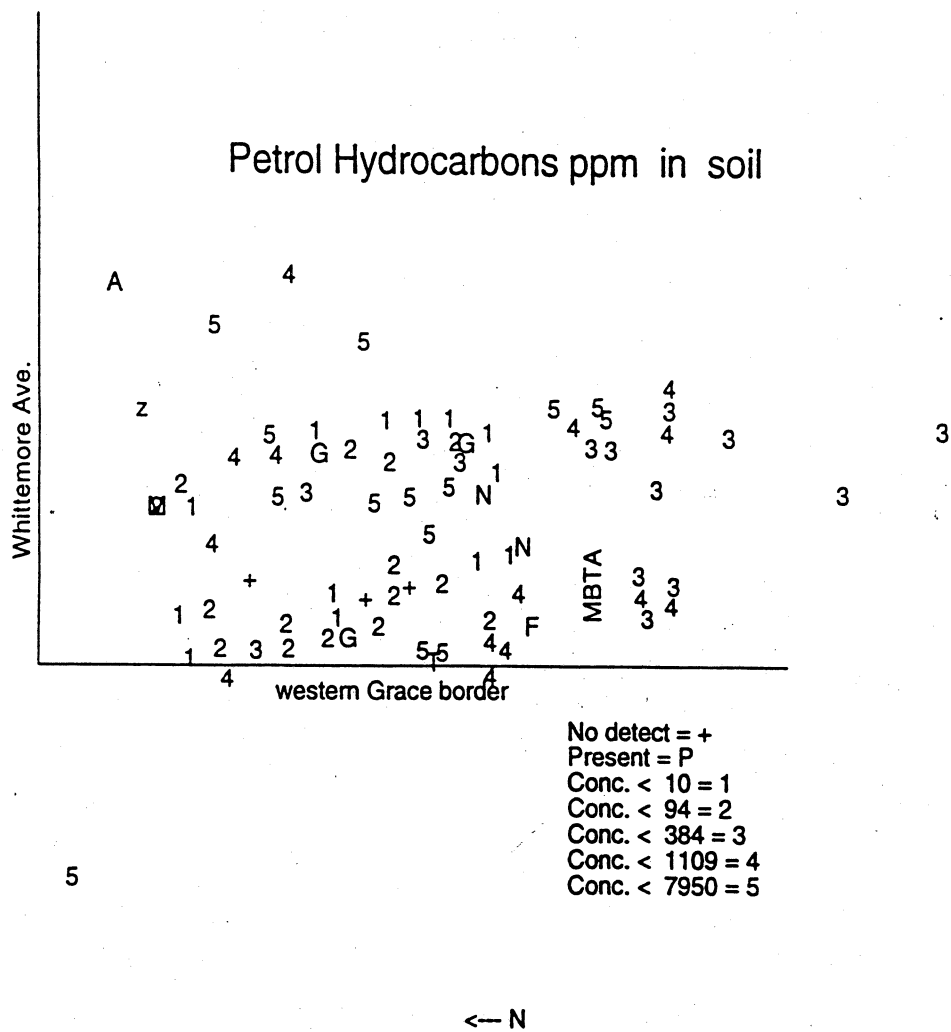






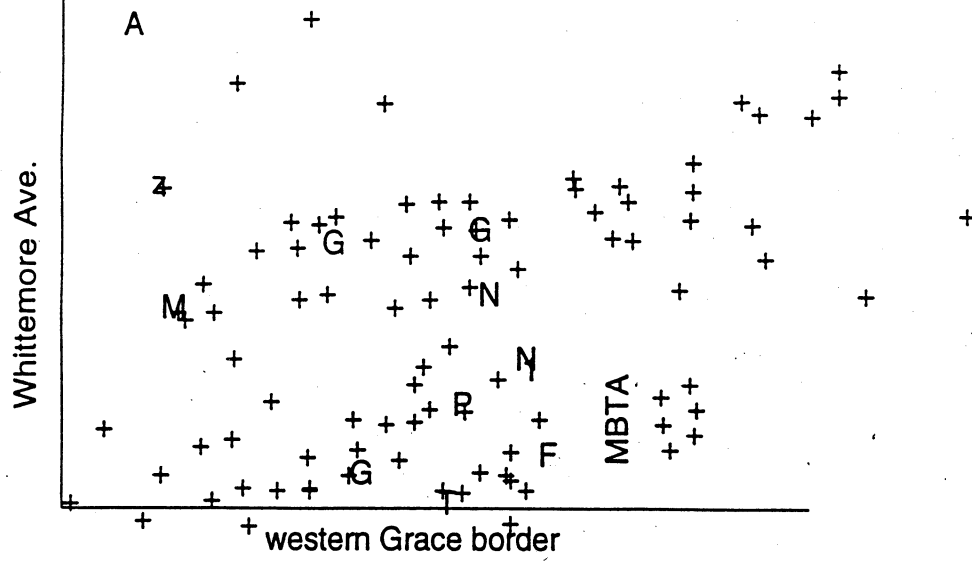


No DEP S-1 Standards. Not used in risk assessment



No DEP S-1 Standards. Not used in risk assessment

Trichloroethene ppb in soil



<-- N

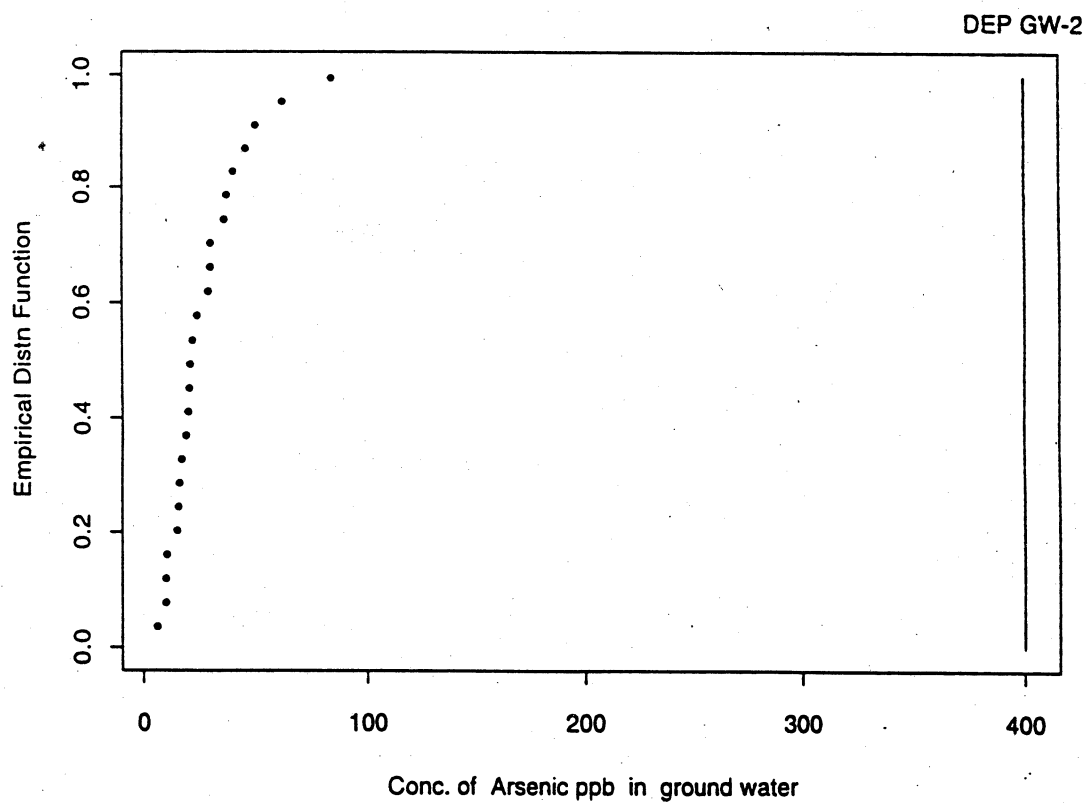
Whittemore Ave.

western Grace border

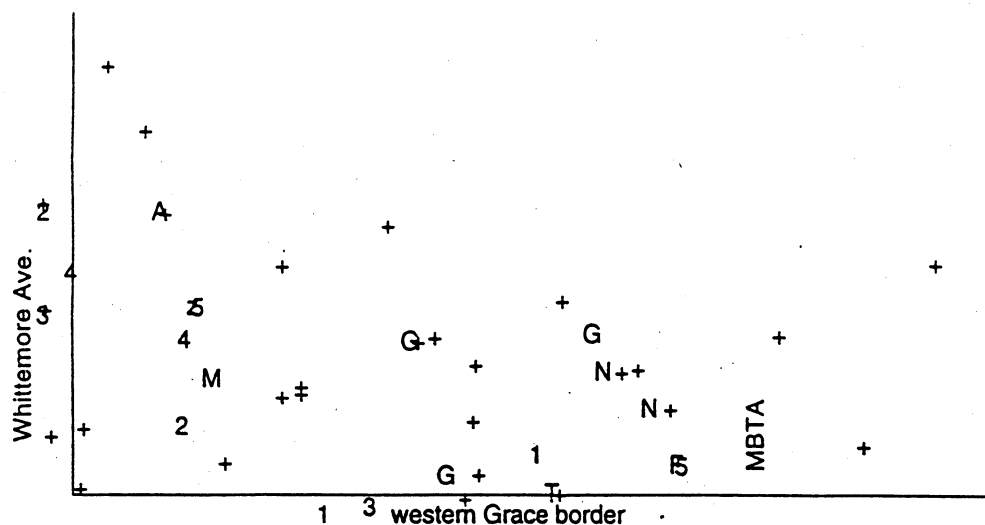
Legend:

- No detect = +
- Conc. < 15 = 1
- Conc. < 20 = 2
- Conc. < 30 = 3
- Conc. < 40 = 4
- Conc. < 50 = 5

<-- N



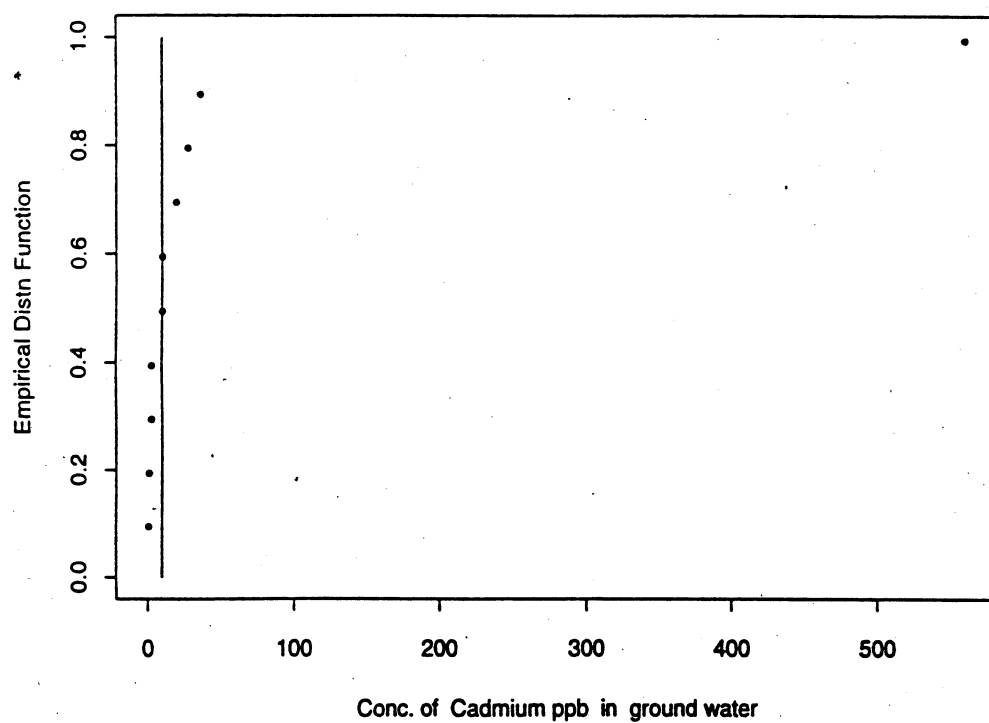
Cadmium ppb in ground water



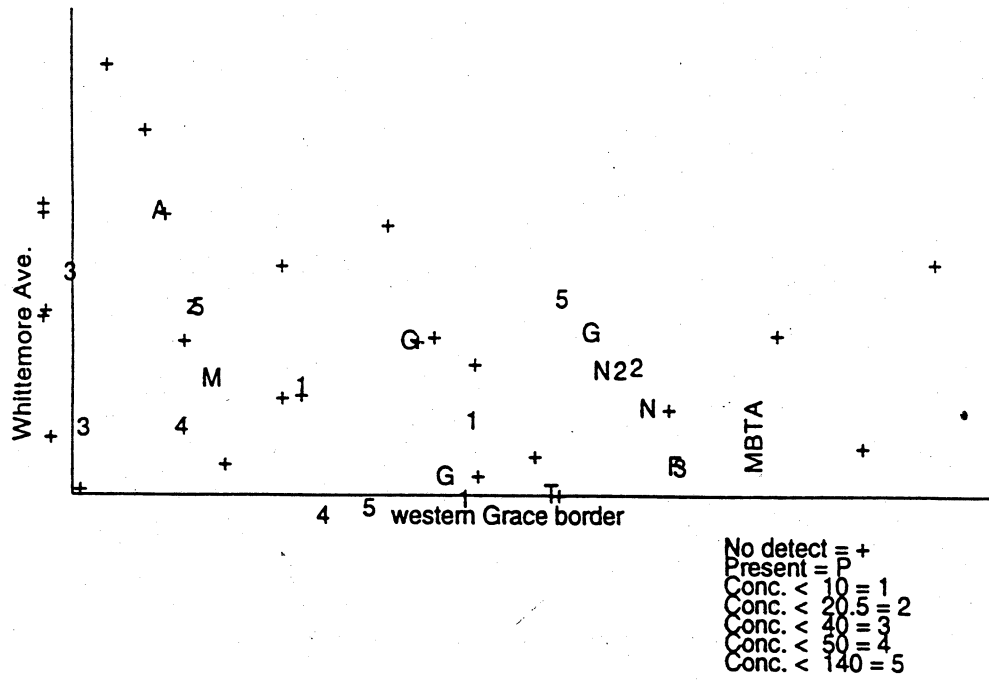
No detect = +
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 Conc. < 2.7 = 2
 Conc. < 10 = 3
 Conc. < 28 = 4
 Conc. < 560 = 5

← N

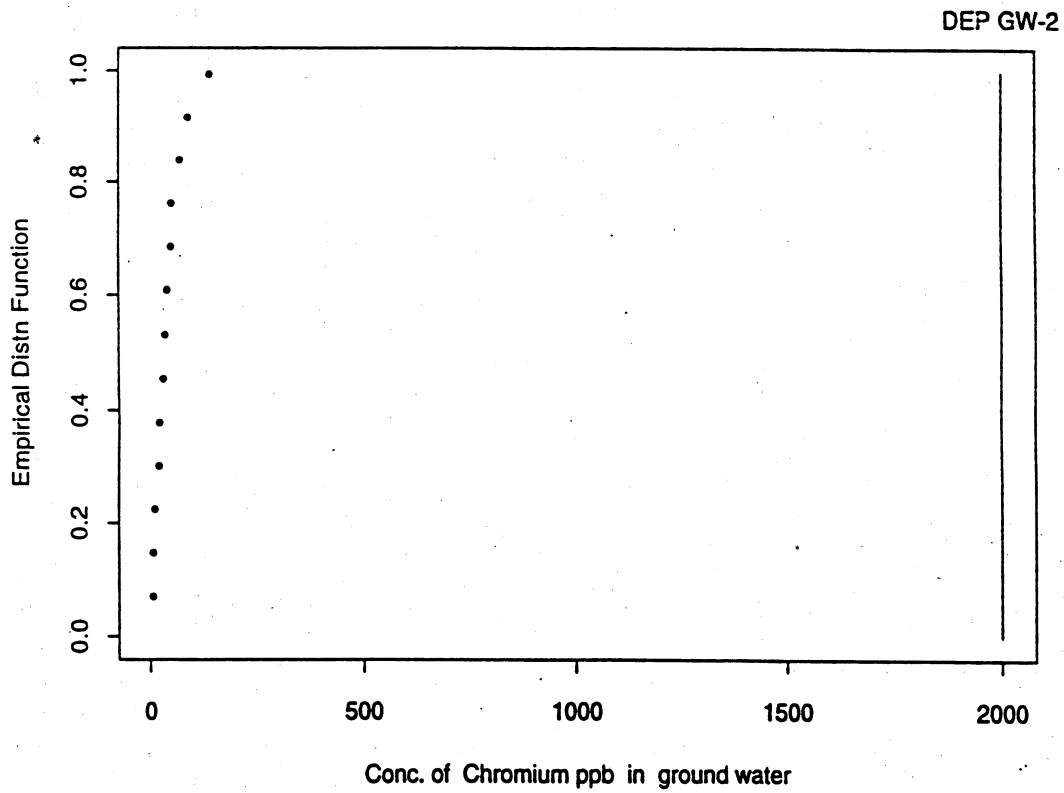
DEP GW-2



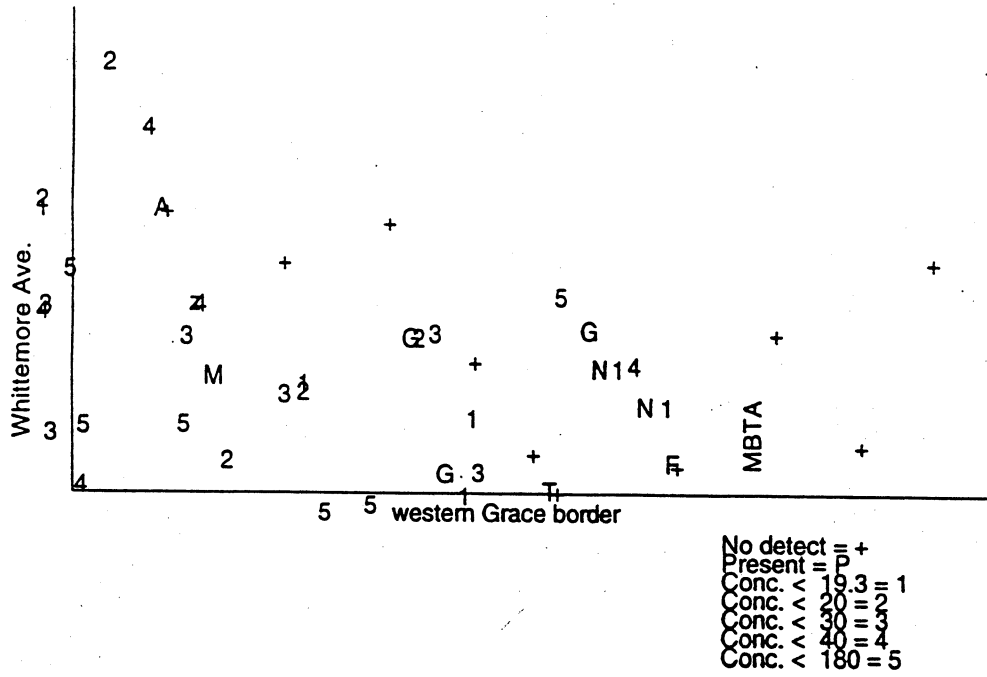
Chromium ppb in ground water



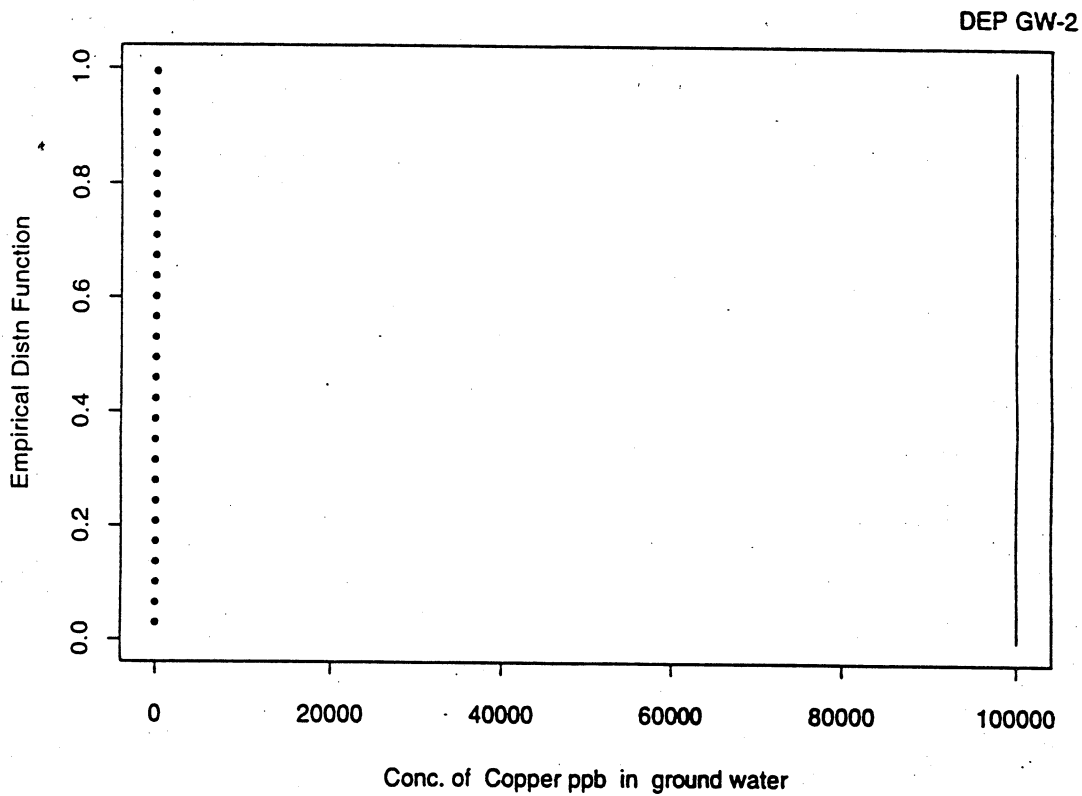
<--- N



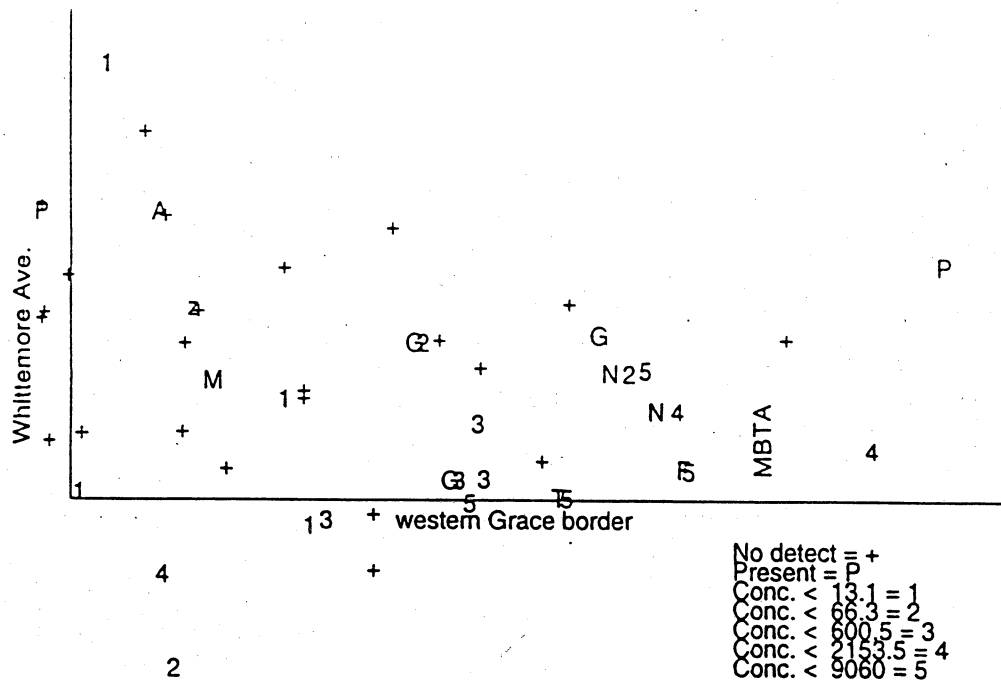
Copper ppb in ground water



← N

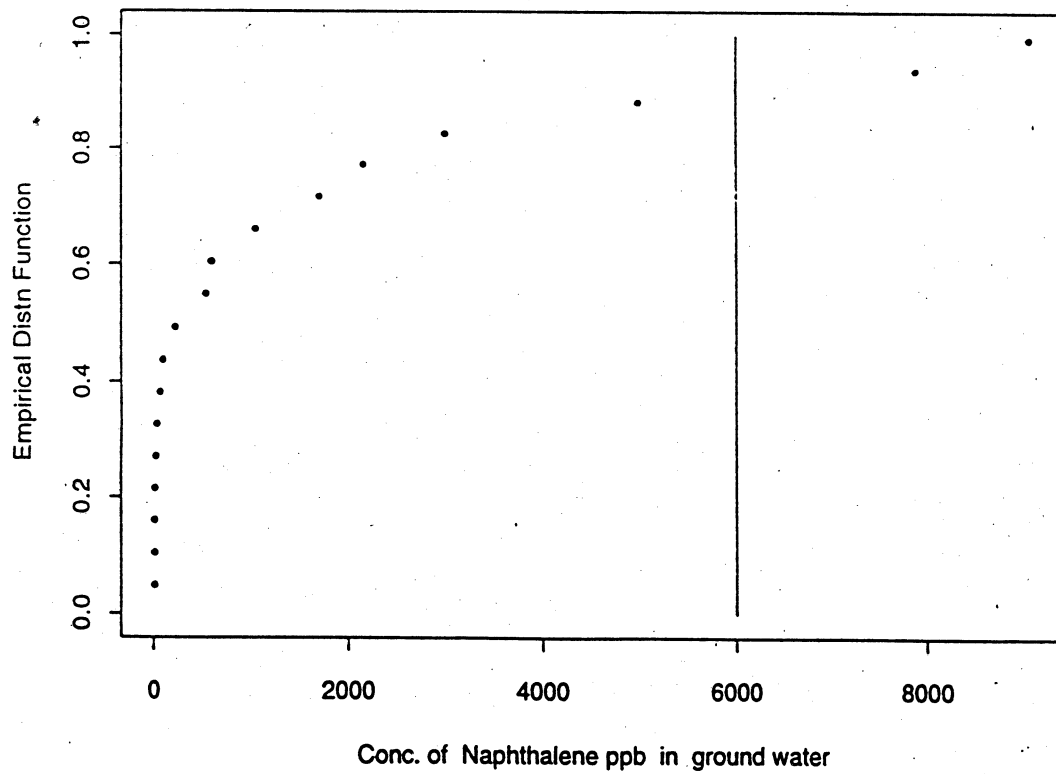


Naphthalene ppb in ground water



← N

DEP GW-2



Whitmore Ave.

western Grace border

2 5

Labels: A, M, 1, G, N2+, N3, MBTA, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

Legend:

- No detect = +
- Present = 0
- Conc. < 1 = 1
- Conc. < 2 = 2
- Conc. < 3 = 3
- Conc. < 4 = 4
- Conc. < 5 = 5

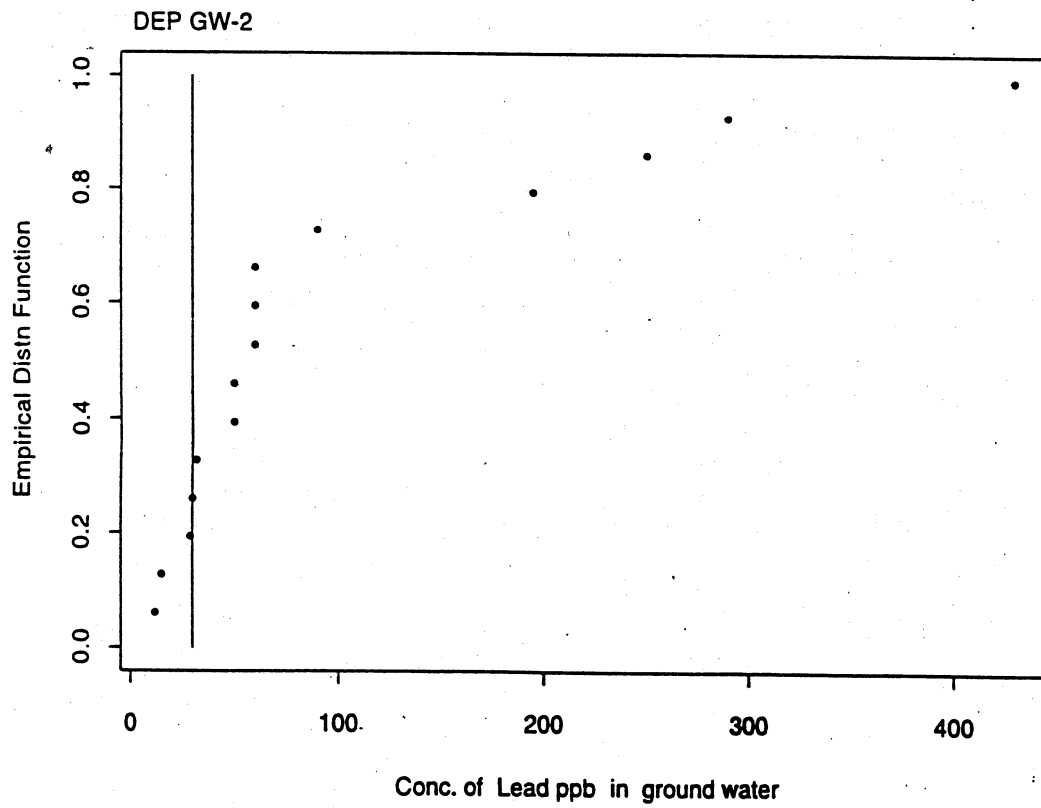
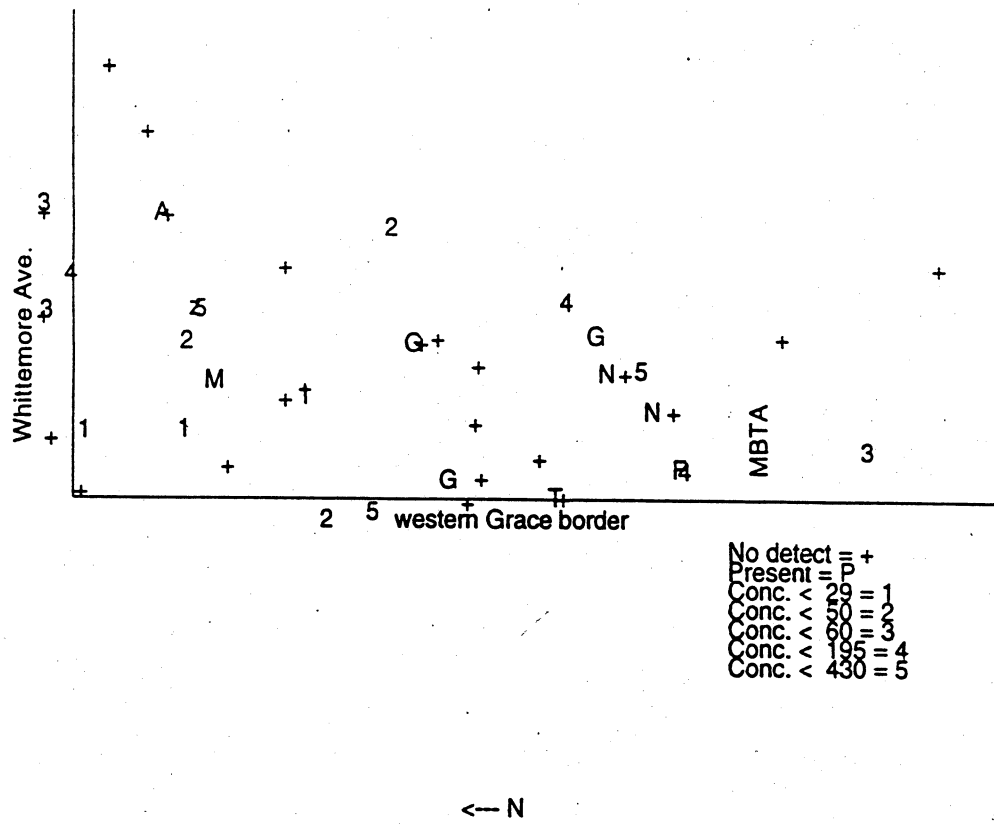
← N

The figure is a scatter plot with the following data points (approximate values):

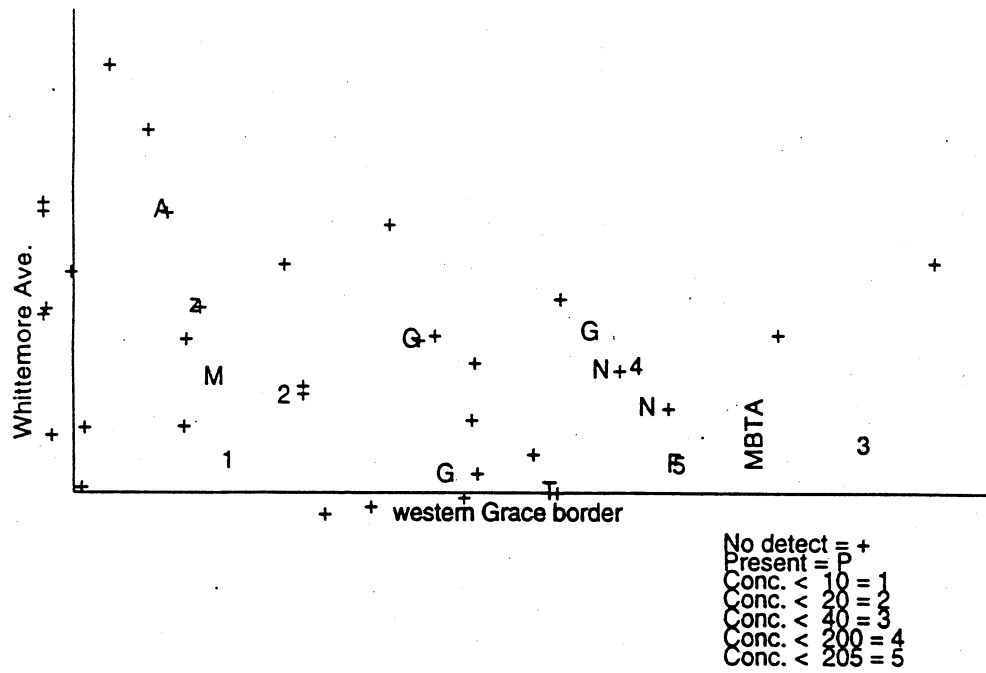
Conc. of Nickel ppb in ground water	Empirical Distn Function
10	0.06
15	0.12
20	0.19
25	0.26
30	0.32
35	0.39
40	0.46
45	0.52
50	0.59
60	0.66
65	0.73
70	0.79
75	0.86
120	0.93
340	0.99

A vertical line is drawn at a concentration of approximately 75 ppb, extending from the x-axis to the top of the plot area.

Lead ppb in ground water

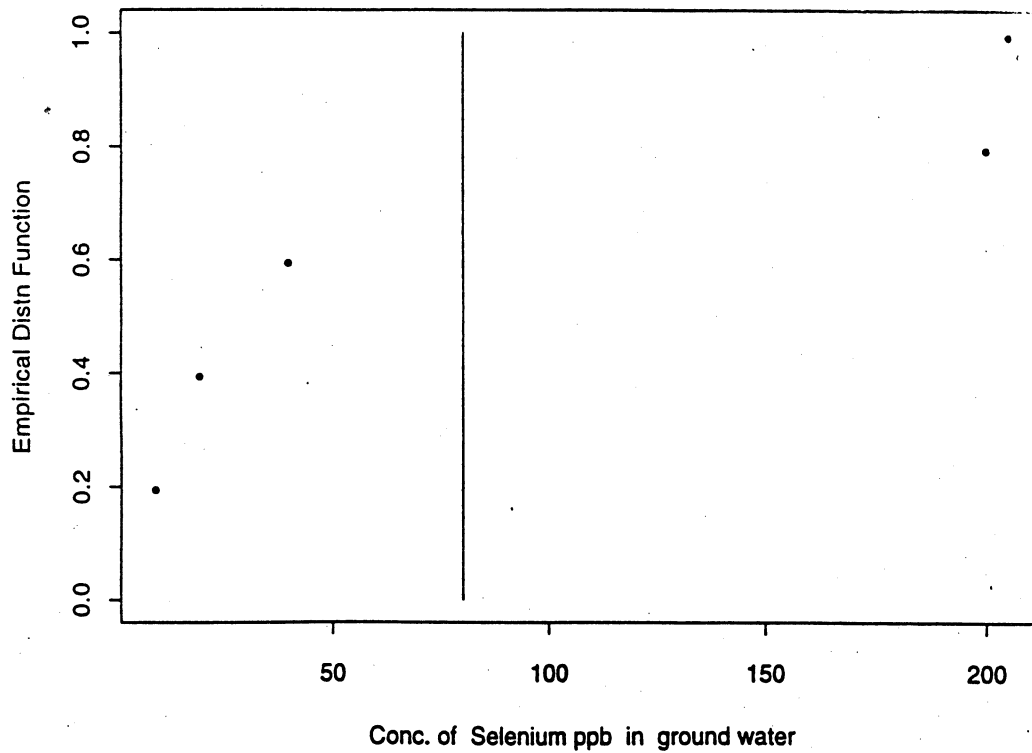


Selenium ppb in ground water



← N

DEP GW-2



Whittemore Ave.

western Grace border

Legend:

- No detect = +
- Present = P
- Conc. < 48 = 1
- Conc. < 130 = 2
- Conc. < 380 = 3
- Conc. < 850 = 4
- Conc. < 9600 = 5

DEP GW-2

Empirical Distn Function

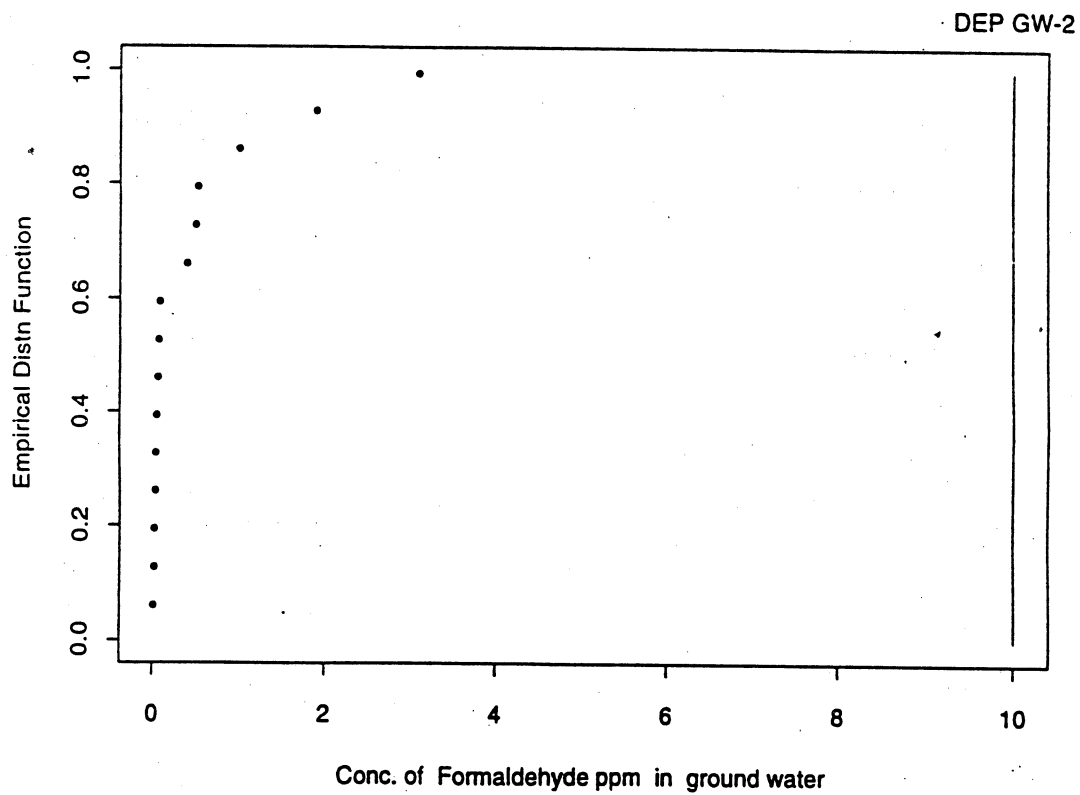
Conc. of Zinc ppb in ground water

Whittemore Ave.

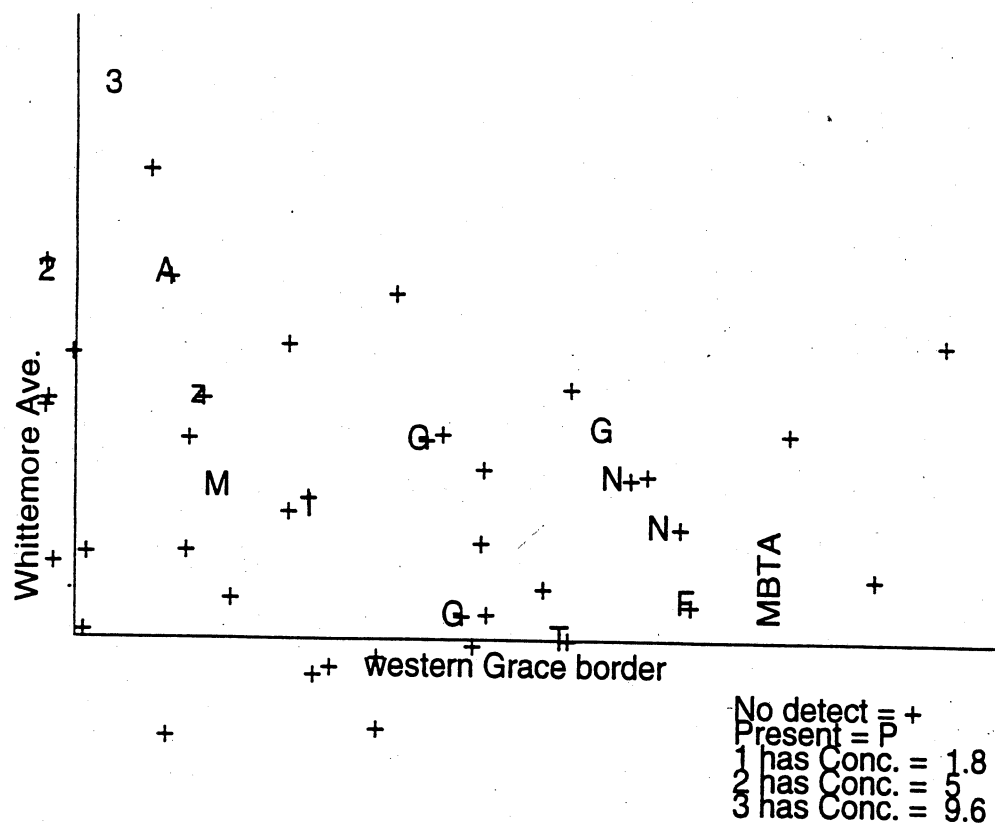
western Grace border

No detect = +
 Present = P
 Conc. < 0.02 = 1
 Conc. < 0.05 = 2
 Conc. < 0.085 = 3
 Conc. < 0.525 = 4
 Conc. < 3.1 = 5

← N

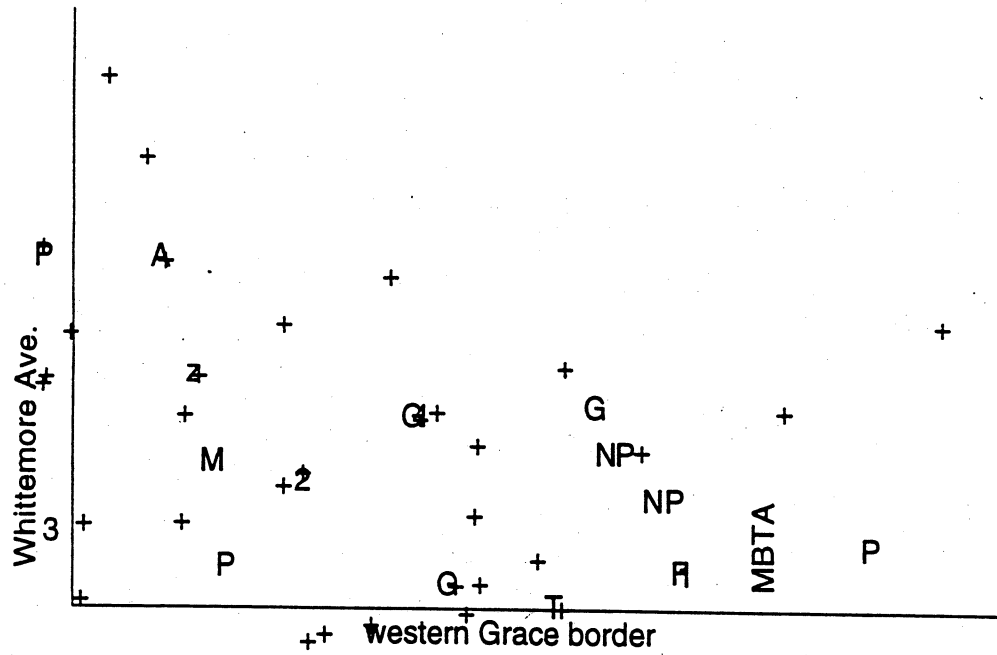


1,1-Dichloroethene ppb in ground water



<--- N

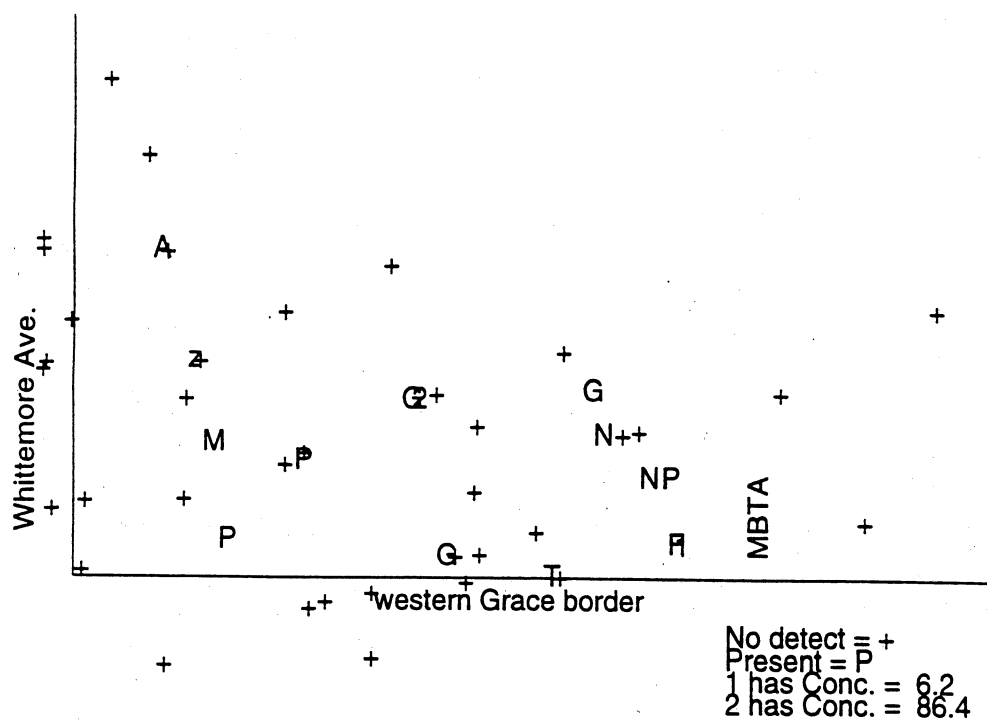
Benzo (a) pyrene ppb in ground water



No detect = +
 Present = P
 1 has Conc. = 2.5
 2 has Conc. = 4.9
 3 has Conc. = 19.2
 4 has Conc. = 41.8

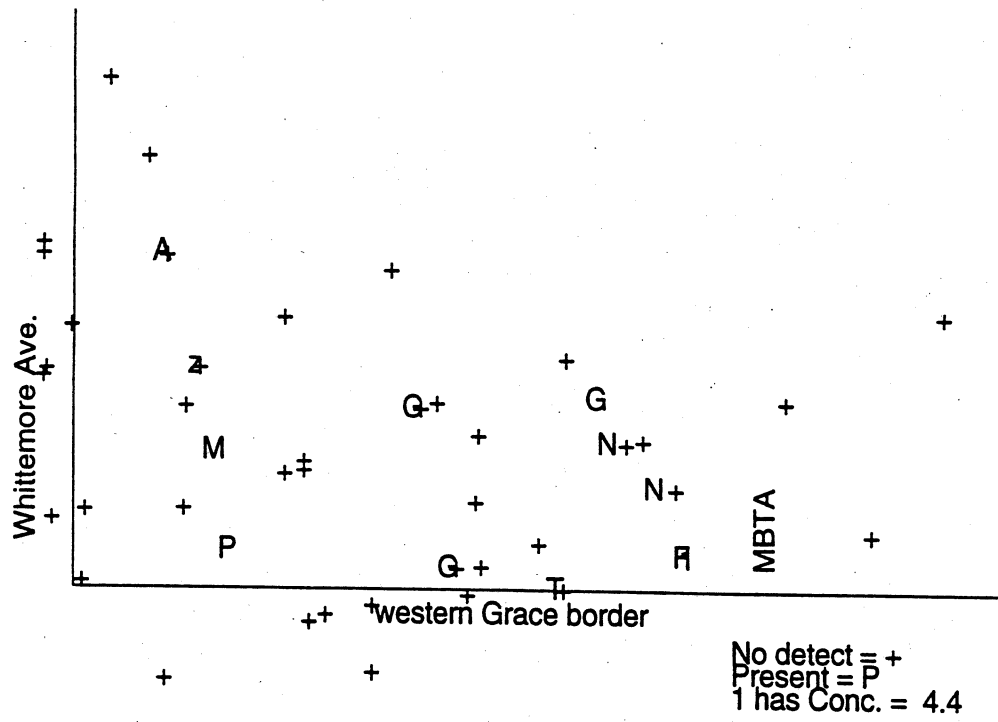
<-- N

Benzo (ghi) perylene ppb in ground water



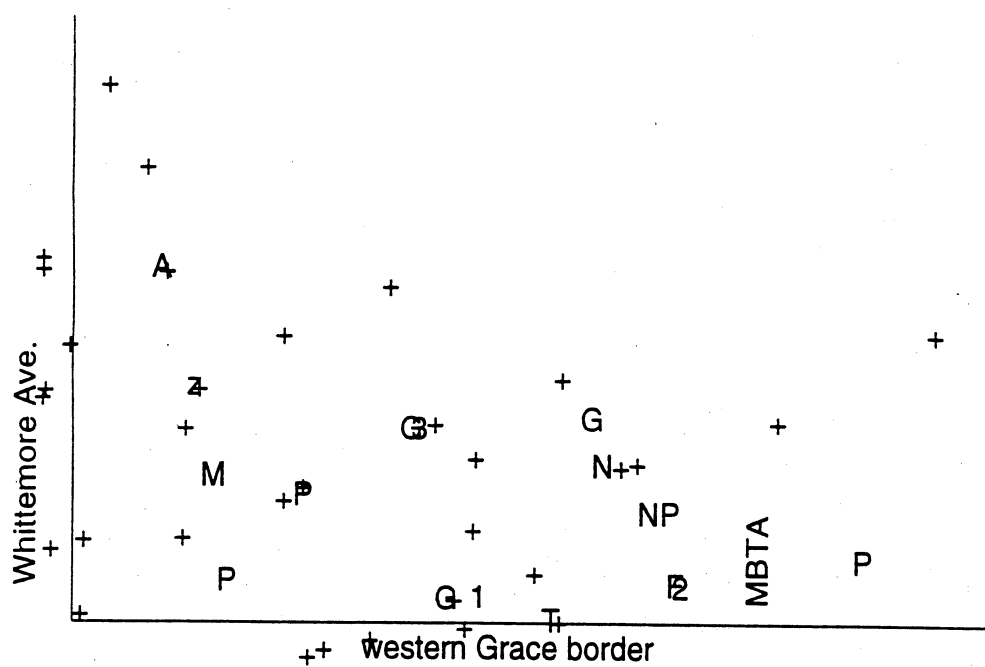
<--- N

Dibenzo (a,h) anthracene ppb in ground water



← N

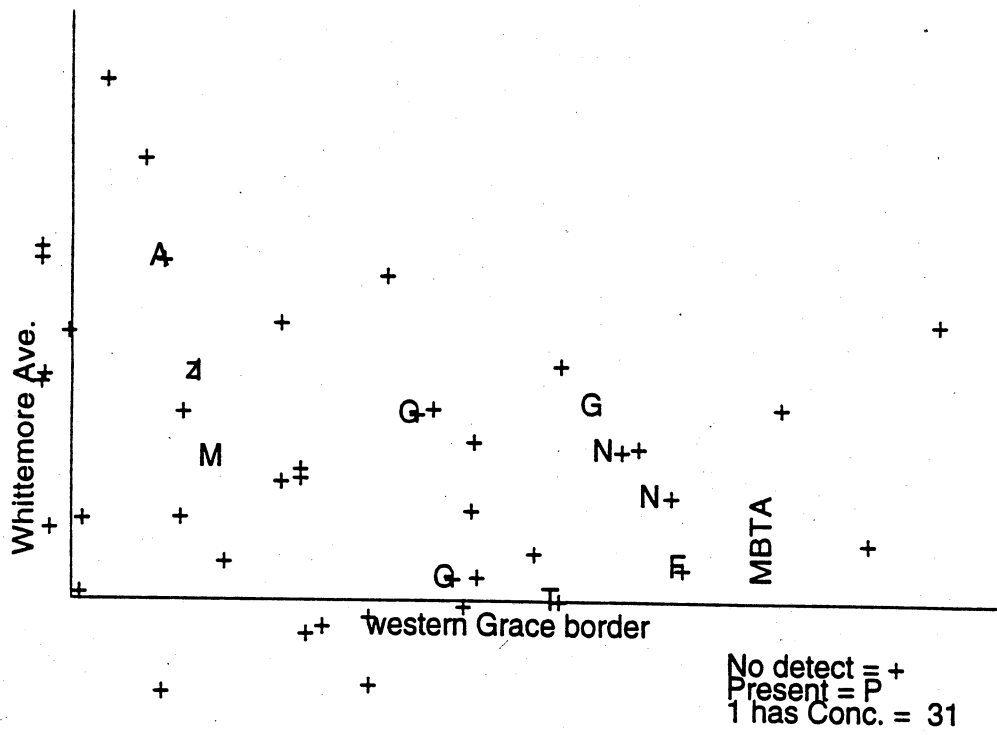
Indeno (1,2,3-cd) pyrene ppb in ground water



No detect = +
 Present = P
 1 has Conc. = 7.7
 2 has Conc. = 8.7
 3 has Conc. = 75

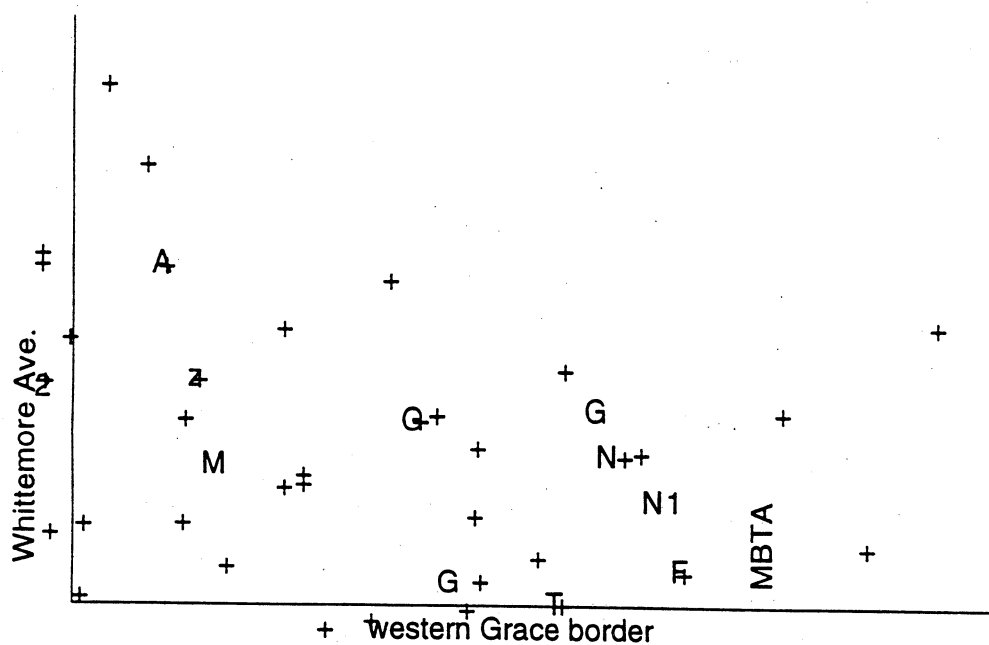
<--- N

Diethyl phthalate ppb in ground water



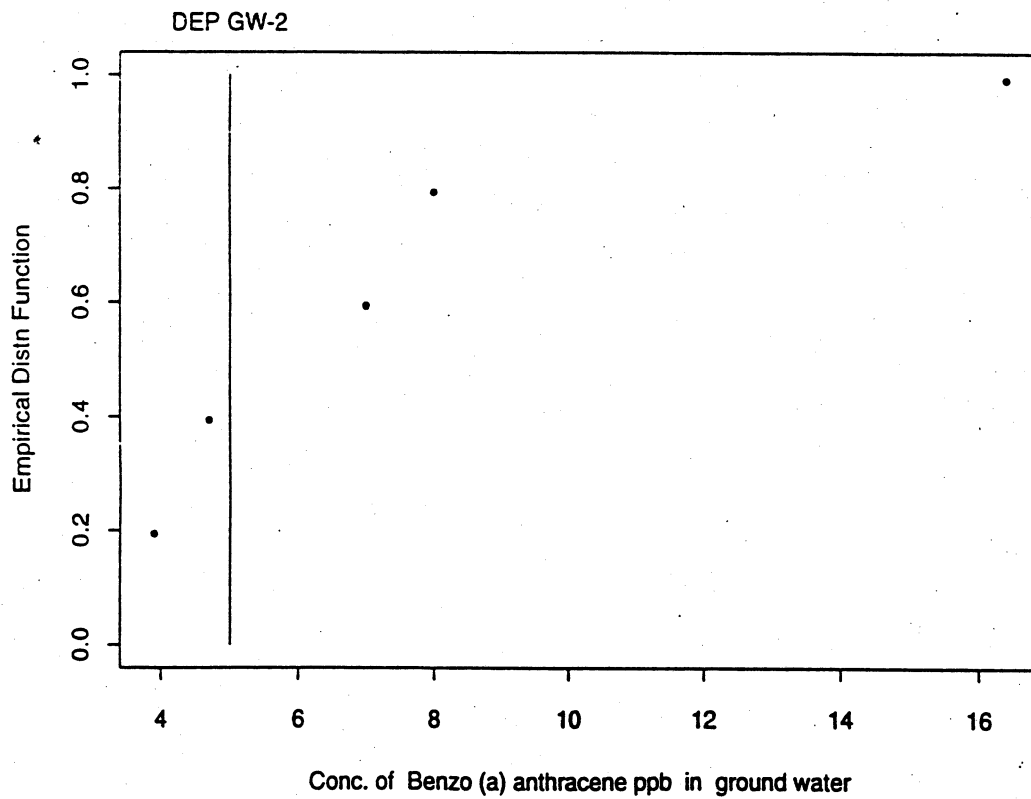
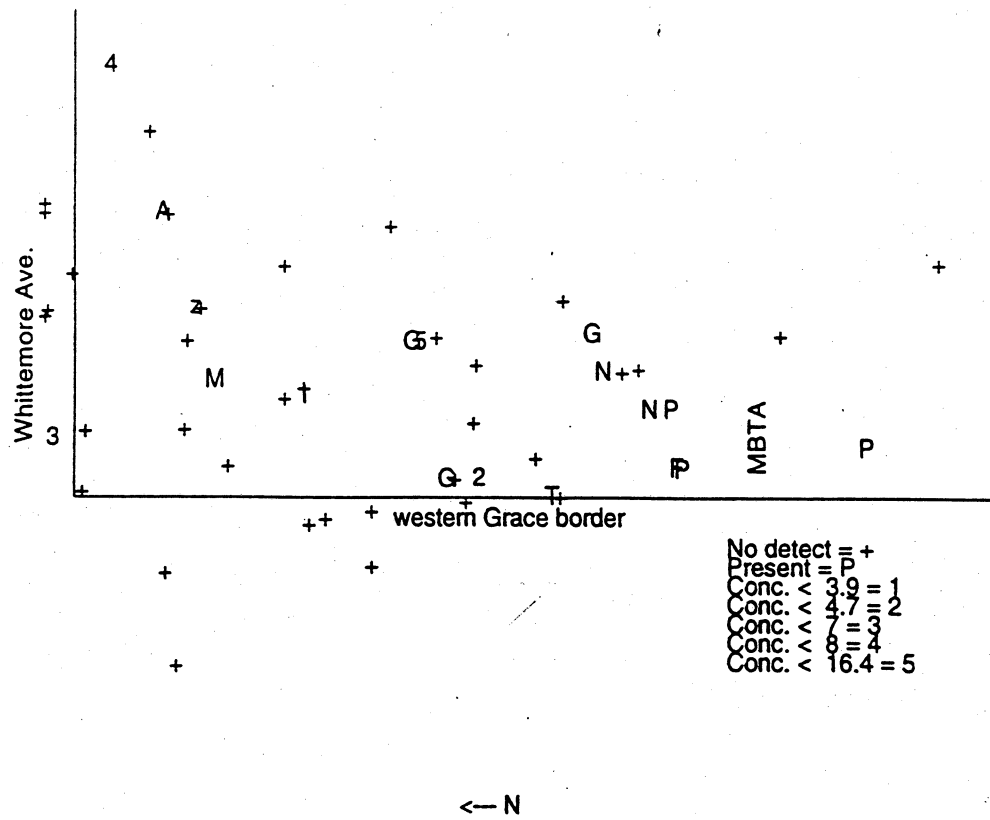
<--- N

Mercury ppb in ground water

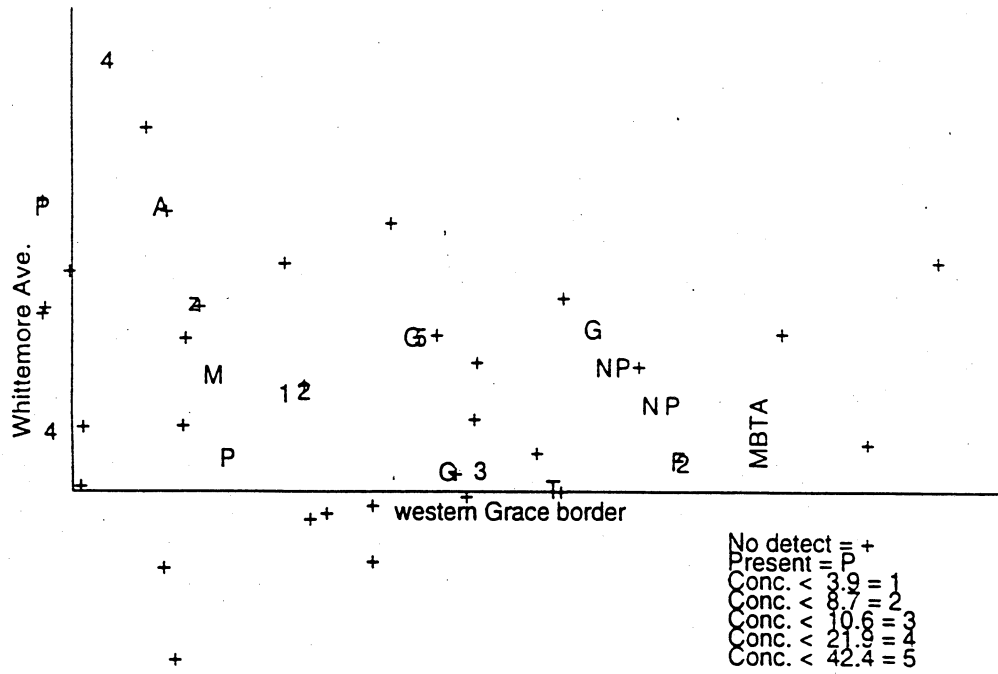


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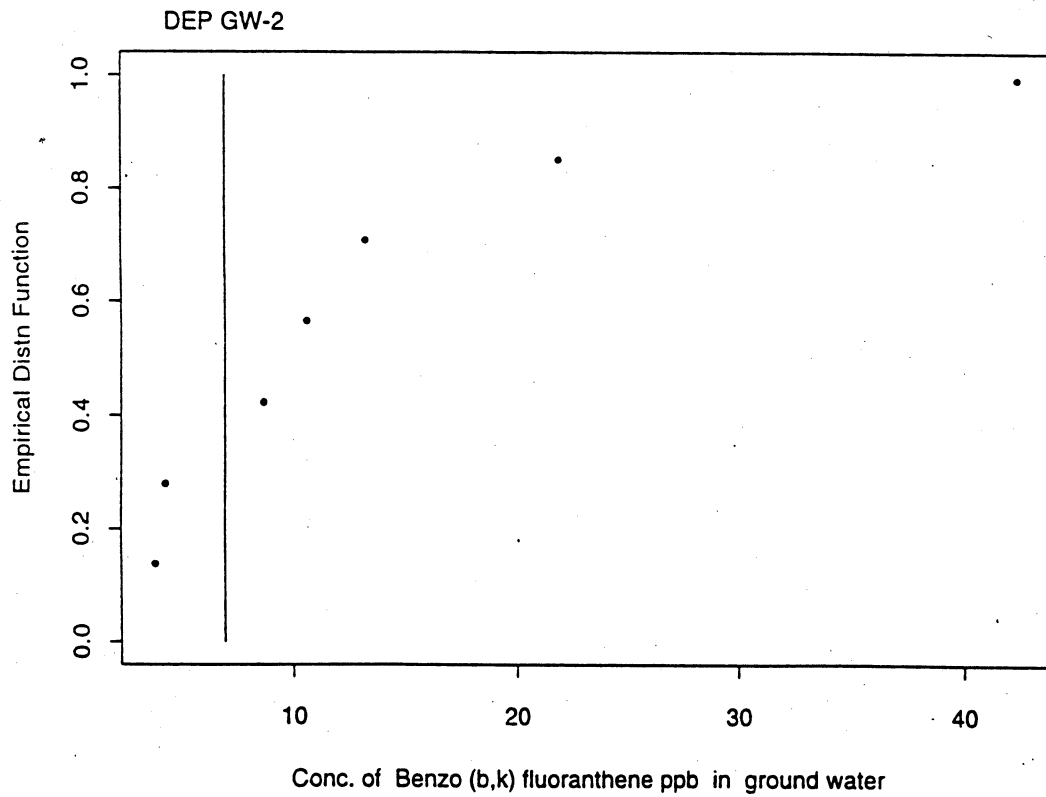
Benzo (a) anthracene ppb in ground water



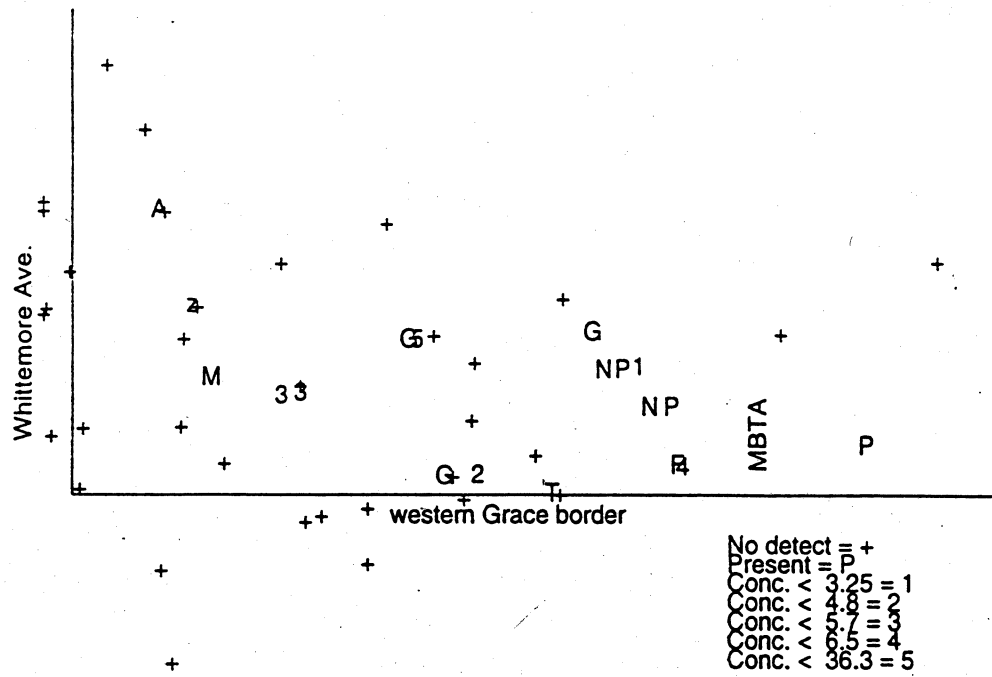
Benzo (b,k) fluoranthene ppb in ground water



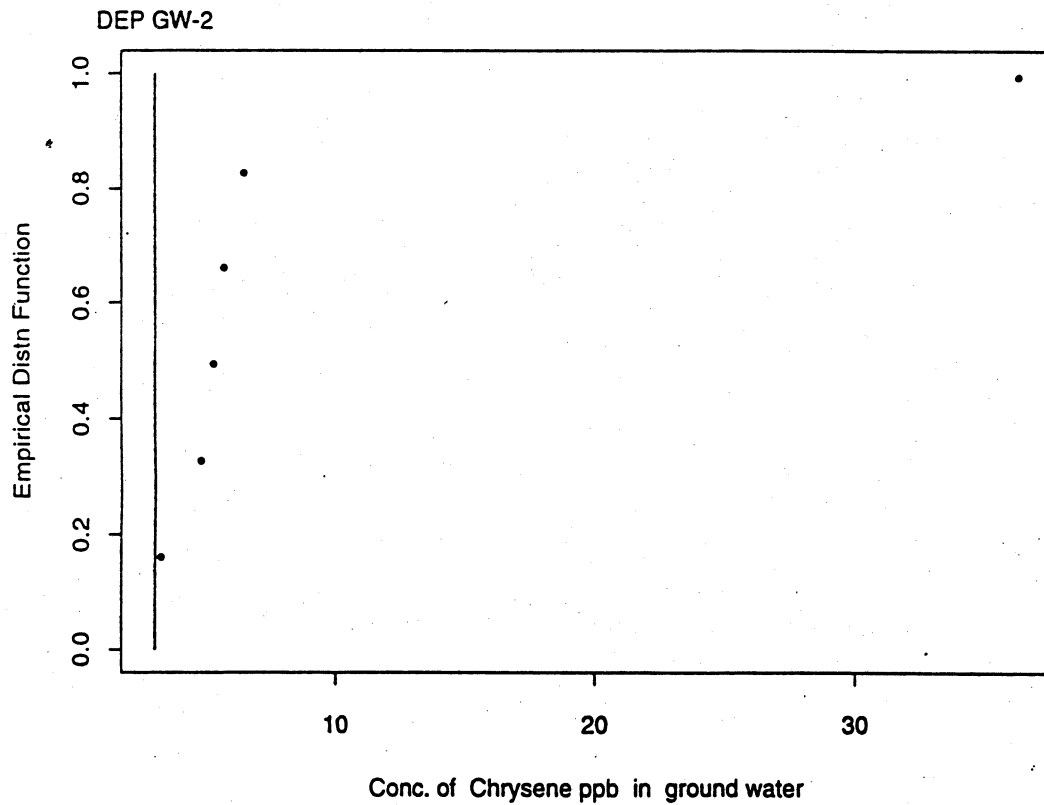
← N



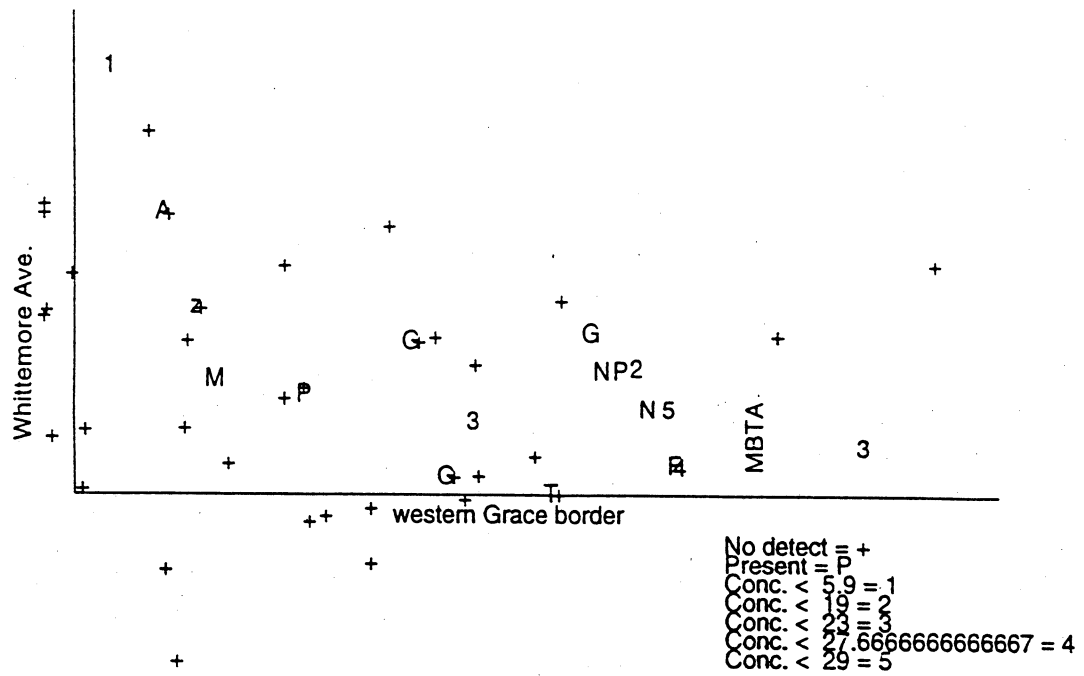
Chrysene ppb in ground water



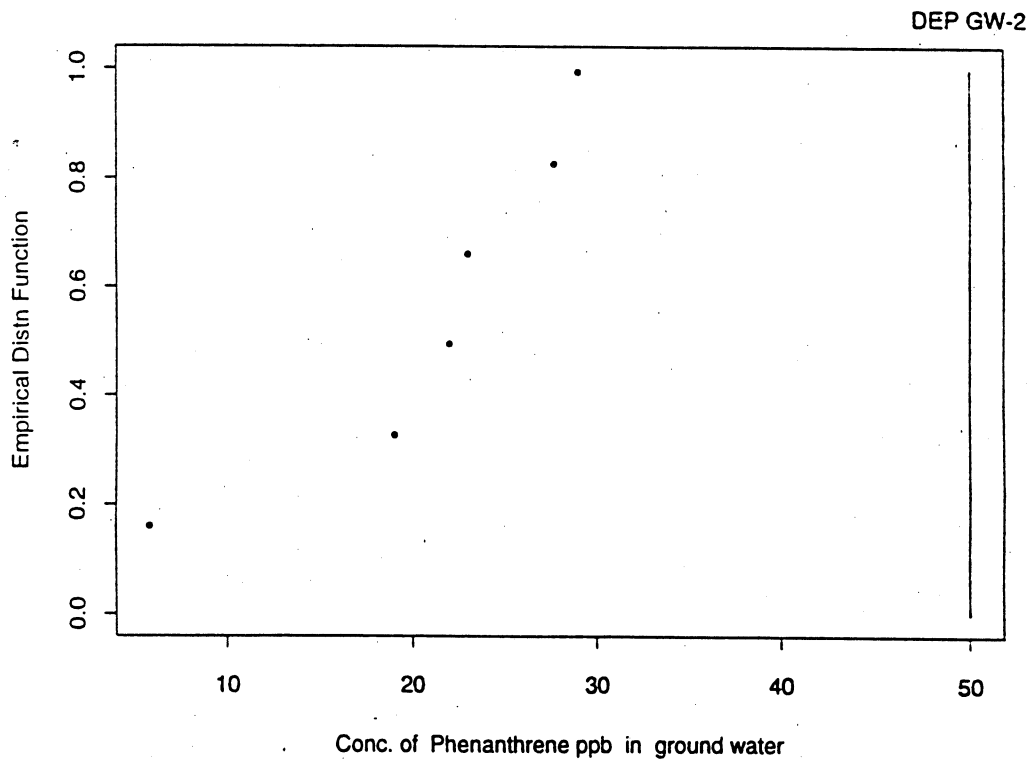
← N



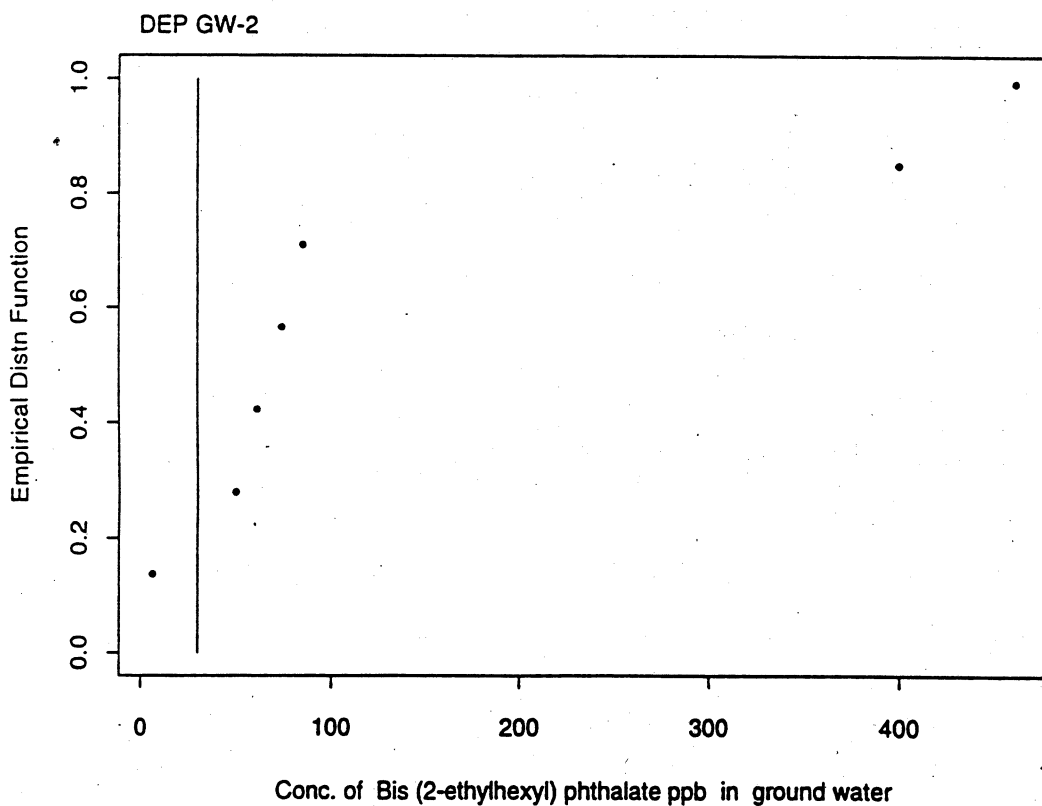
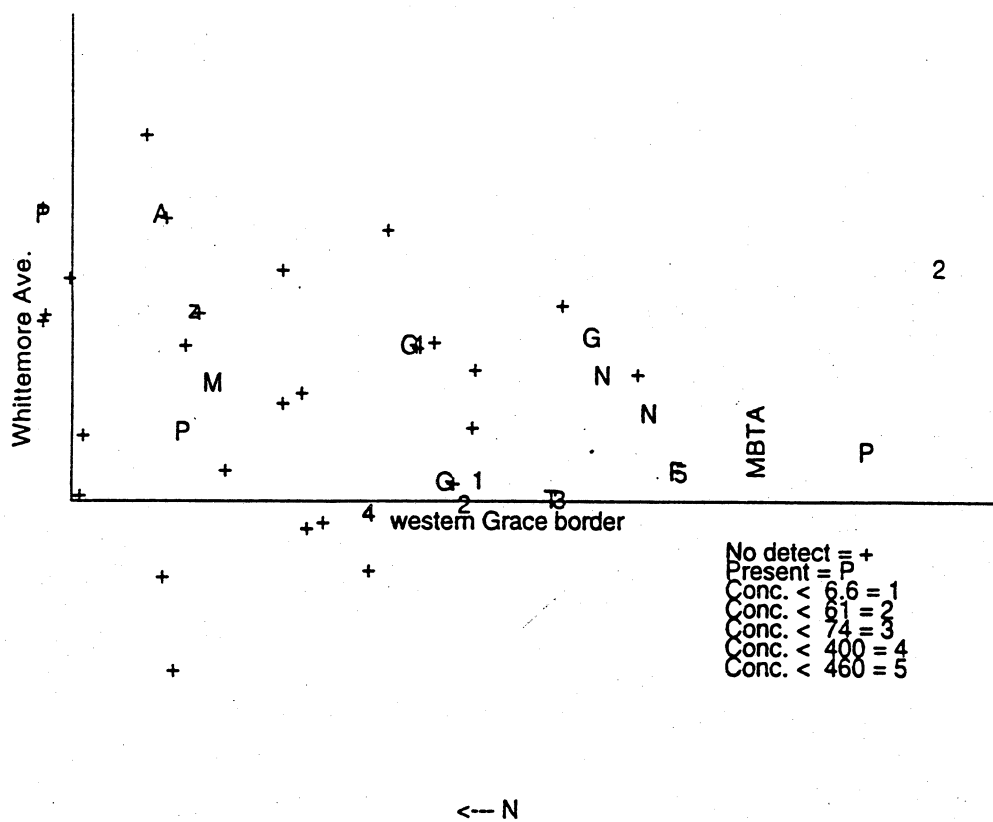
Phenanthrene ppb in ground water



← N



Bis (2-ethylhexyl) phthalate ppb in ground water



APPENDIX C

LIMITATIONS

LIMITATIONS

1. Environmental Health & Engineering, Inc.'s (EH&E) assessment described in the attached report number 95.415, *Public Health Risk Evaluation for W.R. Grace Site in Cambridge, Massachusetts*, (hereafter "the Report"), was performed in accordance with generally accepted practices employed by other consultants undertaking similar studies at the same time and in the same geographical area; and EH&E observed that degree of care and skill generally exercised by such other consultants under similar circumstances and conditions. The observations described in the Report were made under the conditions stated therein. The conclusions presented in the Report were based solely upon the services described therein, and not on scientific tasks or procedures beyond the scope of described services, nor beyond the time and budgetary constraints imposed by the client.
2. Observations were made of the site as indicated within the Report. Where access to portions of the site was unavailable or limited, EH&E renders no opinion as to the presence of chemical residues, or to the presence of indirect evidence relating to chemical residues in that portion of the site.
3. The observations and recommendations contained in the Report are based on limited environmental sampling and visual observation, and were arrived at in accordance with generally-accepted standards of industrial hygiene practice. The sampling and observations conducted at the site were limited in scope, and therefore cannot be considered representative of areas not sampled or observed.
4. Where sample analyses were conducted by an outside laboratory, EH&E has relied upon the data provided, and has not conducted an independent evaluation of the reliability of these data.
5. The purpose of the Report was to assess the characteristics of the subject site as stated within the Report. No specific attempt was made to verify compliance by any party with all federal, state, or local laws and regulations.



**TIER CLASSIFICATION, TIER II EXTENSION &
TIER II TRANSFER TRANSMITTAL FORM**

Pursuant to 310 CMR 40.0510 and 40.0560 (Subpart E)

Release Tracking Number

3

0277

A. DISPOSAL SITE LOCATION:

Disposal Site Name: W.R. Grace & Co. - Conn.

Street: 62 Whittemore Avenue

Location Aid: _____

City/Town: Cambridge

ZIP Code: 02140-1692

Related Release Tracking Numbers That This Submittal Will Address: _____

B. THIS FORM IS BEING USED TO: (check all that apply)

- ☐ Submit a new or revised Tier Classification Submittal for a Tier I Site, including a Numerical Ranking Scoresheet (complete Sections A, B, C, I, J, K and L).
- ☒ Submit a new or revised Tier Classification Submittal for a Tier II Site, including a Numerical Ranking Scoresheet (complete Sections A, B, C, F, G, I, J, K and L).
- ☐ Submit a Notice that an additional Release Tracking Number(s) is (are) being linked to this Tier Classified Site and rescoring is not required at this time (complete Sections A, B, J, K and L). If this submittal is for a Tier I Site, you must also submit a Minor Permit Modification Transmittal Form (BWSC-109).

List Additional Release Tracking Number(s): _____

- ☐ Submit a Phase I Completion Statement supporting a Tier Classification Submittal (complete Sections A, B, I, J, K and L).
- ☐ Submit a Tier II Extension Submittal for Response Actions at a Tier II Site (complete Sections A, B, D, F, G, I, J, K and L).
- ☐ Submit a Tier II Extension Submittal for Response Actions taken after expiration of a Waiver, pursuant to 310 CMR 40.0630(4) (complete Sections A, B, D, F, J, K and L, and also complete Sections G and I or Section H).*
- ☐ Submit a Tier II Transfer Submittal for a change in person(s) undertaking Response Actions at a Tier II Site (complete Sections A, B, E, F, G, I, J, K, L, M, N and O).
- ☐ Submit a Tier II Transfer Submittal for a change in person(s) undertaking Response Actions at a Waiver Site, pursuant to 310 CMR 40.0630(6) (complete Sections A, B, E, F, J, K, L, M, N and O, and also complete Sections G and I or Section H).*

You must attach all supporting documentation required for each use of form indicated, including copies of any Legal Notices and Notices to Public Officials required by 310 CMR 40.1400.

*NOTE: The Waiver expires on the effective date of this submittal and all further Response Actions must be taken as a Tier II Site.

C. TIER CLASSIFICATION SUBMITTAL:

Numerical Ranking Score for Disposal Site: (from Numerical Ranking Scoresheet) 332

Proposed Tier Classification of Disposal Site: (check one) ☐ Tier IA ☐ Tier IB ☐ Tier IC ☒ Tier II

Check which, if any, of the Tier I inclusionary criteria are met by the Disposal Site, pursuant to 310 CMR 40.0520:

- ☐ Groundwater is located within an Interim Wellhead Protection Area or a Zone II, and there is evidence of groundwater contamination by an Oil or Hazardous Material at the time of Tier Classification at concentrations equal to or exceeding the applicable RCGW-1 Reportable Concentration set forth in 310 CMR 40.0360.
- ☐ An Imminent Hazard is present at the time of Tier Classification.
- ☐ Check here if this Tier Classification revises a previous submittal for this Disposal Site. You must include a revised Numerical Ranking Scoresheet with this submittal. If a Tier I Permit has been issued, you may also need to submit a Major Permit Modification Application (BWSC 10).

If incorporating additional Release(s) into the Disposal Site, list Release Tracking Number(s): _____

D. TIER II EXTENSION SUBMITTAL REQUIREMENTS:

State the expiration date of the Tier II Classification or Waiver for the Disposal Site, whichever is applicable: _____

Attach a statement summarizing why a Permanent or Temporary Solution has not been achieved at the Disposal Site.
A Tier II Extension is effective for a period of one year beyond the current expiration date of the Tier II Classification or Waiver.

E. TIER II TRANSFER SUBMITTAL REQUIREMENTS:

State the proposed effective date of the change in person(s) undertaking Response Actions at the Disposal Site: _____

Attach a statement summarizing the reasons for the proposed change in person(s) undertaking the Response Actions.
All Response Actions must be completed by the deadline applicable to the person who first filed either a Tier Classification Submittal for the Disposal Site or received a Waiver of Approvals.



**TIER CLASSIFICATION, TIER II EXTENSION &
TIER II TRANSFER TRANSMITTAL FORM**

Pursuant to 310 CMR 40.0510 and 40.0560 (Subpart E)

Release Tracking Number

3

0277

F. DISPOSAL SITE COMPLIANCE HISTORY SUMMARY:

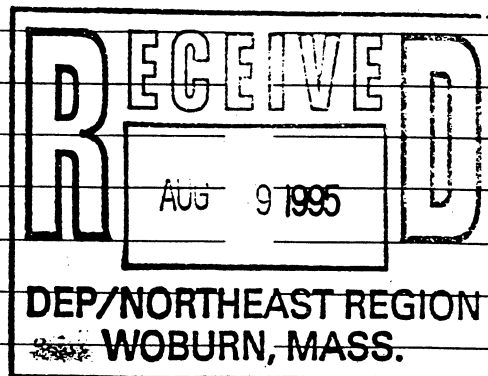
- > If providing either a Tier Classification Submittal for a Tier II Site or a Tier II Extension Submittal for a Waiver Site, the person named in Section J must provide a Compliance History.
- > If providing a Tier II Extension Submittal for a Tier II Site, the person named in Section J must update their Compliance History since the effective date of the Tier II Classification.
- > If providing a Tier II Transfer Submittal for a Tier II or Waiver Site, the person named in Section M must provide a Compliance History.

Compliance History for (provide only one name per History): W. R. Grace & Co.-Conn. Cambridge Facility - Note 1

☐ Check here if there has been no change to the Compliance History of the person named above (Extension Submittal for a Tier II Site ONLY).

List all permits or licenses that have been issued by the Department that are relevant to this Disposal Site:

PROGRAM:	PERMIT NUMBER:	PERMIT CATEGORY:	FACILITY ID:
Air Quality			Note 2
Hazardous Waste (M.G.L. c. 21C)			Note 3
Solid Waste			
Industrial Wastewater Management			
Water Supply			Note 4
Water Pollution Control/Surface Water			
Water Pollution Control/Groundwater			
Water Pollution Control/Sewer Connection			
Wetland & Waterways			



List all other Federal, state or local permits, licenses, certifications, registrations, variances, or approvals that are relevant to this Disposal Site:

ISSUING AUTHORITY OR PROGRAM, OR DOCUMENTATION TYPE:	IDENTIFICATION NUMBER:	DATE ISSUED:
Massachusetts Water Resources Authority	Sewer Use 09001993	6/30/95 Note 5

If needed, attach to this Transmittal Form a statement further describing the Compliance History of this Disposal Site. This statement must describe the compliance history of the person named above with the following:

- (1) DEP regulations; and
- (2) other laws for the protection of health, safety, public welfare and the environment administered or enforced by any other government agency.

Such a statement should identify information such as:

- (1) actions relevant to the Disposal Site taken by the Department to enforce its requirements including, but not limited to, a Notice of Noncompliance (NOC), Notice of Intent to Assess Civil Administrative Penalty (PAN), Notice of Intent to Take Response Action (NORA), and an administrative enforcement order;
- (2) administrative consent orders;
- (3) judicial consent judgements;
- (4) similar administrative actions taken by other Federal, state or local agencies;
- (5) civil or criminal actions relevant to the Disposal Site brought on behalf of the DEP or other Federal, state, or local agencies; and
- (6) any additional relevant information.

For each action identified, provide the following information:

- (1) name of the issuing authority, type of action, identification number and date issued;
- (2) description of noncompliance cited;
- (3) current status of the matter; and
- (4) final disposition, if any.

**COMPLIANCE HISTORY SUMMARY FOR W.R. GRACE & CO. - CONN. (GRACE) OFFICE/LABORATORY
BUILDINGS AT 62 WHITTEMORE AVENUE, CAMBRIDGE, MASSACHUSETTS**

NOTE 1 - The compliance history information that is enclosed pertains to the office/laboratory buildings that are currently owned by Grace and are located adjacent to the areas subject to 21E requirements. Specifically, Grace has performed a review of its available records to identify current permits/licenses pertaining to these buildings as well as violation notices on file for the previous five years (back to 1/1/90).

The 21E disposal site sits upon an area that was the site of a former chemical manufacturing facility. The facility operated from 1919 to 1983 when manufacturing was discontinued and the buildings were demolished. As referenced above, Grace stills owns and operates several office buildings located on the site that are used to house administrative workers and contain laboratories that conduct research and development (R&D) and pilot plant work. Grace believes that it would be virtually impossible to reconstruct a complete permit and compliance history for the site's manufacturing facilities that operated for 64 years and were discontinued 12 years ago. Further, Grace believes that such a history is not relevant to the Company's current ability to perform remediation which may be required. Grace has previously submitted to the Department extensive information concerning this site including the seven volume report titled, Environmental Data Report for the W. R. Grace & Co. Property in Cambridge Massachusetts (Haley & Aldrich, 4/88). Grace requests that the Department contact the facility if it believes that specific additional historic information is required.

NOTE 2 - The facility has an air registration on file with the Department (Application Number MBR-84-COM-001).

NOTE 3 - The facility is not permitted by the Department to store, treat or dispose of waste classified as hazardous under the Resource Conservation and Recovery Act (RCRA). The facility is classified as a hazardous waste generator (identification number MAD00140915).

As a follow-up to a RCRA regulatory compliance inspection the facility received a Notice of Noncompliance (NON) from the Department dated 10/17/91. The NON requested that the facility update its RCRA contingency plan, revise the labels of some hazardous waste drums and move some hazardous waste drums from a satellite accumulation area to an accumulation area. The facility promptly implemented the requested actions.

The NON described above concerns the paperwork requirements under the RCRA hazardous waste regulations that apply to the waste materials managed in Grace's current office/laboratory buildings. Grace is aware of no information to suggest that these purported violations resulted in any environmental impairment or that these resulted in a release of hazardous materials onto the property that is subject to 21E requirements.

NOTE 4 - The facility has numerous cross connection permits issued by the Department due to tie-ins to the MWRA water system. These include permit numbers 049170939, 049170242, 049170879, 049170878, 049170877, and 049170244.

NOTE 5 - Grace's Cambridge facility maintains a sewer use permit from the Massachusetts Water Resource Authority (MWRA) under which wastewater from the office/laboratory buildings are discharged into MWRA sewer system. Notices of Noncompliance (NON) concerning this permit that were identified during the facility record review, are discussed below. In each case in which a NON was received, the facility investigated the cause of the purported violation and sought to take corrective actions to the satisfaction of the MWRA. These written NON's fall into several categories.

First, the facility's MWRA permit requires that the facility monitor its sewer discharge for numerous parameters. One such requirement is continuous monitoring for pH with a specified pH discharge limitation range. Based upon Grace's self reporting of pH results, reportable excursions were experienced on the following dates, 11/22/91, 8/19/92, 12/22/92, 3/16/93 and 8/30/93. In spite of the fact that the facility has remained in compliance with its pH limitations greater than 99% of the time, in each case of a reportable excursion Grace promptly contacted the MWRA with its view as to whether a violation had in fact occurred, and its plan to prevent a reoccurrence. Another monitoring requirement is quarterly sampling and analysis for chromium. The facility received a Notice of Violation (NOV) from the MWRA, dated 9/14/93, that cited one purported exceedance of the facility's chromium discharge limit. Although the facility could not identify a basis for this purported violation it reviewed its solids settling procedures to minimize the potential that any such violation would occur. The facility received a Notice of Noncompliance and Order, dated 3/11/94, from MWRA citing many of these purported exceedances and requesting submittal of a corrective action plan. Grace submitted the plan and has continued to implement steps to minimize discharge violations.

Second, the facility received an order from the MWRA on 9/30/92 to cease a discharge into the MWRA sewer from a pilot scale manufacturing facility. Grace and the MWRA had a dispute as to whether this discharge was authorized by Grace's then existing discharge permit. Grace immediately took steps to modify its permit to explicitly include this discharge. Subsequently, in order to resolve the disagreement, Grace signed a Consent Agreement with the MWRA on 1/10/94 in which it agreed to pay a \$90,000 penalty without an admission that a separate permit was required. As stated in the Agreement "the payment is made for settlement purposes only and does not reflect a finding or admission that Grace was in violation of the MWRA regulations or orders." Grace is aware of no information to suggest that the discharge that was the subject of the dispute resulted in any environmental impairment.

Third, the facility received an NOV from the MWRA dated 7/26/93 in which it asserted that Grace had failed to submit a result for pH in a required report. Grace had in fact submitted the result in a timely manner but had placed the data on the wrong MWRA form. The facility resubmitted the data to MWRA on the proper form. On early 1994 Grace notified the MWRA that due to personnel error, a 12/93 monthly sample and a fourth quarter 1993 sample had not been taken for analysis. At MWRA's request Grace promptly took additional samples and submitted the analyses to MWRA. In addition the facility revised sample scheduling procedures to prevent a reoccurrence. The subsequent MWRA Order of 3/11/94 cited the facility for failure to collect the quarterly sample.

The NOV's described above concern the wastewater discharges of Grace's current office/laboratory buildings to the MWRA sewer system. Grace is aware of no information to suggest that these purported violations have resulted in any environmental impairment or that these have resulted in a release of hazardous materials onto the property that is subject to 21E requirements.



**TIER CLASSIFICATION, TIER II EXTENSION &
TIER II TRANSFER TRANSMITTAL FORM**

Pursuant to 310 CMR 40.0510 and 40.0560 (Subpart E)

Release Tracking Number

3

0277

G. CERTIFICATION OF ABILITY AND WILLINGNESS:

- > If providing either a Tier II Classification Submittal or a Tier II Extension Submittal, the person who signs this certification **MUST** be the person named in Section J, or that person's agent.
- > If providing a Tier II Transfer Submittal, the person who signs this certification **MUST** be the person named in Section M, or that person's agent.

I attest under the pains and penalties of perjury that (i) I/the person(s) or entity(ies) on whose behalf this submittal is made has/have personally examined and am/is familiar with the requirements of M.G.L. c. 21E and 310 CMR 40.0000; (ii) based upon my inquiry of the/those Licensed Site Professional(s) employed or engaged to render Professional Services for the disposal site which is the subject of this Transmittal Form and of the person(s) or entity(ies) on whose behalf this submittal is made, and my/that person's(s') or entity's(ies') understanding as to the estimated costs of necessary response actions, that/those person(s) or entity(ies) has/have the technical, financial and legal ability to proceed with response actions for such site in accordance with M.G.L. c. 21E, 310 CMR 40.0000 and other applicable requirements; and (iii) that I am fully authorized to make this attestation on behalf of the person(s) or entity(ies) legally responsible for this submittal. I/the person(s) or entity(ies) on whose behalf this submittal is made is aware of the requirements in 310 CMR 40.0172 for notifying the Department in the event that I/the person(s) or entity(ies) on whose behalf this submittal is made learn(s) that it/they is/are unable to proceed with the necessary response actions.

By: [Signature]
(signature)

Title: Vice President Administration

For: W.R. Grace & Co. - Conn.
(print name of person or entity recorded in Section J or M, as appropriate)

Date: August 4, 1995

If you are submitting either a Tier II Extension Submittal for a Waiver Site or a Tier II Transfer Submittal for a Waiver Site, you may choose to sign the alternative Ability and Willingness Certification found in Section H in place of providing the certification in Section G and the LSP Opinion in Section I.

H. ALTERNATIVE CERTIFICATION OF ABILITY AND WILLINGNESS:

- > If providing a Tier II Extension Submittal for a Waiver Site, the person who signs this certification **MUST** be the person named in Section J, or that person's agent
- > If providing a Tier II Transfer Submittal for a Waiver Site, the person who signs this certification **MUST** be the person named in Section M, or that person's agent.

I attest under the pains and penalties of perjury that (i) I/the person(s) or entity(ies) on whose behalf this submittal is made has/have personally examined and am/is familiar with the requirements of M.G.L. c. 21E and 310 CMR 40.0000; (ii) based upon my inquiry of the Consultant-of-Record for the disposal site which is the subject of this Transmittal Form and of the person(s) or entity(ies) on whose behalf this submittal is made, and my/that person's(s') or entity's(ies') understanding as to the estimated costs of necessary response actions, that/those person(s) or entity(ies) has/have the technical, financial and legal ability to proceed with response actions for such site in accordance with M.G.L. c. 21E, 310 CMR 40.0000 and other applicable requirements; and (iii) that I am fully authorized to make this attestation on behalf of the person(s) or entity(ies) legally responsible for this submittal. I/the person(s) or entity(ies) on whose behalf this submittal is made is aware of the requirements in 310 CMR 40.0172 for notifying the Department in the event that I/the person(s) or entity(ies) on whose behalf this submittal is made learn(s) that it/they is/are unable to proceed with the necessary response actions.

By: _____
(signature)

Title: _____

For: _____
(print name of person or entity recorded in Section J or M, as appropriate)

Date: _____

I. LSP OPINION:

I attest under the pains and penalties of perjury that I have personally examined and am familiar with this transmittal form, including any and all documents accompanying this submittal. In my professional opinion and judgment based upon application of (i) the standard of care in 309 CMR 4.02(1), (ii) the applicable provisions of 309 CMR 4.02(2) and (3), and (iii) the provisions of 309 CMR 4.03(5), to the best of my knowledge, information and belief,

> if Section B of this form indicates that a Tier I or Tier II Classification Submittal which relies upon a previously submitted Phase I Completion Statement is being submitted, this Tier Classification Submittal has been developed in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000;

> if Section B of this form indicates that a Phase I Completion Statement or a Tier I or Tier II Classification Submittal which does not rely upon a previously submitted Phase I Completion Statement is being submitted, the response action(s) that is (are) the subject of this submittal (i) has (have) been developed and implemented in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, and (iii) complies(y) with the identified provisions of all orders, permits, and approvals identified in this submittal;

SECTION I IS CONTINUED ON THE NEXT PAGE



**TIER CLASSIFICATION, TIER II EXTENSION &
TIER II TRANSFER TRANSMITTAL FORM**
Pursuant to 310 CMR 40.0510 and 40.0560 (Subpart E)

Release Tracking Number

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0277

I. LSP OPINION: (continued)

> if Section B of this form indicates that a Tier II Extension Submittal or a Tier II Transfer Submittal is being submitted, the response action(s) that is (are) the subject of this submittal (i) is (are) being implemented in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, and (iii) complies(y) with the identified provisions of all orders, permits, and approvals identified in this submittal.

I am aware that significant penalties may result, including, but not limited to, possible fines and imprisonment, if I submit information which I know to be false, inaccurate or materially incomplete.

☐ Check here if the Response Action(s) on which this opinion is based, if any, are (were) subject to any order(s), permit(s) and/or approval(s) issued by DEP or EPA. If the box is checked, you MUST attach a statement identifying the applicable provisions thereof.

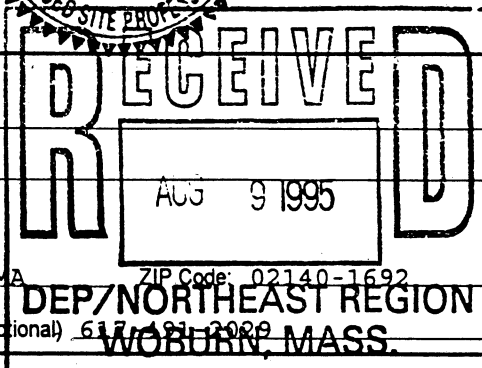
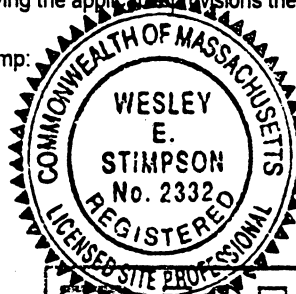
LSP Name: Wesley E. Stimpson LSP #: 2332 Stamp:

Telephone: 617-494-1606 Ext.: 715

FAX: (optional) 617-577-8142

Signature: [Signature]

Date: 4 AUG 1995



J. PERSON MAKING SUBMITTAL:

Name of Organization: W.R. Grace & Co. - Conn.

Name of Contact: David Wightman Title: _____

Street: 62 Whittemore Avenue

City/Town: Cambridge

State: MA ZIP Code: 02140-1692

Telephone: 617-498-4983 Ext.: _____

FAX: (optional) 617-498-2089

K. RELATIONSHIP TO DISPOSAL SITE OF PERSON MAKING SUBMITTAL: (check one)

☒ RP or PRP Specify: ☒ Owner ☐ Operator ☐ Generator ☐ Transporter Other RP or PRP: _____

☐ Fiduciary, Secured Lender or Municipality with Exempt Status (as defined by M.G.L. c. 21E, s. 2)

☐ Agency or Public Utility on a Right of Way (as defined by M.G.L. c. 21E, s. 5(j))

☐ Any Other Person Making Submittal Specify Relationship: _____

L. CERTIFICATION OF PERSON MAKING SUBMITTAL:

I, David Wightman, attest under the pains and penalties of perjury (i) that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this transmittal form, (ii) that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained in this submittal is, to the best of my knowledge and belief, true, accurate and complete, and (iii) that I am fully authorized to make this attestation on behalf of the entity legally responsible for this submittal. I/the person or entity on whose behalf this submittal is made am/is aware that there are significant penalties, including, but not limited to, possible fines and imprisonment, for willfully submitting false, inaccurate, or incomplete information.

By: [Signature]
(signature)

Title: Vice President Administration

For: W.R. Grace & Co. - Conn.
(print name of person or entity recorded in Section J)

Date: August 4, 1995

Enter address of the person providing certification(s), including Ability and Willingness Certification where applicable, if different from address recorded in Section J:

Street: _____

City/Town: _____

State: _____ ZIP Code: _____

Telephone: _____ Ext.: _____

FAX: (optional) _____

YOU MUST COMPLETE ALL RELEVANT SECTIONS OF THIS FORM OR DEP MAY RETURN THE DOCUMENT AS INCOMPLETE. IF YOU SUBMIT AN INCOMPLETE FORM, YOU MAY BE PENALIZED FOR MISSING A REQUIRED DEADLINE, AND YOU MAY INCUR ADDITIONAL COMPLIANCE FEES.



**TIER CLASSIFICATION, TIER II EXTENSION &
TIER II TRANSFER TRANSMITTAL FORM**

Pursuant to 310 CMR 40.0510 and 40.0560 (Subpart E)

Release Tracking Number

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Only complete and submit this page if you are providing a Tier II Transfer Submittal for a Tier II Site or a Waiver Site.

M. PERSON WHO IS TRANSFEREE:

Name of Organization: _____

Name of Contact: _____ Title: _____

Street: _____

City/Town: _____ State: _____ ZIP Code: _____

Telephone: _____ Ext.: _____ FAX: (optional) _____

N. RELATIONSHIP TO DISPOSAL SITE OF PERSON WHO IS TRANSFEREE: (check one)

☐ RP or PRP Specify: ☐ Owner ☐ Operator ☐ Generator ☐ Transporter Other RP or PRP: _____

☐ Fiduciary, Secured Lender or Municipality with Exempt Status (as defined by M.G.L. c. 21E, s. 2)

☐ Agency or Public Utility on a Right of Way (as defined by M.G.L. c. 21E, s. 5(j))

☐ Any Other Person Who is Transferee Specify Relationship: _____

O. CERTIFICATION OF PERSON WHO IS TRANSFEREE:

I, _____, attest under the pains and penalties of perjury (i) that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this transmittal form, (ii) that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained in this submittal is, to the best of my knowledge and belief, true, accurate and complete, and (iii) that I am fully authorized to make this attestation on behalf of the entity legally responsible for this submittal. I/the person or entity on whose behalf this submittal is made am/is aware that there are significant penalties, including, but not limited to, possible fines and imprisonment, for willfully submitting false, inaccurate, or incomplete information.

By: _____ Title: _____
(signature)

For: _____ Date: _____
(print name of person or entity recorded in Section M)

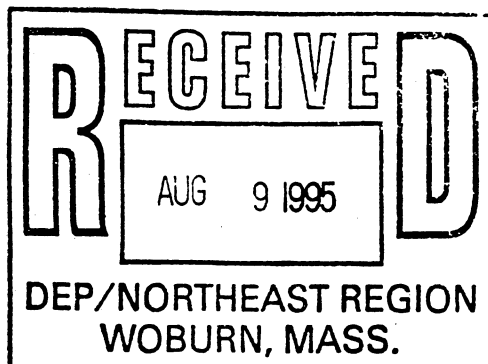
Enter address of the person providing certification, if different from address recorded in Section M:

Street: _____

City/Town: _____ State: _____ ZIP Code: _____

Telephone: _____ Ext.: _____ FAX: (optional) _____

YOU MUST COMPLETE ALL RELEVANT SECTIONS OF THIS FORM OR DEP MAY RETURN THE DOCUMENT AS INCOMPLETE. IF YOU SUBMIT AN INCOMPLETE FORM, YOU MAY BE PENALIZED FOR MISSING A REQUIRED DEADLINE, AND YOU MAY INCUR ADDITIONAL COMPLIANCE FEES.



MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

Bureau of Waste Site Cleanup

NUMERICAL RANKING SYSTEM SCORESHEET

(310 CMR 40.1511)

CLASSIFICATION SUBMITTAL	
Initial Submittal	Re-Classification
☒	☐

DISPOSAL SITE SCORE					
II	III	IV	V	VI	TOTAL
<u>105</u>	<u>122</u>	<u>25</u>	<u>100</u>	<u>-20</u>	<u>332</u>

Disposal Site Tier Classification	I			II
Permit Category (Tier I Only)	A	B	C	

I.	DISPOSAL SITE INFORMATION
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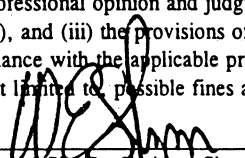
DEP Release Tracking Number(s)	3-0277
DEP Disposal Site Number(s)	

UTM Coordinates	N: 4695775
	E: 323850

Disposal Site Name	W.R. Grace & Co. - Conn.		
Disposal Site Address	62 Whittemore Avenue		
	City: Cambridge, Massachusetts	Zip: 02140-1692	

Is the Disposal Site classified Tier I because it is located within the boundaries of a Zone II or Interim Wellhead Protection Area and groundwater concentrations equal or exceed RCGW-1 at the time of Tier Classification pursuant to 310 CMR 40.0520(2)(a)1.?	Yes ☐	No ☒
Is the Disposal Site classified Tier I because an Imminent Hazard is present at the time of Tier Classification pursuant to 310 CMR 40.0520(2)(a)2.?	Yes ☐	No ☒

I attest under the pains and penalties of perjury that I have personally completed this Numerical Ranking System Scoresheet, and have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this submittal, and in my professional opinion and judgment based upon: (i) the standard of care in 309 CMR 4.02(1), (ii) the applicable provisions of 309 CMR 4.02(2) and (3), and (iii) the provisions of 309 CMR 4.03(5), to the best of my knowledge, information and belief, this Scoresheet was developed in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000. I am aware that significant penalties may result, including, but not limited to, possible fines and imprisonment, if I submit information which I know to be false, inaccurate or materially incomplete.


 Licensed Site Professional Signature

2332
 LSP Registration Number

4 AUG 1995
 Date

Wesley E. Stimpson

Haley & Aldrich, Inc.

(617) 494-1606

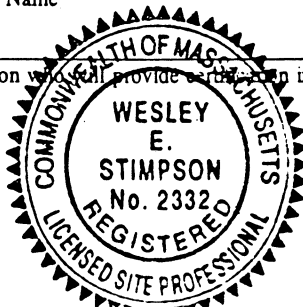
LSP Name (Printed)

Company Name

Telephone Number

W.R. Grace & Co. - Conn.

Responsible Party, Potentially Responsible Party, or Other Person who will provide certain information in accordance with 310 CMR 40.0009.



40.1511 (Continued)

II. EXPOSURE PATHWAYS

II. EXPOSURE PATHWAYS				
Score according to 40.1512 - Exposure Pathway Designation Criteria				
MEDIA	DESIGNATION			
	NONE or NOT APPLICABLE	EVIDENCE OF CONTAMINATION	POTENTIAL EXPOSURE PATHWAY	LIKELY OR CONFIRMED EXPOSURE PATHWAY
A. SOIL (Includes Sediment)	0	15	100	150
B. GROUNDWATER	0	20	100	150
C. SURFACE WATER (Includes Wetlands)	0	20	100	150
D. AIR	0	15	100	200

Note: Score only the highest value for each media, i.e., score None or Not Applicable or Evidence of Contamination or Potential Exposure Pathway or Likely or Confirmed Exposure Pathway.

II. (A - D) Summary Rationale for Section II A - D Values and Phase I Report References	
A.	OHM has been identified in soils at concentrations above applicable RCs (Environmental Data Report (EDR) by Haley & Aldrich, April 1988, Table I) - OHM is located beneath paved surfaces and at depths > 6".
B.	OHM has been identified in groundwater at concentrations above applicable RCs (EDR April 1988; Table II) - No drinking water wells or Zone II areas.
C.	OHM has been identified in surface water at concentrations above applicable RCs (EDR April 1988; Table II) - Surface water is not used for drinking, boating, or swimming.
D.	OHM attributable to the disposal site has not been identified in, and is not anticipated to be identified in air.

II.E. OHM SOURCES			
Number of OHM Sources	1	2	≥ 3
	0	25	50

SECTION II SCORE (A. + B. + C. + D. + E.)					
A. 15	B. 20	C. 20	D. 0	E. 50	TOTAL: (15 - 700) 105

Check here if Section VI has been used to amend the score for this Section of the NRS.	☐
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40.1511 (Continued)

III. DISPOSAL SITE CHARACTERISTICS

III.A. OHM TOXICITY SCORE <i>Highest OHM Toxicity Score</i> <i>From Table III.A. or Worksheet III.A.1. on Following Pages.</i>	
OHM Scored: <u>LEAD</u>	Toxicity Score (1 - 80)
Concentration and Media: <u>4,900 ppm in soil</u>	<u>40</u>

III.B. MULTIPLE OHMs		
More Than One OHM With an OHM Toxicity Score of ≥ 30	No	Yes
	<u>0</u>	<u>30</u>

III.C. OHM MOBILITY and PERSISTENCE <i>Score according to 40.1514 - OHM Mobility and Persistence</i>	
OHM Scored:	Score (0 - 50)
<u>TCE</u>	<u>40</u>

III.D. DISPOSAL SITE HYDROGEOLOGY <i>Score according to 40.1515 - Soil Permeability</i>			
DEPTH TO GROUNDWATER (in feet)	SOIL PERMEABILITY		
	Low	Medium	High
> 25	2	4	8
10.1 - 25	4	8	12
5.1 - 10	8	<u>12</u>	16
0 - 5	12	16	20

SECTION III SCORE (A + B + C + D)				
A.	B.	C.	D.	TOTAL: (3 - 180)
<u>40</u>	<u>30</u>	<u>40</u>	<u>12</u>	<u>122</u>

Check here if Section VI has been used to amend the score for this Section of the NRS.	☐
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40.1511 (Continued)

Table III.A. OHM TOXICITY SCORE							
OHM	CONCENTRATION (soil/sediment: $\mu\text{g/g}$; surface/groundwater $\mu\text{g/l}$)						
	≤ 99	100 - 999	1,000 - 9,999	10,000 - 100,000	$> 100,000$ NAPL $< 0.5''$	NAPL $0.5'' - 12''$	NAPL $> 12''$
Arsenic	(20)	30	40	50	60		
Benzene	15	(25)	35	45	55	65	75
Bis(2-ethylhexyl)phthalate	10	(20)	30	40	50	60	70
Cadmium	(10)	20	30	40	50		
Carbon Tetrachloride	(20)	30	40	50	60	70	80
Chlorobenzene	5	15	25	35	45	55	65
Chromium III	1	10	20	30	40		
Chromium VI	10	(20)	30	40	50		
Coal Tar	5	15	25	35	45	55	65
Cyanide	5	(15)	25	35	45		
1,1 Dichloroethane	(10)	20	30	40	50	60	70
1,2 Dichloroethane	(10)	20	30	40	50	60	70
Ethylbenzene	5	15	(25)	35	45	55	65
Ethylene Dibromide	20	30	40	50	60	70	80
#2 Fuel Oil (virgin product)	5	15	25	35	45	55	65
Gasoline (virgin product)	10	20	30	40	50	60	70
Lead	20	30	(40)	50	60		
Mercury	(20)	30	40	50	60	70	80
Methylene Chloride	10	(20)	30	40	50	60	70
Methyl Ethyl Ketone	5	15	(25)	35	45	55	65
Methyl Tert Butyl Ether	10	20	30	40	50	60	70
Nickel	5	(15)	25	35	45		
Phenol	(1)	10	20	30	40	50	60
PAHs	10	20	30	40	50	60	70
PCBs	20	30	40	50	60	70	80
Tetrachloroethylene	10	(20)	30	40	50	60	70
Toluene	(1)	10	20	30	40	50	60
1,1,1 Trichloroethane	5	(15)	25	35	45	55	65

Table III.A. OHM TOXICITY SCORE							
OHM	CONCENTRATION (soil/sediment: $\mu\text{g/g}$; surface/groundwater $\mu\text{g/l}$)						
	≤ 99	100 - 999	1,000 - 9,999	10,000 - 100,000	$> 100,000$ NAPL $< 0.5''$	NAPL 0.5'' - 12''	NAPL $> 12''$
Trichloroethylene	15	25	35	45	55	65	75
Vinyl Chloride	15	25	35	45	55	65	75
Xylenes	1	10	20	30	40	50	60
Zinc	1	10	20	30	40		

40.1511 (Continued)

Use Worksheet III.A.1. to determine the OHM Toxicity Score for OHM not listed in Table III.A.
See 40.1513 for Human Health-Based Toxicity Values for each OHM.

Worksheet III.A.1 OHM TOXICITY SCORE							
HUMAN HEALTH-BASED TOXICITY VALUE	CONCENTRATION						
	Use $\mu\text{g/g}$ for Soil and $\mu\text{g/l}$ for Surface Water and Groundwater						
	≤ 99	100 - 999	1,000 - 9,999	10,000 - 100,000	$> 100,000$ NAPL $< 0.5^*$	NAPL 0.5* - 12*	NAPL $> 12^*$
< 5	1	10	20	30	40	50	60
5 - 19	5	15	25	35	45	55	65
20 - 29	10	20	30	40	50	60	70
30 - 39	15	25	35	45	55	65	75
40 - 50	20	30	40	50	60	70	80

III.A.1. OHM and Concentrations Used in Section III.A.1.				
OHM	Human Health-Based Toxicity Value	Concentration (Soil - $\mu\text{g/g}$) ppm	Concentration (Water - $\mu\text{g/l}$) ppb	OHM Toxicity Score
Chloromethane	22	-ND-	9.9	10
Carbon Disulfide	8	0.18	300	15
1,1 Dichloroethene	28	0.042	9.6	10
2 Butanone (methyl ethyl ketone) *	8	0.110	1100	25
4 Methyl - 2 Pentanone *	8	1.2	380	15
2 Hexanone	25	0.38	310	20
Styrene	20	25	-ND-	10
2,2 Oxybis propane *		-NA-	28	
Bromodichloromethane	25	-ND-	5.5	10

* No human health based toxicity value given in MCP

40.1511 (Continued)

Use Worksheet III.A.1. to determine the OHM Toxicity Score for OHM not listed in Table III.A.
See 40.1513 for Human Health-Based Toxicity Values for each OHM.

Worksheet III.A.1 OHM TOXICITY SCORE							
HUMAN HEALTH-BASED TOXICITY VALUE	CONCENTRATION						
	Use $\mu\text{g/g}$ for Soil and $\mu\text{g/l}$ for Surface Water and Groundwater						
	≤ 99	100 - 999	1,000 - 9,999	10,000 - 100,000	$> 100,000$ NAPL $< 0.5^*$	NAPL 0.5" - 12"	NAPL $> 12^*$
< 5	1	10	20	30	40	50	60
5 - 19	5	15	25	35	45	55	65
20 - 29	10	20	30	40	50	60	70
30 - 39	15	25	35	45	55	65	75
40 - 50	20	30	40	50	60	70	80

III.A.1. OHM and Concentrations Used in Section III.A.1.				
OHM	Human Health-Based Toxicity Value	Concentration (Soil - $\mu\text{g/g}$) ppm	Concentration (Water - $\mu\text{g/l}$) ppb	OHM Toxicity Score
Napthalene	18	150	24,000	35
Nitrobenzene	40	-ND-	3.7	20
Benzo(a)anthracene	28	41	71.5	10
Benzo(a)pyrene	44	24	179	30
Benzo(b,k)fluoranthene	28	182.9	221	20
Chrysene	28	26	36.3	20
Benzo(g,h,i)perylene*	18	82	148.3	15
Chloroform	22	-ND-	12	10
1,2 Dichloroethene	25	-ND-	2.6	10
Phenanthrene	25	69	99.3	10

* No human health based toxicity value given in MCP

40.1511 (Continued)

Use Worksheet III.A.1. to determine the OHM Toxicity Score for OHM not listed in Table III.A.
See 40.1513 for Human Health-Based Toxicity Values for each OHM.

Worksheet III.A.1 OHM TOXICITY SCORE							
HUMAN HEALTH-BASED TOXICITY VALUE	CONCENTRATION						
	Use $\mu\text{g/g}$ for Soil and $\mu\text{g/l}$ for Surface Water and Groundwater						
	≤ 99	100 - 999	1,000 - 9,999	10,000 - 100,000	$> 100,000$ NAPL $< 0.5"$	NAPL 0.5" - 12"	NAPL $> 12"$
< 5	1	10	20	30	40	50	60
5 - 19	5	15	25	35	45	55	65
20 - 29	10	20	30	40	50	60	70
30 - 39	15	25	35	45	55	65	75
40 - 50	20	30	40	50	60	70	80

III.A.1. OHM and Concentrations Used in Section III.A.1.				
OHM	Human Health-Based Toxicity Value	Concentration (Soil - $\mu\text{g/g}$)	Concentration (Water - $\mu\text{g/l}$)	OHM Toxicity Score
Dibenzo (a,h) anthracene*		35.8	175.4	
Indeno 1,2,3 - cd pyrene*	44	97.5	138	30
Butyl benzyl phthalate	20	0.111	10.2	10
Di-n-octyl phthalate*		24	85	
p-chloro-m-cresol*		0.217	7.4	
2,4 - Dimethyl phenol	18	-ND-	150	15
2,4 Dinitrophenol	25	-ND-	170	20
n-nitrosodiphenylamine	22	0.123	2.8	10
silver	25	3.6	20	10

* No human health based toxicity value given in MCP

40.1511 (Continued)

Use Worksheet III.A.1. to determine the OHM Toxicity Score for OHM not listed in Table III.A.
See 40.1513 for Human Health-Based Toxicity Values for each OHM.

Worksheet III.A.1 OHM TOXICITY SCORE							
HUMAN HEALTH-BASED TOXICITY VALUE	CONCENTRATION						
	Use $\mu\text{g/g}$ for Soil and $\mu\text{g/l}$ for Surface Water and Groundwater						
	≤ 99	100 - 999	1,000 - 9,999	10,000 - 100,000	> 100,000 NAPL < 0.5*	NAPL 0.5* - 12*	NAPL > 12*
< 5	1	10	20	30	40	50	60
5 - 19	5	15	25	35	45	55	65
20 - 29	10	20	30	40	50	60	70
30 - 39	15	25	35	45	55	65	75
40 - 50	20	30	40	50	60	70	80

III.A.1. OHM and Concentrations Used in Section III.A.1.				
OHM	Human Health-Based Toxicity Value	Concentration (Soil - $\mu\text{g/g}$) ppm	Concentration (Water - $\mu\text{g/l}$) ppb	OHM Toxicity Score
Barium	8	611	160	15
Beryllium	38	2.8	-ND-	15
Copper	25	420	90	20
Antimony	40	3.9	-ND-	20
Selenium	25	4.0	400	20
Iron*		16,000	-NA-	
Total Phenolics*		28.4	0.06	
Formaldehyde	20	320	4.6	20
Oil & Grease*		81,700	464	
Petroleum Hydrocarbons*		11,000	-NA-	

* No human health based toxicity value given in MCP

40.1511 (Continued)

IV. HUMAN POPULATION AND LAND USES

IV.A. HUMAN POPULATION				
Residential Population Within ½ Mile	None 0	1 - 99 5	100 - 999 10	≥ 1,000 (15)
Institutions Within 500 feet	None (0)		One or More 10	
On-Site Workers	None 0	1 - 99 5	100 - 999 (10)	≥ 1,000 15

IV.B. AQUIFERS		
Sole Source Aquifer	No (0)	Yes 25
Potentially Productive Aquifer	No (0)	Medium or High 15

IV.C. WATER USE					
Proximity of Disposal Site to Public Drinking Water Supply Source	Not Applicable (NA) (0)			Zone A 20	Zone II, IWPA, or SW Intake ≤ 400' 50
Persons Served by Public Drinking Water Supply	NA (0)	25 - 999 5	1,000 - 4,999 10	5,000 - 49,999 20	≥ 50,000 25
Private Water Supplies Within 500 Feet	None (0)		Commercial Industrial 10	Agriculture Residential (Not Ingested) 15	Drinking Food Processing 25
Alternative Public Water Supply Available (Viable Public Water Supply in Disposal Site Community and Public Water Connection ≤ 500 Feet from Site)	Yes (0)			No 25	

SECTION IV SCORE (A + B + C)			
A. 25	B. 0	C. 0	TOTAL: (0 - 205) 25

Check here if Section VI has been used to amend the score for this Section of the NRS.	☐
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40.1511 (Continued)

V. ECOLOGICAL POPULATION

V.A. ENVIRONMENTAL RESOURCE AREAS			
RESOURCE	LOCATION		
Area of Critical Environmental Concern	> 500' from Site (0)	≤ 500' from Site 20	On-Site 30
Species of Special Concern, Threatened or Endangered Species Habitat	> 500' from Site (0)	On-Site or ≤ 500' from Habitat 30	
Wetlands, Certified Vernal Pool, or Outstanding Resource Water	> 100' from Site 0	≤ 100' from Site 20	On-Site (30)
Fish Habitat	> 500' from Site 0	≤ 500' from Site 20	On-Site (30)
Protected Open Space (Local/State/Federal/Trustee)	> 500' from Site 0	≤ 500' from Site (20)	On-Site 30

SCORE SECTION V.B. ONLY IF SECTION V.A. SCORE IS ≥ 30.

V.B. ENVIRONMENTAL TOXICITY SCORE <i>Highest Environmental Toxicity Score From Table V.B. or Worksheet V.B.1. on Following Pages.</i>	
OHM Scored: <u>Cadmium, Mercury, Lead, MEK, Zinc</u> Concentration and Media: <u>560 ppb (GW), 3.8 ppm (S), 4900 ppm (S), 1,100 ppb (GW), 11,975 ppm (S)</u>	Toxicity Score (1 - 35) 20

SECTION V. SCORE (A. + B.)		
A. 80	B. 20	TOTAL: (0 - 185) 100

Check here if Section VI has been used to amend the score for this Section of the NRS.	☒
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40.1511 (Continued)

Table V.B. ENVIRONMENTAL TOXICITY SCORE					
OHM	CONCENTRATION (soil/sediment: $\mu\text{g/g}$; surface/groundwater $\mu\text{g/l}$)				
	< 1	1 - 99	100 - 999	1,000 - 9,999	$\geq 10,000$
Arsenic	5	(10)	15	20	25
Benzene	0	1	(5)	10	15
Bis(2-ethylhexyl)phthalate *	5	10	(15)	20	25
Cadmium	10	15	(20)	25	30
Carbon Tetrachloride	0	(1)	5	10	15
Chlorobenzene *	5	10	15	20	25
Chromium III	1	5	10	15	20
Chromium VI	5	10	(15)	20	25
Coal Tar *	5	10	15	20	25
Cyanide	5	10	(15)	20	25
1,1 Dichloroethane *	5	10	15	20	25
1,2 Dichloroethane	0	(1)	5	10	15
Ethylbenzene	0	1	5	(10)	15
Ethylene Dibromide *	5	10	15	20	25
#2 Fuel Oil (virgin product) *	1	5	10	15	20
Gasoline (virgin product) *	5	10	15	20	25
Lead	5	10	15	(20)	25
Mercury	15	(20)	25	30	35
Methylene Chloride *	5	10	(15)	20	25
Methyl Ethyl Ketone *	5	10	15	(20)	25
Methyl Tert Butyl Ether *	1	5	10	15	20
Nickel	1	5	(10)	15	20
Phenol	0	(1)	5	10	15
PAHs *	5	10	15	20	25
PCBs	15	20	25	30	35
Tetrachloroethylene	0	1	(5)	10	15
Toluene	0	(1)	5	10	15
1,1,1 Trichloroethane	0	1	(5)	10	15
Trichloroethylene	0	(1)	5	10	15

Table V.B. ENVIRONMENTAL TOXICITY SCORE					
OHM	CONCENTRATION (soil/sediment: $\mu\text{g/g}$; surface/groundwater $\mu\text{g/l}$)				
	< 1	1 - 99	100 - 999	1,000 - 9,999	$\geq 10,000$
Vinyl Chloride *	5	10	15	20	25
Xylenes *	5	10	15	20	25
Zinc	1	5	10	15	20

* Scores derived by default methods 40.1516(2).

NON-TEXT PAGE

40.1511 (Continued)

Use Worksheet V.B.1. to determine Environmental Toxicity Scores for OHM not listed in Table V.B.

See 40.1516 for Environmental Toxicity Values for each OHM.

Worksheet V.B.1		ENVIRONMENTAL TOXICITY SCORE				
ENVIRONMENTAL TOXICITY VALUE	CONCENTRATION					
	Use $\mu\text{g/g}$ for Soil and $\mu\text{g/l}$ for Surface Water or Groundwater					
	< 1	1 - 99	100 - 999	1,000 - 9,900	$\geq 10,000$	
10	0	1	5	10	15	
20	1	5	10	15	20	
30	5	10	15	20	25	
40	10	15	20	25	30	
50	15	20	25	30	35	

[illegible]

40.1511 (Continued) VI. MITIGATING DISPOSAL SITE-SPECIFIC CONDITIONS

VI. MITIGATING DISPOSAL SITE-SPECIFIC CONDITIONS	
Disposal site-specific conditions that warrant amending the site score. Changes directly related to NRS Sections or Subsection scores may not reduce the score more than the relevant subsection value assigned for the disposal site in that subsection. Section VI must reference specific pages of the Phase I. Section VI may not exceed $\pm$ 50 Points and may be scored only in 5-point increments. Attach additional pages as necessary.	
The site has been characterized at a level of detail greater than a Phase II Comprehensive Site Characterization. A groundwater and surface water monitoring program has been underway for the last seven years. Therefore significantly more data exists than is commonly available at the end of a Phase I study.	
As a result of the availability of this data, the following reductions have been made:	
Under Section V. - Ecological Population, Part A, the fish habitat on-site (Jerrys Pond) score of 30 points is reduced by 10 points (to a total of 20 points) due to data from post Phase II investigations (Long-Term Monitoring Report, December 1994) indicating that surface water and sediment contamination do not exist in Jerrys Pond.	
Under Section V. Ecological Population, Part A, the protected open space $\leq$ 500 ft. from the site (Alewife Brook Reservation) score of 20 points is reduced by 10 points (to a total of 10 points) due to data from the Long-Term Monitoring Report indicating that surface water contamination does not exist in Alewife Brook at locations both upstream and downstream of the site. The Reservation is also located across Alewife Brook Parkway from the site. Alewife Brook Parkway is a divided, four lane highway with no opportunity for surficial contamination from the site to impact the Reservation.	
Disposal Site Score Amendment (Not to Exceed $\pm$ 50 Points)	Score <u>-20</u>

40.1512 Exposure Pathway Designation Criteria

C

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I

W.R. Grace & Co., Inc. Superfund Status
Cambridge, Massachusetts

Site Information: W.R. Grace & Co., Inc.
62 Whittemore Avenue
Cambridge, MA 02140
ID No. MAD001409150

EPA Superfund Site Assessment Investigations:

- EPA received "Notification of Hazardous Waste Site" from W.R. Grace; Site Discovery date of 11/01/80 entered into CERCLIS
- EPA contractor (NUS Corporation) completed first investigation; Preliminary Assessment date of 09/12/85 entered into CERCLIS; further investigation is recommended
- EPA contractor (NUS Corporation) completed second investigation; Site Inspection date of 06/14/89 entered into CERCLIS; site is assigned a "No Further Remedial Action Planned" (NFRAP) designation based on low Hazard Ranking System score and therefore is not eligible for the National Priorities List
- At the completion of the Site Inspection, EPA referred the site to MADEP for any further investigation/remediation in accordance with the Massachusetts Waste Site Cleanup program
- In accordance with EPA policy, the site was removed, or archived, from CERCLIS in 1995

Massachusetts CERCLIS Status

Total # of CERCLIS sites in New England	2,633
Total # of Massachusetts sites in CERCLIS	1,015
Total # of sites removed from CERCLIS (NFRAP or RCRA Deferral)	354 (35%)
Total # of sites on the NPL	30 (3 %)
Total # of sites removed from the NPL	1
Total # of sites that remain active	630 (62%)

* Data as of 07/10/96

Sites assigned NFRAP or deferred to RCRA decisions are removed from EPA's CERCLIS database, and archived as historical records to ensure EPA does not needlessly repeat the investigations in the future.

Definitions:

CERCLIS:	Comprehensive Environmental Response, Compensation and Liability Information System
NFRAP:	No Further Remedial Action Planned
RCRA:	Resource Conservation and Recovery Act
NPL:	National Priorities List/Superfund List

THE SUPERFUND PROGRAM SITE ASSESSMENT PROCESS

Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 1980 (and amended by the Superfund Amendments and Reauthorization Act (SARA) in 1986), to address the environmental threats posed by the nation's uncontrolled hazardous waste sites. CERCLA directed the U.S. Environmental Protection Agency (EPA) to identify the sites that pose the greatest relative danger to human health or the environment. In response, EPA developed a Site Assessment process to evaluate and screen sites within the Superfund program. The main components of the Site Assessment process are:

CERCLIS: The CERCLA Information System (CERCLIS) is the EPA Superfund program database used to record and track activities at all known and suspected hazardous waste disposal sites. EPA learns of sites in a number of ways, including through other federal, state and local government programs, and by citizen and private industry notifications. All potential hazardous waste disposal sites brought to the attention of the EPA Superfund Site Assessment program are entered into the CERCLIS database, as a prerequisite to site evaluation. Inclusion of a specific location in the CERCLIS data base carries no legal or regulatory consequences.

Preliminary Assessment (PA): The Preliminary Assessment, first step in the Superfund Site Assessment process, is a relatively quick, low-cost compilation of readily available information about a site and its surroundings. An EPA contractor or the state (via an EPA grant) conducts a PA at every site entered into CERCLIS, usually within one year of the site's entry into CERCLIS. Through interviews, review of available information and a site visit, the PA provides an initial screening to determine whether a site may be eligible for inclusion on the National Priorities List (NPL or "Superfund List"), the list of the nation's most serious hazardous waste disposal sites. At the conclusion of the PA, EPA decides either to send the site forward in the assessment process, to defer the site to another federal program, or to classify the site as "No Further Remedial Action Planned" (NFRAP). Sites receiving a NFRAP or deferred decision are removed from CERCLIS and archived as historical records.

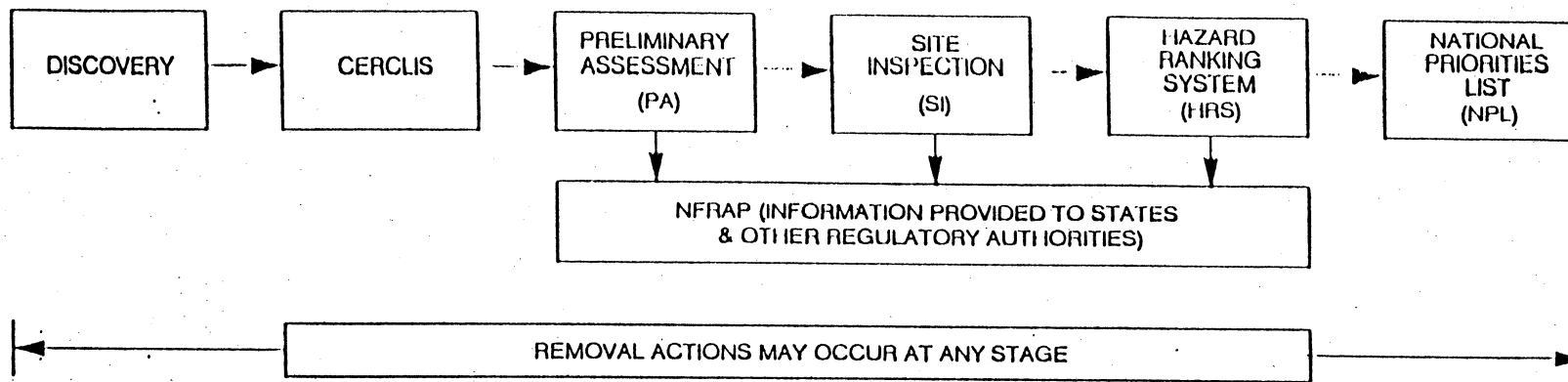
No Further Remedial Action Planned (NFRAP): A NFRAP decision does not necessarily mean that there is no hazard associated with a given site; it means only that based upon information available at the time of the assessment, the location is not judged to warrant further federal Superfund remedial action. Thus, a NFRAP decision means that no additional steps will be taken to list the site on the NPL. Sites with NFRAP decisions are referred to the state for possible further action under state authorities. NFRAP decisions may be changed in the future if additional information is received which indicates that further investigation of the site under CERCLA is appropriate.

Site Inspection (SI): The Site Inspection is the second step in the Superfund Site Assessment process. An EPA contractor or the state (via an EPA grant) conducts an SI at each site recommended for continued CERCLA investigation following the PA. An SI involves more extensive data gathering and typically includes an onsite reconnaissance and the collection and analysis of waste and environmental samples to determine whether a release of hazardous substances has occurred. Based on the information gathered during the SI, EPA will either classify the site as NFRAP, or assign the site a relative priority for preparation of an HRS package to support listing the site on the NPL.

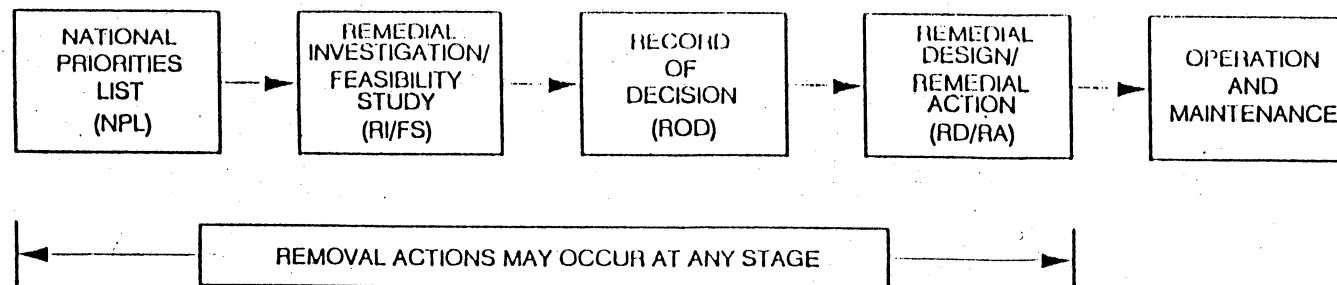
Hazard Ranking System (HRS): The HRS uses information gathered during the Site Assessment process to consistently screen all of the potential hazardous waste disposal sites in CERCLIS and to identify suitable candidates for inclusion on the National Priorities List (NPL). The HRS model is used to assess the relative human health and environmental threats posed by releases or potential releases of hazardous substances at a site. The HRS results in a numerical score between 0-100. Sites scoring 28.5 and above may be considered for inclusion on the NPL, and sites scoring below 28.5 are classified as NFRAP and referred to the state for possible response actions under state authorities.

The Superfund Process

SITE ASSESSMENT PHASE



REMEDIAL PHASE



Preliminary HRS evaluations are performed at each step in the Site Assessment process. Sites which are to be proposed for inclusion on the National Priorities List (NPL) are scored using the full HRS model. At this point, extreme care is taken to ensure that every element of the HRS score is clearly documented and fully supported via rigorous quality review. Completed HRS packages form the basis for EPA to propose sites for inclusion on the NPL (refer to the NPL process described below). For this reason, HRS evaluations may not be discussed with parties outside EPA, and are only released when the site is assigned a NFRAP decision due to its low HRS score, or the site is proposed for inclusion on the NPL.

National Priorities List: The NPL informs the public of uncontrolled hazardous waste sites that warrant further investigation to determine if they pose risks to human health or the environment, and if long-term remedial actions are necessary. EPA uses informal rulemaking to place sites on the NPL. Sites are first proposed to the NPL in the Federal Register. EPA then accepts public comments on the sites (typically for 60 days), responds to the comments, and finally places on the NPL those sites that continue to meet the requirements for listing following comment resolution.

Only a small percentage of sites evaluated by the EPA Site Assessment program are proposed for inclusion on the NPL. Currently, there are just under 100 NPL sites in New England, representing 3.7% of the more than 2,600 New England sites which have been entered into CERCLIS since 1980. Approximately 1,200 sites have been assigned NFRAP designations or deferred to other federal programs, and the remaining 1,400+ sites are being evaluated by EPA via the Superfund Site Assessment process.

Emergency Response: Sites which may pose an immediate threat to public health or the environment are referred to EPA's Emergency Planning and Response Branch for possible emergency actions. These referrals are made as soon as the potential threat is recognized, and may occur at any step in the Site Assessment process. Sites which are referred to the Emergency Planning and Response Branch also continue to be evaluated via the Site Assessment program, and may be proposed for inclusion on the NPL.

Objectives of the Site Assessment Program: The primary objective of the Site Assessment program, as specified in the National Contingency Plan, is to obtain enough data to evaluate sites under the HRS and to identify those that should be placed on the NPL. The revised HRS model requires more data than the original HRS, and the Site Assessment process has been restructured to balance the need to accurately assess site conditions with the need to conserve resources. Thus, each step in the Site Assessment process is limited in scope, and designed to achieve the specific goal of identifying appropriate candidate sites for inclusion on the NPL.

Secondary goals of the Site Assessment program are to support potential removal or enforcement actions, and to collect data to support the Remedial Investigation and Feasibility Study (if the site is consequently placed on the NPL) or response action under other authorities.

City of Cambridge

The Environment Committee held a public meeting on Tuesday, September 24, 1996, beginning at 7:15 p.m. in the M.E. Fitzgerald School Cafeteria, 70 Rindge Avenue, for the purpose of hearing testimony from City, State and Federal officials and consultants concerning contamination and necessary steps to remediate the site at and around the former W.R. Grace site at the corner of Whittemore Avenue, Rindge Avenue and Route 2 in North Cambridge.

Present at the hearing were Councillor Francis H. Duehay, Chair of the Committee, Vice Mayor Kathleen L. Born, Councillor Henrietta Davis, Councillor Anthony D. Galluccio, Councillor Michael A. Sullivan, Councillor Timothy J. Toomey, Jr., Councillor Katherine Triantafillou, and City Clerk D. Margaret Drury. Also present were Robert W. Healy, City Manager, Dr. Harold Cox, Chief Public Health Officer, Elizabeth Epstein, Deputy Director of Community Development Department, Kathleen Brown, Environmental Program, Community Development Department.

Councillor Duehay convened the hearing and explained the purpose. He described the agenda (Attachment A), and explained that this will be a working meeting of the Committee to enable the committee members to increase their understanding by hearing from and questioning the experts and professionals who have been involved in this issue. Councillor Duehay then introduced Robert W. Healy, Harold Cox and Elizabeth Epstein. He stated that Senator Warren Tolman is present and has several other meetings to attend. He invited Senator Tolman to make a statement.

Senator Tolman expressed his concern for this issue. He added that he knows that doubts remain regarding the site, particularly regarding groundwater contamination. He also noted concerns that have been expressed to him by citizens regarding Russell Field.

Senator Tolman stated that he has had previous experience with site remediation through the process of cleaning up the old arsenal site in Watertown, which is now the site of housing and the Arsenal Mall. He said that most important issue for this site at this time is the restoration of trust.

Councillor Duehay expressed appreciation for Senator Tolman's concern and assistance at the state level. He then noted the presence of former Mayor and State Representative candidate Alice Wolf.

Councillor Duehay then introduced Dr. John D. Spengler, Ph. D, Harvard School of Public Health and Environmental Health and Engineering. Dr. Spengler reviewed his history with the site.

He noted that no additional data collection efforts were made at the time he conducted his analysis. Statistical analysis was done to check on whether the samples collected and identified by Haley and Aldrich, W.R. Grace's consultant, conformed with statistical expectations. The first issue in a risk assessment is the risk from contaminants. There are two components to this risk assessment. One is that a pathway is necessary for human exposure. The second component is a damage component.

A formal risk assessment was done in 1988 and updated in 1994. Dr. Spengler reviewed this risk assessment. It looked at cancer risk and noncancer risk.

After review, Dr. Spengler's team did not see an unacceptable risk based on the compounds that were there. The projections were for workers on site, users and neighbors.

Dr. Spengler emphasized that this is very different from risk perception. His team tried to look at the issue of confidence in the data base, that is whether there were sufficient samples and appropriate analytic analysis of the samples collected and used in the risk assessment.

Dr. Spengler stated that the team was not as confident about the pathways analysis. There is some evidence that groundwater has moved some of these materials. Regarding the dangers of excavation, the team believed that there would be sufficient oversight of construction to remediate risks associated with excavation.

Dr. Spengler pointed out the lack of knowledge regarding groundwater movement north of the MBTA tunnel. There is no data; however, there is evidence that groundwater flow has changed, and there are changed circumstances that could have affected groundwater movement, the tunnel cut and the change in elevation. Dr. Spengler added that another unknown is the history of Russell Field.

Councillor Duehay then invited questions from City Councillors.

Councillor Triantafillou asked why the 1994 and 1988 soil samples are relevant and why new soil samples are not taken. Dr. Spengler stated that water samples were taken from forty-four wells, nine of which have continued to be monitored so some information is much more current than 1988 and 1994. Regarding soil samples, the question is what would have changed? Contaminants could have migrated or concentrations may have been reduced, but it is virtually impossible for the soil contamination to have increased. The earlier soil test represented some of the upper boundaries of toxicity.

Councillor Triantafillou asked for recommendations on how to determine toxicity on Russell Field, which has not been tested.

Dr. Spengler said that there are various ways. One is through testing topsoils, because there is no access to any potential contaminants four-five feet down. Samples could be pooled and homogenized.

Councillor Triantafillou asked for a further explanation.

Dr. Spengler said that the testing would have to be of a representative number of samples because you cannot take an infinite number. One could take several samples from one or two feet down, and then blend them.

Dr. Spengler continued that the next set of questions has to do with concern for future exposures; and that is the question of whether deeper contaminants could migrate through the groundwater. For this, it is necessary to know which way the groundwater is moving, and then to test deeper in those areas.

Councillor Triantafillou asked whether if you knew that peoples' basements were flooding, you would test those areas. Dr. Spengler said that it would depend on which way the groundwater is flowing. You would not want to test surface water, if that was what was causing the flooding.

Councillor Triantafillou asked whether other tests would be recommended for Russell Field.

Dr. Spengler said that this would depend on what was found in these first tests. If contamination were found, there would need to be a good understanding of where it came from and where it was likely to go.

Councillor Triantafillou asked about the possibility of contamination going through the tunnel and out the MBTA exhaust system. Dr. Spengler said the issue of tunnel air contamination was explored. Some contaminants were found in the tunnel air, but the amount of dilution would be substantial.

Councillor Triantafillou asked why there is no understanding of what was dumped on Russell Field during the MBTA excavation. Dr. Spengler said that in a excavation of that size, unless the material was specifically required to be tracked, it would be unusual to find adequate records of where it went.

Councillor Triantafillou asked whether Dr. Spengler knew what was in the little ponds in the area, such as Parkway Pond. Dr. Spengler said that there have been measurements over time because sumps in the MBTA tunnel discharge into that pond, as does the drainage from the Alewife parking lot.

Councillor Triantafillou asked Dr. Spengler how excavation would affect the chemicals in the ground at the Grace site. Dr. Spengler said that two things could happen. The construction could alter the groundwater flow. Soluble materials could then migrate off site and lead to an exposure pathway. The other thing is that there could be exposure of what is in the ground to the air which could lead to volatilization, dispersion through the air or further degradation. This could also lead to an exposure pathway.

Councillor Triantafillou asked how slab construction or other construct techniques would affect the potential for exposure pathways.

Dr. Spengler said that slab construction does create some disruption, but there is less than with a foundation construction which requires moving earth. The risk assessments which Dr. Spengler reviewed did evaluate foundation construction, and found low risks. He noted that his team felt that the risk assessment was done conservatively and if all the assumptions are there, the risks are very low. However there is always the risk of something else that was not tested for being there.

Councillor Triantafillou observed that the predictions regarding groundwater were not accurate. The water is going into basements. She asked how citizens can believe other predictions.

Dr. Spengler stated that you have to go back and look at the assumptions. His team is also concerned that the groundwater was not flowing as predicted.

Councillor Sullivan asked for an explanation of the "recharging" of groundwater by rain. Dr. Spengler explained that groundwater eventually evaporates and disperses and that rainwater on an annual basis seeps into groundwater to resupply it.

Councillor Sullivan asked how much time went into doing his reports. Dr. Spengler said several months. Councillor Sullivan asked about the discrepancy in the language of the two reports regarding the basements and groundwater flow.

Dr. Spengler said that there were several meetings with citizens on Clifton Street. The goal was to meet with residents and hear their reports and concerns. The language difference reflects this. Dr. Spengler said that at this point he does not believe that anyone knows whether the basement flooding has to do with surface runoff or a change in groundwater movement. Groundwater movement change could create a pathway.

Councillor Davis said that part of the question for the City Council is whether they have enough information to make a decision. If Dr. Spengler had all of the resources to do testing, would he have done some things differently.

Dr. Spengler said that he would like to open up other wells and test those. The criteria for choosing the nine for longterm monitoring is not clear to him. In addition, he would have liked to do more work on resolving the tunnel issue. The tunnel might hold a clue to what chemicals are below the groundwater and might leach out. If he were truly unbound by money concerns, he might recommend preventive mediation, for example, an experimental technology such as drilling a series of wells and injecting bacteria to ingest the chemicals. He stated that he is not suggesting that this is necessary.

Councillor Davis asked what his competition would say about his testing and what standards Dr. Spengler was following: were they industry standards? Dr. Spengler said that he was asked for a good faith assessment from a public health standpoint.

Dr. Spengler noted the importance of coming to grips with the fundamental issue of whether there is confidence in the data on which the analysis is based.

Councillor Davis noted Dr. Spengler's recommendation for continued testing to make sure that the results are expected. Dr. Spengler said that this is true. Councillor Davis asked whether he can envision anything that would come up that could not be dealt with.

Dr. Spengler said that he did not believe that would be the case. The most disruptive event was putting the tunnel through the middle of the pits and settling pond. The tunnel would be the early warning indication.

Councillor Davis asked about the dangers from dust during construction and if there would be sufficient remediation. Dr. Spengler said that monitors do exist. In addition the community will report discomfort that it experiences. The mitigation possibly includes wetting down the soils, using other dust control, changing truck routes, etc.

Councillor Davis asked how we can make sure that remediation takes place. Dr. Spengler said it depends in the vigilance of those given the monitoring responsibilities. You can do everything from video taping, to requiring public reporting of measurements, or hiring an on-site monitor.

Councillor Galluccio asked how open-ended is his report and its conclusions. He noted that the groundwater uncertainties and lack of knowledge of Russell Field stand out.

Dr. Spengler said that he has worked on some other sites such as Love Canal. The data here does not show obvious pathways of such concentrations of dangerous materials that all activity should stop. The next question is whether everything is known well enough to say there is no danger. That is the case here. There are signature chemicals of the site in property boundary wells. It is important to have an early warning system in place.

Councillor Galluccio asked if Dr. Spengler's conclusions after analysis was complete surprised him. Dr. Spengler said that from the site inventory, the result is not surprising. The site is somewhat different from some others. No one is drinking the water.

Councillor Galluccio asked whether Dr. Spengler had reviewed any other W.R Grace or Dewey and Almy sites. Dr. Spengler said no, although he has had some peripheral experience with the Woburn site.

Councillor Galluccio asked Dr. Spengler what his "batting average" is. Dr. Spengler said that he comes to the process with a public health bias to err on the side of caution.

Councillor Galluccio asked if there are other questions the City should be asking, for example, is there any risk to the water at Fresh Pond. Dr. Spengler said that he did bring a colleague from the Cambridge Water Board, Dr. Harrington into the process. Dr. Harrington was very concerned about any risk to Fresh Pond. Dr. Spengler recommended that the committee speak to his colleague on this matter.

Dr. Spengler said that there will always be some risk, even if the site is left alone. The question is what covenant can be made with the developer. That covenant can encompass all kinds of risks, including traffic and other quality of life and health concerns.

Councillor Galluccio said that it is important to have clarification of exactly the scope of what Dr. Spengler's review is.

Councillor Triantafillou asked for further clarification of Councillor Galluccio's question of should we have asked a different question.

Dr. Spengler said the question he would have liked to have had put to him would have been a request to help resolve the questions between the developer and the neighborhood regarding environmental issues of this site. Risk is part of it; so is traffic, so are other quality of life issues.

Councillor Triantafillou asked for clarification of Dr. Spengler's earlier remarks about trust of data. Dr. Spengler said that it is important to decide whether data gathering will be part of the project. If not, you look at what is before you. Here it was reputable firms, identifiable laboratories. There can be lab tracing, etc. The team chose instead to do statistical analysis of the available data and came away satisfied that this represented the material on the site.

Councillor Triantafillou asked if the analysis could be different if Dr. Spengler had looked at the other wells. Dr. Spengler said that it was possible.

Vice Mayor Born asked whether some materials on site are toxic. Dr. Spengler replied in the affirmative. Vice Mayor Born asked which substances besides naphthalene cause him the most concern. Dr. Spengler listed aromatic hydrocarbons, benzoathracene, benzopyrenes and cadmium. Dr. Spengler said there are other contaminants besides naphthalene, and he is not quite sure how to formulate an answer to this question. He stated that in the issue of risk perception, this is exactly the dread that exists. For example, naphthalene will smell, but there is no evidence that this smell is associated with a public health risk.

Vice Mayor Born said that there are two pieces to the public perception. One is understanding what the contaminants are and what are the ways for them to get into peoples' bodies. She asked how far down is the toxic soil on the Grace site. Dr. Spengler said that in some cases it is several feet down.

Vice Mayor Born asked whether it is thirty feet down. Dr. Spengler said that he does not believe that any testing has been done to that depth.

Vice Mayor Born asked for a explanation of groundwater. Dr. Spengler said that some rainwater percolates down into the soil and stays there. That becomes groundwater. Contaminants at the surface can be carried by surface water.

Vice Mayor Born asked whether before the Red Line construction, all groundwater eventually flowed to Alewife Brook. Dr. Spengler said yes, and now it may have changed.

Dr. Spengler said that he believes that the tunnel was constructed to be transparent to groundwater.

Vice Mayor Born asked if the tunnel is not in fact transparent to groundwater, can it be fixed. Dr. Spengler said that there are some solutions.

Councillor Sullivan asked when Dr. Spengler was first hired by the City. Dr. Spengler replied that it was about a year ago.

Councillor Duehay requested that Dr. Spengler put in writing some amplification of his suggestion that at the time of construction there could be some risk-reduction agreement.

Councillor Duehay asked whether Dr. Spengler had reviewed the City Manager's proposal for looking at the Russell Field site and asked Dr. Spengler to tell the City Council what the cost would be to review the site the way he would recommend.

Councillor Triantafillou asked about the chart on page fourteen and fifteen of Dr. Spengler's final report. Is it possible that there are other chemicals on the site but not on the list. Dr. Spengler said yes it is possible, but the test would have identified 125 of the chemicals with which public health and environmental protection agencies are the most concerned.

Vice Mayor Born asked whether Dr. Spengler recommends further health assessments. Dr. Spengler said that his team did not address the issue. Dr. Spengler said that in the Woburn case, there were other occurrences such as unexplained rashes, not just diseases. If there is a rare outcome, like angiosarcoma, there may be a starting point for a demonstration of a health risk in the community. However, cancer is a rather common disease. Such studies are not easy. Information regarding connection of parents' smoking with asthma was generated from very large population studies. Dr. Spengler said that this kind of study would easily cost about \$200,000, and would be using a very small sample population.

Councillor Duehay thanked Dr. Spengler.

Councillor Duehay then introduced Edward Weagle, Massachusetts Department of Environmental Protection, Bureau of Waste Site Clean-up.

Mr. Weagle said that the Department of Environmental Protection (DEP) reviewed all the cleanup activities and documents under its previous regulations. Under its new regulations, promulgated in October, 1993, review has been privatized. Where DEP is not involved, the audit process uses "licensed site professionals". He said that the audit at this site was narrowly focused to issues of whether it was properly tanked, the potential of contamination present at the surface of Russell Field, and the groundwater issues.

Mr. Weagle said that DEP findings include findings that a small portion of the ranking of the site was done incorrectly and should be revised. Regarding the potential for contaminated groundwater, DEP agrees with W.R. Grace that it is not impacting Whittemore Avenue, but DEP needs a better explanation regarding Harvey and Clifton Streets. Regarding Russell Field, he has gone through MBTA documentation in Charlestown. Photos show that the grade was

raised five feet. The material used looks sandy and clean and this clean soil could not have come from that area. Photos also indicate that sod was put on the field. The DEP has concluded that there is very little possibility of contamination at the surface of Russell Field. He said that DEP also found a very minor deficiency in the public process utilized. Mr. Weagle noted that DEP has determined that the site should be classified as a Tier IC rather than a Tier II. The only difference is that with the new classification, DEP would review the remediation actions taken.

Mr. Weagle then invited questions.

Councillor Duehay asked whether cleanup must occur by the year 2000 under the DEP regulations and Mr. Weagle stated that this is so.

Councillor Duehay asked whether a remediation plan has been approved. Mr. Weagle said no. He said that W.R. Grace has identified a number of alternatives.

Councillor Duehay asked if DEP has to approve a timetable. Mr. Weagle said no.

Councillor Duehay asked what if there is no development. Mr. Weagle said that there is still the five year timeline. Councillor Duehay requested that the new DEP audit be made part of the record and distributed to the City Council as soon as possible.

Councillor Triantafillou asked how the site was re-tiered. Mr. Weagle said that DEP has evaluated the scoring of the site on a point-by-point criteria. DEP looked at the Tier Classification submitted by W.R. Grace. Councillor Triantafillou asked whether the Committee on the Environment has a copy. Councillor Duehay said he will request that the City Clerk obtain a copy. (Copy attached to this report as Attachment B).

In response to a question by Councillor Triantafillou, Mr. Weagle said that since W.R. Grace did not complete the cleanup under the old regulations, which did not have timelines, W.R. Grace now must comply with the five-year timeline under the new regulations.

Councillor Galluccio asked where DEP study stands with respect to this site, now that further information has been requested. Mr. Weagle said that W.R. Grace has not achieved the final solution, so DEP is not through with the site but DEP is not interested in if the site is developed.

Councillor Galluccio noted that there has been discussion of the new height of Russell Field. There should be a study of the effect of the new height on Clifton Street. That study should really be done now.

Vice Mayor Born asked what cleaning up the site means to DEP, does it mean removing the contaminants or covering it up. Mr. Weagle said that either option is possible.

Vice Mayor Born noted the requirement for small property owners to remove oil tanks. She queried why it is so much easier for large developers. Mr. Weagle said that at the W.R. Grace site, the chemicals are basically oil. Vice Mayor Born said that her question still applies. She said that the premise should be that all of the contaminants should be removed. She added that the end of Russell Field closer to the pool did not seem to have had fill piled on it because it is much lower. She suggested examination of that area.

Councillor Duehay then introduced Sharon Hayes, Site Assessment Manager, US Environmental Protection Agency. She distributed a description of the Superfund assessment process (Attachment C); and described the assessment of the W.R. Grace site. EPA determined in 1989 that the site's hazard ranking system score was not high enough to qualify for further federal attention. Only three percent of the sites looked at by EPA are on the list of Superfund sites.

Councillor Duehay asked whether the EPA has any way to prod states to move more quickly on sites that are not designated as Superfund sites. Ms. Hayes said that the EPA, with its limited budget, concentrates its resources on the worst sites. She does not believe that the EPA has ever brought back a site designated as "no further remedial action".

Councillor Galluccio asked whether DEP has a different criteria for risk. Mr. Weagle answered in the affirmative.

Councillor Duehay thanked Edward Weagle and Sharon Hayes for coming.

Councillor Duehay then introduced MBTA representatives Howard Haywood, Chief of Design and Construction, and John Powers, Assistant Director of Design and Construction, and invited questions from the City Council.

Councillor Davis asked what was the procedure followed in reconstructing Russell Field. Mr. Haywood said that about twelve to eighteen inches of topsoil was peeled back and stored at the edge of the site. Then they worked with the Cambridge Department of Public Works to determine the level and grade, because the field did not drain well before. New clean fill was brought in, none of the old was reused. Then they used the original topsoil and put sod down. There were issues of basement flooding on Clifton Street before the reconstruction, so much work was done with the community. Nothing that was done to Russell Field should have brought contaminants. There was very little excavation. At the edge of the field there is a swail that should help the drainage. Nothing from the tunnel excavation was stored on the field.

Councillor Triantafillou asked if there would be records of material removed from the site. Mr. Haywood said that if the material was designated as hazardous, there would be records. Mr. Haywood said that very little of the material excavated from the tunnel was designated as hazardous.

Councillor Triantafillou asked for a definition of "swail". Mr. Haywood said that it is a drainage ditch. Councillor Duehay asked about problems with the tunnel at the time. Mr. Haywood said he worked on the site from 1980 to completion. There were at least four different toxicity tests done on the tunnel.

Councillor Duehay asked whether the MBTA would cooperate with the City if further testing was required. Mr. Haywood said he believed that the MBTA would cooperate.

Vice Mayor Born asked about the water situation. Mr. Haywood said that there is a history of drainage problems on Clifton Street, particularly the lower end.

Mr. Haywood described the siphon designed around the tunnel. It was laid on a bed of gravel that was designed to wick the water under the tunnel and back up the other side. There is a extensive record on this. Ed Kowalski, Department of Environmental Quality Engineering, was constantly on site.

Vice Mayor Born asked whether the siphon isn't working, the MBTA would be willing to fix it. Mr. Powers and Mr. Haywood said that they cannot speak for Mr. Moynihan.

Councillor Triantafillou asked whether he was sure that there was no stockpiling of contaminated soil on the Russell Field site. He said no. Councillor Triantafillou asked why he signed a report that said "special waste" containing naphthalene was stored on Russell Field. Mr. Haywood said that "special waste" was not considered contaminated soil at that time. The playing field had loam and construction material on it. West of the playing field special waste was stored.

Councillor Duehay requested that the letters to which Councillor Triantafillou referred be made part of the record.

Councillor Duehay thanked all of the speakers, the City Councillors and the public for their attendance.

The meeting was adjourned at 10:45 p.m.

For the Committee,

Francis H. Duehay

Councillor Francis H. Duehay, Chair *FD*

A meeting held on September 24, 1996
for the purpose of hearing testimony
from City, State and Federal officials
and consultants concerning contamination
and necessary steps to remediate the
site at and around the former W.R. Grace
site at the corner of Whittemore Avenue,
Rindge Avenue and Route 2 in North Cambridge.

In City Council October 7, 1996