Ecological Risk Assessment Pilot
For
Cañon de Valle.
Status Report

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The purpose of this interim report is to provide the status of the Ecological Risk Assessment pilot for Cañon de Valle. The ecological risk screening is complete and is included in this report.

An issue that needs to be addressed by the stakeholders in this process is the availability of toxicity response data for birds, mammals, plants and invertebrates. Many contaminants of potential concern have a full complement of risk assessment endpoints across all environmental media and can be used to assess potential ecological risks. There are also quite a few contaminants that have less than a full set of endpoints. In some cases this is simply because endpoints have yet to be retrieved from the literature. It is also very likely that some contaminants have not been evaluated in toxicological studies. Additionally, the design and quality of the toxicity studies varies. Decisions on how to proceed with the available information will be a necessary component to a successful problem formulation for the baseline risk assessment.

Previous Ecological Risk Screening Assessment

A screening ecological risk assessment for Cañon de Valle was included in the "RFI Report of Potential Release Site 16-021(2)," LA-UR-98-4101, September 1998. The assessment used a methodology that was still under development at that time. Since then, the screening methodology has been completed and an EcoRisk Screening Database is under continuing development. The methodology is published as, "Screening Level Ecological Risk Assessment Methods," LA-UR-99-1405, Rev. 1, December 1999.

The screening ecological risk assessment for Cañon de Valle has been partially repeated to take advantage of the completed methodology and the current EcoRisk Data Base. The scoping checklist has not been revised. The reader is directed to the RFI report referenced above for the scoping information.

Overview of the Process

The Ecological Risk Assessment pilot is intended to prototype a process that the Environmental Restoration Project will use for assessing sites that fail ecological screening criteria. This pilot follows the guidance provided by, "Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments," Interim Final Report. EPA 1997 and "Ecological Risk Assessment and Risk Management Principles for Superfund Sites," EPA 1999. The ecological risk assessment process consists of the following generalized steps:

- Environmental Restoration Ecological Risk Screening methodology,

- Baseline risk assessment problem formulation,
- Sampling/study design and data quality objectives to fill information gaps,
- Field verification of the sampling design,
- Site investigation,
- Baseline risk characterization,
- Risk management.

The baseline risk assessment problem formulation for Cañon de Valle is presently underway. This step includes refining the preliminary list of contaminants of potential ecological concern (COPECs). The screening assessment uses maximum contaminant values. Refining the list of COPECs includes considerations of fate, transport, completed exposure pathways, exposure model parameters, data distributions of contaminants, and the natural history of potential receptors. Additionally, the problem formulation is the process step where stakeholders come to agreement on assessment endpoints, exposure pathways that warrant additional evaluation, and risk questions that will be answered using the information collected from the sampling/study design.

Analytical Data Evaluation

Table 1 is a list of all the detected potential contaminants for Cañon de Valle. The data are organized into five environmental media. Water is divided among three media types: surface water, springs and alluvial water. Surface water is the perennial flowing reach of Cañon de Valle. Springs are SWSC Spring, Burning Ground Spring, and Peter Seep. Peter Seep is the upper extent of the perennial flowing reach and migrates up and down canyon, depending upon the rainfall and snowmelt. Alluvial water is collected with monitoring wells from the shallow alluvial system in the canyon. These wells are screened at the alluvium:rock interface and are less than ten feet deep. Sediment refers to the active channel of the Cañon de Valle. Soil refers to the overbanks and terraces in the canyon bottom. The table entries provide the number of detects and the number of non-detects for each combination of media and analyte. The "Nas" in the table indicate that the analyte was not detected or that the analysis was not conducted.

Infrequently Detected Analytes

The purpose of an ecological risk assessment is to evaluate the potential for population level effects due to the presence of contaminants in the environment. The exception is for threatened or endangered species where potential impacts to individuals are important. For sites such as Cañon de Valle, the assessment focus is on chronic effects of contaminants. This is because overt signs of ecological stress or die-off are not evident.

The data used for this assessment are from fixed laboratory analyses of environmental samples. The analytical methods, including quality control, were consistent with EPA protocols. These data were validated prior to evaluation and interpretation, in accordance with LANL ER procedures.

looks ok.

COPECs that are detected in less than 5% of the samples for a medium are eliminated from further consideration. Chronic exposures to these analytes is very unlikely. Table 2 provides a list, by medium, of the COPECs that are eliminated using this 5% criterion. The table also provides the number of samples, the number of detects, and the percent detects.

Radionuclides

Mg not be time through system.

The presence of radionuclides was evaluated previously in the Phase II RFI report, (page 3-39). All radionuclides detected in Cañon de Valle are within background concentrations of naturally occurring nuclides or are within typical fallout concentrations for transuranics and fission products. The single exception is a Cs-137 value of 1.06 pCi/g. The isotope concentration data and process knowledge for TA-16 suggest that it is very unlikely that the presence of these isotopes are associated with laboratory activities. Radionuclides will not be considered further in this assessment.

Commonly Occurring Analytes in Water

Several analytes have been reported in water samples from Cañon de Valle that are not typically associated with releases from Laboratory operations. These materials are nutrients, anions, and compounds that are benign under usual environmental conditions. The list of analytes is bromide, calcium, chlorate, chloride, magnesium, silicon, silicon dioxide, sodium, and sulfate. The anions could be environmental stressors at high concentrations. The pH range for surface water, alluvial water, and springs combined is 6.9 to 8.3. Under these neutral to basic conditions these analytes are not a concern and will not be considered further in this assessment.

Comparisons to LANL Background Values

Upper tolerance limits (UTL) of background data distributions are available for inorganics in sediments and soils at LANL. These values were used to eliminate COPECs from further consideration. Additionally, when one or more data values exceeded a background UTL, non-parametric statistical testing was performed to compare the background data distribution to the site data distribution. The two procedures used are the Gehan test and the quantile test. The Gehan test is a modification of the non-parametric Wilcoxon rank sum test procedure that can accommodate non-detects and multiple detection limits. This test is reliable up to a 50% non-detect rate. The results are questionable for data that are more highly censored. The quantile test uses the upper 20 percent of the combined site and background data. Consequently, this test is reliable at higher rates of censoring. Both tests were performed and the results were compared to corroborate conclusions regarding whether site data are different from background.

Soil COPECs that do not exceed LANL background UTLs are aluminum, arsenic, beryllium, calcium, iron, magnesium, mercury, potassium, sodium and vanadium. These analytes are dropped from further consideration. Soil COPECs that are not different from background, based upon the Gehan and quantile tests are chromium, cobalt, and manganese. These COPECs will also be dropped from further consideration.

Soil data for antimony and cadmium have insufficient detection rates for statistical testing. Antimony was detected in 7 of 30 samples. All 7 detects were above the background UTL. The non-detects were at, or near the UTL. Cadmium was detected in 10 of 30 samples with 3 values above the background UTL. The antimony values that exceed the UTL are at 200m (1 value) 800m (2 values), 1050m(1 value) and >1200 (3 values) from where the 260 outfall drainage joins Cañon de Valle. Similarly, cadmium data show two values above the UTL at 800m and one value above the background UTL at 1300m. If these analytes were associated with outfall discharges, then the highest values would be near the discharge point with decreasing concentrations with distance from the outfall. The low detection rates and lack of decreasing trend from the outfall suggests that these data are not associated with contaminant releases. Antimony and cadmium are dropped from further consideration.

30%! trend not good evidence when potential samples for stat testing.

Sediment COPECs that do not exceed LANL background UTLs are aluminum, beryllium, calcium, magnesium, potassium, and sodium. Sediment COPECs that do not exceed background based upon the Gehan and quantile tests are iron, arsenic, chromium, manganese, mercury, uranium, and zinc. These COPECs will be dropped from further consideration.

cadmium was also detected in 2 media

Sediment data for cadmium and selenium have insufficient detection rates for statistical testing. Cadmium was detected in 8 of 51 samples, with 4 values above the background UTL. One cadmium value exceeds the UTL at 300m and three values exceed the UTL at 1500m. **Cadmium will be dropped from further consideration.**

15% of samples may dropping the COC >10% of risk estimate

Selenium was detected in 11 of 51 samples. The detection limits for 48 of the analyses were above the sediment background UTL. Selenium will be carried forward to the problem formulation.

Spurious Organics

Several organics were infrequently detected at low concentrations. The total number of samples was sufficiently small that the percent detects exceeded the 5% criterion used to screen out low detection rates. Dichloroethane[1,2-] was detected 3 times in springs and three times in alluvial water. The values range from 3 to 7 ug/l, of which three are estimated values below the reporting limit. Chloromethane was detected in 3 out of 29 spring samples. The results were 5, 12, and 30 ug/l, one of which is an estimated value below the reporting limit. All three values are flagged for focused evaluation.

Justification for dropping

Five semi-volatile organics were detected in sediments at very low concentrations. The data warrant evaluation by a chemist, given that 4 of the analytes were reported from a single sampling round and the fifth was reported six times in a different single sampling round. The analytes are: dichlorodifluoromethane, diethylphthalate, isopropyltoluene[4-], trichloro-1,2,2-trifluoroethane, and trichlorofluoromethane.

These volatile and semi-volatile organics will be dropped from further consideration in this assessment.

Ecological Risk Screening Receptors

The ecological risk screening methodology adopted by LANL uses multiple screening receptors. The purpose for having multiple wildlife endpoints is to represent different trophic levels and diets for birds and mammals. Wildlife exposures can also be summed across media to evaluate cumulative effects from multiple sources of exposure. Additionally, the aquatic free-water community, aquatic sediment community, terrestrial plants and terrestrial invertebrates and water quality criteria are represented by generic endpoints. Water data are screened against eight wildlife endpoints and one generic aquatic community endpoint. Wildlife endpoints for the drinking water pathway include kestrel, robin, swallow, fox, cottontail, bat, deer mouse, and shrew. Sediment data are screened against two wildlife endpoints and a generic aquatic community endpoint. The wildlife endpoints are bat and swallow, both of which are insectivorous and assumed to have diets consisting of emergent aquatic insects. Soil data are screened against eleven endpoints. There is a generic plant, a generic invertebrate, and nine wildlife receptors that address different trophic levels and diets. They are kestrel (flesh), kestrel (50% flesh, 50% insect), fox (flesh), robin (insect), robin (plant), robin (50% insect, 50% plant), shrew (insect), cottontail (plant), deer mouse (50% plant, 50% invertebrate).

The EcoRisk database is a work in progress. Consequently, many of the COPECs have a full complement of toxicity values, and some do not. Missing toxicity values and endpoints may be filled in as primary literature is reviewed and values are developed. Some COPECs may continue to have gaps because toxicology studies are not available to support the calculation of screening values.

Ecological Risk Screening Results

Table 3. is an overview presentation of the COPECs that exceed at least one of the screening endpoints for the media being assessed. The list of COPECs increases moving from left to right. Surface water has eleven COPECs that exceed a screening value. Springs add three more COPECs to the list, but do not exceed the criteria for four of the surface water COPECs. Alluvial water exceeds at least one screening value for all of the COPECs that are associated with surface water and springs and adds three more to the list. Sediments add four COPECs to the list and exceed sediment criteria for eight of the water COPECs. Soil adds two COPECs and exceeds soil criteria for two sediment COPECs and six water COPECs. There are a total of twenty-three COPECs that exceed at least one endpoint in at least one medium.

The information in Table 3 is supported by more detailed information presented in Tables 4 through 8. These tables provide the screening results by medium and show the COPECs that passed the screen with a full set of endpoints (P); COPECs that passed the screen with an incomplete set of endpoints (p); COPECs that failed the screen and the number of endpoints exceeded; and the number of data values that exceed the endpoint(s), number of detected values, and the number of samples.

Plots of the data for the COPECs in Table 3 are provided in Figure 1. There are a total of forty data plots that show the data values, the locations of the screening values relative to the data values, information on the detects, and the available endpoints and their relative ranking. The plot numbering in Figure 1 matches the row numbers in Table 3. While the

screening was conducted with the unfiltered data for water samples, the data presentations in Table 9 use the filtered sample results. This is because all seventeen water COPECs that failed the screen did so for the aquatic community endpoint that is based upon the NAWQC standards or Tier II chronic values. The single exception is aluminum, which also exceeded up to 5 wildlife endpoints. The aquatic community endpoint is intended to be used with filtered sample data.

do they all pass when filtered samples are compared to endpoints

Initial Problem Formulation Data Assessment

Water COPECs

& are there any background values for water for comparison?

Unless otherwise stated the water COPECs pass the ecological risk screen for all wildlife endpoints.

Barium – Figure 1, plot 1. All three water media fail the aquatic community endpoint for all data. This contaminant will be carried forward in the problem formulation.

Cobalt – Figure 1, plot 2. All three water media fail the aquatic community endpoint for some of the data in each media. This contaminant will be carried forward in the problem formulation.

Copper – Figure 1, plot 3. The screening aquatic community values are dependent upon hardness. Figure 2. presents the computed chronic and acute criteria for each water sample and the location of the copper concentration data relative to those sample-based criteria. A single surface water datum exceeds the both chronic and acute criteria. One alluvial water datum exceeds both criteria and one datum exceeds the chronic criterion. Several samples across the three media have detection limits that exceed the screening criteria. Where copper is detected, the values are below the criteria, except as noted above. Given that the aquatic community criteria are more than three orders of magnitude below the wildlife endpoints and that most of the detected values fall below the criteria, copper is dropped from further consideration.

← probably all checking more in depth (80% of the wildlife are included)

Manganese – Figure 1, plot 4. All three water media fail the aquatic community endpoint for some of the data in each media. This contaminant will be carried forward in the problem formulation.

Lead – Figure 1, plot 5. The screening aquatic community values are dependent upon hardness. Figure 3. presents the computed chronic and acute criteria for each water sample and the location of the lead concentration data relative to those sample-based criteria. The detected values and reporting limits for the non-detects are located at the chronic criteria values, with few exceptions. The wildlife endpoints are 4 orders of magnitude above the aquatic community criteria, and the detection rates across the three water media range from 14% to 28%. Lead is dropped from further consideration.

only 3 non detects above chron

Nickel – Figure 1, plot 6. The screening aquatic community values are dependent upon hardness. Figure 4. presents the computed chronic and acute criteria for each water sample and the location of the nickel concentration data relative to those sample-based criteria. The values in Figure 1, plot 6. that exceed the aquatic community criteria using a default hardness

maybe aquatic community criteria is too low – should it be recalculated.

value are below the criteria in Figure 4. using hardness calculated for each sample. Nickel is dropped from further consideration.

Chromium – Figure 1, plot 7. The filtered data plot shows a that a single alluvial water sample exceeds the aquatic community criterion for the filtered sample results. Chromium is dropped from further consideration.

Iron – Figure 1, plot 8. Filtered samples for surface water do not exceed the aquatic community criterion of 1000 ug/l. Two of the filtered spring sample results, out of fifteen detects, exceed the criterion. Five of eleven alluvial water filtered samples results exceed the criterion. Based upon the infrequent number of samples where the criterion is exceeded for water that is in direct contact with the aquatic community, iron is dropped from further consideration.

Selenium – Figure 1, plot 9. The aquatic community criterion in the EcoRisk database for selenium is the New Mexico State standard for total recoverable selenium of 2 ug/l. The NAWQC chronic criterion for selenium is 5 ug/l. The lowest relevant chronic values are 91.65 ug/l for daphnids and 100 ug/l for aquatic plants (Suter, 1996). The fish chronic value is not considered because Cañon de Valle does not support fish. Based upon the NAWQC chronic value and the species chronic values, selenium is dropped from further consideration.

Zinc – Figure 1, plot 10. The screening aquatic community values are dependent upon hardness. Figure 5. presents the computed chronic and acute criteria for each water sample and the location of the zinc concentration data relative to those sample-based criteria. All surface water data from filtered samples fall below the criterion. Two spring water values exceed the criterion and five alluvial water value equal or exceed the criterion. Based upon the infrequent number of samples where the criterion is exceeded for water that is in direct contact with the aquatic community, zinc is dropped from further consideration.

Aluminum – Figure 1, plot 11. All three water media fail the aquatic community endpoint for all data. Furthermore, alluvial water fails the shrew, deer mouse, bat, cottontail, and fox wildlife endpoints. This contaminant will be carried forward in the problem formulation.

Silver – Figure 1, plot 12. Silver aquatic community criterion is a Tier II secondary chronic value 0.36 ug/l. The relevant sensitive species values are 2.6 ug/l for daphnids and 30 ug/l for aquatic plants, (Suter, 1996). Fish has a lowest chronic value of 0.12, but Cañon de Valle does not support fish. While silver was detected in only three of fifty-five filtered samples, the detection limits for the non-detect results range from 0.67 to 40 ug/l. These detection limits are not sufficiently low to support the assessment. Silver is carried forward in the problem formulation.

Cadmium – Figure 1, plot 13. Criteria for this COPEC are based upon hardness. Figure 6. shows plots of the data and the acute and chronic criteria. Surface water fails the aquatic community endpoint for all data. Additionally, spring and alluvial waters have detects just above the screening values. The non-detects for all three media exceed the screening values. This contaminant will be carried forward in the problem formulation.

Mercury – Figure 1, plot 14. The dotted line in this plot is the aquatic community criterion for inorganic mercury. All of the filtered sample data, both detects and non-detects, are bracketed by the inorganic and organic aquatic community criteria. This contaminant will be carried forward in the problem formulation.

Vanadium – Figure 1, plot 15. Two values for alluvial water, out of eight detects and nineteen samples, exceed the criteria. All non-detects across the three media are below the criteria. Based upon the infrequent exceedences by alluvial water and the acceptable values for aquatic community contact water, vanadium is dropped from further consideration.

Beryllium – Figure 1, plot 16. All filtered data, including non-detects range from 0.11 to 4.6 ug/l. The New Mexico stream standard is 5.3 ug/l. Beryllium is dropped from further consideration.

Lithium – Figure 1, plot 17. Two alluvial water values out of eleven filtered alluvial water samples exceed the aquatic community criteria. Nine filtered samples from springs did not exceed the criteria. Based upon the infrequent exceedences by alluvial water and the acceptable values for aquatic community contact water, lithium is dropped from further consideration.

Sediment COPECs

Barium – Figure 1, plot 1 Sed. Forty-eight of fifty-one data values exceed background. Barium in sediments will be carried forward in the problem formulation.

Cobalt – Figure 1, plot 2 Sed. Data from near the 260 Outfall exceed background and trend to lesser concentrations 1500m down canyon. Screening endpoints are below background. Cobalt in sediments will be carried forward in the problem formulation.

Copper – Figure 1, plot 3 Sed. Data from near the 260 Outfall exceed background and trend to lesser concentrations 1500m down canyon. One endpoint of three is exceeded in the first 1500m below the outfall. Copper in sediments will be carried forward in the problem formulation.

Lead – Figure 1, plot 5 Sed. Data from near the 260 Outfall exceed background and trend to lesser concentrations within 1500m down canyon. One endpoint of three is exceeded in the first 1500m below the outfall. Lead in sediments will be carried forward in the problem formulation.

Nickel – Figure 1, plot 6 Sed. Data trend in decreasing value from above the 260 outfall. Three samples, out of fifty-one, have concentrations that exceed the lowest screening criterion. Based upon the infrequent exceedences of the criterion, Nickel will be dropped from further consideration.

Selenium – Figure 1, plot 9 Sed. Five detects exceed criteria, out of eleven detects and fifty-one samples. Ten of the forty non-detects exceed one or more criteria. Sufficient non-detects are below the screening criteria to suggest that selenium is not a pervasive stressor to the biological community. Selenium is dropped from further consideration.

Silver – Figure 1, plot 12 Sed. Silver exceeds background and the swallow insectivore criterion. This COPEC will be carried forward in the problem formulation.

Vanadium – Figure 1, plot 15 Sed. Background exceeds the available screening criteria. Seven values out of 51 samples exceed background. These data are in the vicinity of the outfall, and there is a declining trend in concentration away from the outfall. This COPEC will be carried forward in the problem formulation.

HMX – Figure 1, plot 18 Sed. Only one screening criterion available. Five of fifteen detects out of fifty-one samples exceed the value. This COPEC will be carried forward in the problem formulation.

RDX – Figure 1, plot 19 Sed. One value out of eleven detects and fifty-one samples exceeds the available screening criterion. Since RDX was one of the known contaminants released from the 260 outfall, it will be carried forward in the problem formulation for consideration of additional screening information

Di-n-butylphthalate – Figure 1, plot 20 Sed. Detected in twenty-seven out of thirty-three samples. Twenty-six detects exceed the lowest criterion. This COPEC will be carried forward in the problem formulation.

Thallium – Figure 1, plot 21 Sed. All detects exceed the single screening criterion. Thirty-eight of the forty non-detects also exceed the screening criterion. This COPEC will be carried forward in the problem formulation.

Soil COPECs

Barium – Figure 1, plot 1 Soil. Twenty-nine of thirty samples exceed background and five screening endpoints. This COPEC will be carried forward in the problem formulation.

Copper – Figure 1, plot 3 Soil. Copper exceeds background and up to five screening endpoints. This COPEC will be carried forward in the problem formulation.

Lead – Figure 1, plot 5 Soil. Lead exceeds background and up to two screening endpoints. This COPEC will be carried forward in the problem formulation.

Nickel – Figure 1, plot 6 Soil. Nickel exceeds the lowest screening endpoint. of 20 mg/kg for the generic plant. Eight of thirty results exceed the endpoint. Six of the values are less than thirty and the highest value is 40.3. The next highest endpoint is 100 mg/kg for the generic invertebrate. Given that nickel passes ten of the eleven endpoints and that the exceedances are close the screening value, this COPEC will be dropped from further consideration.

Zinc – Figure 1, plot 10 Soil. Seven of the thirty values for zinc exceed LANL background. Two values exceed the next two highest criteria. These samples are 800m down canyon from the 260 outfall. In addition, the data do not show a declining trend from the outfall.

The zinc concentrations do not appear to be associated with the 260 outfall and zinc is dropped from further consideration.

any background value for comparison?

Silver – Figure 1, plot 12 Soil. Silver exceeds four criteria and will be carried forward in the problem formulation.

HMX – Figure 1, plot 18 Soil. HMX exceeds three criteria and will be carried forward in the problem formulation.

RDX – Figure 1, plot 19 Soil. One value of twenty-one detects from thirty samples exceeds the lowest screening criteria. Five endpoints are available out of a possible eleven. Because of the paucity of endpoints, RDX will be carried forward in the problem formulation.

Boron – Figure 1, plot 22 Soil. One value for boron exceeds the lowest of ten available screening criteria. The data do not show a decreasing trend with distance from the 260 outfall. These concentrations do not appear to be associated with the 260 outfall and boron is dropped from further consideration.

TNT – Figure 1, plot 23 Soil. Three values of sixteen detects from thirty samples exceed the lowest of six endpoints. The endpoint is generic invertebrate with a value of 0.3 mg/kg. The three data values are 0.35, 0.39, and 0.67. Given the heterogeneity of soil samples, these values are very likely not different from the screening criteria. TNT is dropped from further consideration.

see exam. it should have been dropped

Summary of Initial Problem Formulation Data Assessment

Table 9 is a reduced version of Table 3 that shows the COPECs, by media that warrant further consideration in the baseline risk assessment problem formulation.

Table 1. Cañon de Valle
Ecological Risk Screening Assessment
All Detects for All Media

	Contaminant	Number of Detects/Number of Non-Detects				
		Surface Water	Springs	Alluv Water	Sediment	Soil
1	Acetone	1/35	18/11	17/16	1/11	NA
2	Actinium-228	NA	NA	NA	24/3	NA
3	Aluminum	46/16	41/5	38/6	51/0	30/0
4	Amino-2,6-dinitrotoluene[4-]	43/3	16/24	13/25	15/30	20/10
5	Amino-4,6-dinitrotoluene[2-]	37/2	16/17	7/23	5/22	18/12
6	Annihilation Radiation	NA	NA	NA	1/26	NA
7	Antimony	4/56	NA	3/40	NA	7/23
8	Arsenic	4/58	6/40	18/26	24/26	30/0
9	Barium	62/0	46/0	44/0	51/0	30/0
10	Benzoic Acid	NA	NA	NA	1/32	NA
11	Benzyl Alcohol	NA	NA	NA	1/31	NA
12	Beryllium	3/59	6/40	18/26	12/39	30/0
13	Bis(2-ethylhexyl)phthalate	3/36	NA	1/21	12/21	NA
14	Bismuth-214	NA	NA	NA	23/4	NA
15	Boron	NA	32/0	30/0	NA	5/25
16	Bromide	NA	5/36	11/27	NA	NA
17	Bromomethane	NA	1/28	NA	NA	NA
18	Butanone[2-]	NA	4/25	1/32	NA	NA
19	Cadmium	3/59	4/42	8/36	8/43	10/20
20	Cadmium-109	NA	NA	NA	2/25	NA
21	Calcium	61/1	44/2	44/0	51/0	30/0
22	Cesium	NA	1/3	NA	NA	NA
23	Cesium-137	NA	NA	NA	8/19	NA
24	Chlorate	NA	NA	1/4	NA	NA
25	Chloride	15/0	41/0	38/0	NA	NA

Table 1, continued

	Contaminant	Number of Detects/Number of Non-Detects				
		Surface Water	Springs	Alluv Water	Sediment	Soil
26	Chloromethane	NA	3/26	NA	NA	NA
27	Chlorophenol[2-]	1/38	NA	NA	NA	NA
28	Chromium, Total	4/58	26/20	24/20	49/2	30/0
29	Cobalt	10/52	11/35	22/22	49/2	30/0
30	Copper	11/51	10/36	27/17	49/2	30/0
31	Cyanide, Total	NA	NA	1/23	2/43	NA
32	Di-n-butylphthalate	NA	1/27	NA	27/6	NA
33	Di-n-octylphthalate	1/38	NA	NA	NA	NA
34	Dichlorodifluoromethane	NA	NA	NA	3/9	NA
35	Dichloroethane[1,2-]	3/33	3/26	NA	NA	NA
36	Diethylphthalate	NA	NA	NA	6/27	NA
37	Dinitro-2-methylphenol[4,6-]	1/38	NA	NA	NA	NA
38	Dinitrobenzene[1,3-]	NA	1/42	NA	NA	NA
39	Dinitrotoluene[2,4-]	20/40	5/38	NA	NA	NA
40	Fluoranthene	NA	NA	NA	1/32	NA
41	Fluoride	1/14	38/3	31/6	NA	NA
42	HMX	43/16	26/17	30/10	15/36	27/3
43	Iron	43/19	37/9	32/12	51/0	30/0
44	Isopropyltoluene[4-]	NA	NA	NA	1/11	NA
45	Lanthanum-140	NA	NA	NA	2/25	NA
46	Lead	15/47	15/31	30/14	51/0	30/0
47	Lead-212	NA	NA	NA	26/1	NA
48	Lead-214	NA	NA	NA	26/1	NA
49	Lithium	NA	17/3	21/1	NA	NA
50	Magnesium	53/9	41/5	34/10	51/0	30/0
51	Manganese	35/27	35/11	42/2	50/0	30/0
52	Mercury	1/58	4/42	11/33	12/39	28/2
53	Methylene Chloride	1/35	NA	NA	NA	NA
54	Molybdenum	NA	1/19	7/15	NA	NA

Table 1, continued

	Contaminant	Number of Detects/Number of Non-Detects				
		Surface Water	Springs	Alluv Water	Sediment	Soil
55	Neptunium-237	NA	NA	NA	7/20	NA
56	Nickel	24/38	17/29	28/16	46/5	30/0
57	Nitrobenzene	2/58	NA	NA	1/50	1/29
58	Nitrogen, Nitrate + Nitrite (E	NA	NA	NA	12/15	NA
59	Nitrotoluene[2-]	18/37	NA	NA	NA	NA
60	Nitrotoluene[3-]	NA	1/42	NA	1/50	NA
61	Phenol	NA	NA	NA	1/32	NA
62	Potassium	NA	NA	NA	50/1	30/0
63	Potassium-40	NA	NA	NA	27/0	NA
64	Protactinium-231	NA	NA	NA	1/26	NA
65	Protactinium-234M	NA	NA	NA	1/26	NA
66	Pyrene	NA	NA	NA	1/32	NA
67	RDX	43/16	41/2	25/15	11/40	21/9
68	Radium-224	NA	NA	NA	4/23	NA
69	Radium-226	NA	NA	NA	6/21	NA
70	Rubidium	NA	4/0	NA	NA	NA
71	Selenium	8/53	2/44	13/31	11/40	NA
72	Silicon	1/1	16/0	NA	NA	NA
73	Silicon Dioxide	NA	4/0	1/0	NA	NA
74	Silver	1/60	4/42	10/34	25/26	28/2
75	Sodium	56/6	44/2	40/4	48/3	30/0
76	Strontium	NA	20/0	22/0	NA	NA
77	Sulfate	15/0	41/0	38/0	NA	NA
78	Tetrachloroethene	NA	4/25	NA	NA	NA
79	Tetryl	NA	1/42	NA	NA	NA
80	Thallium	2/60	5/41	11/33	11/40	NA
81	Thallium-208	NA	NA	NA	24/3	NA
82	Titanium	NA	4/0	NA	NA	NA
83	Toluene	NA	NA	2/31	4/8	NA

Table 1, continued

	Contaminant	Number of Detects/Number of Non-Detects				
		Surface Water	Springs	Alluv Water	Sediment	Soil
84	Trichloro-1,2,2-trifluoroethane	NA	NA	NA	1/11	NA
85	Trichloroethene	NA	8/21	NA	NA	NA
86	Trichlorofluoromethane	NA	NA	NA	2/10	NA
87	Trinitrobenzene[1,3,5-]	1/38	15/28	NA	1/50	1/29
88	Trinitrotoluene[2,4,6-]	13/37	7/36	2/38	7/44	16/14
89	Uranium	23/3	NA	NA	27/0	NA
90	Vanadium	24/38	30/16	32/12	51/0	30/0
91	Zinc	18/44	22/24	36/8	51/0	30/0

Table 2. COPECs Detected in Less Than Five Percent of the Samples

COPEC	Total Samples	Number of Detects	% Detects
Surface Water			
Silver	61	1	1.6
Mercury	59	1	1.7
Chlorophenol[2-]	39	1	2.6
Di-n-octylphthalate	39	1	2.6
Dinitro-2-methylphenol[4,6-]	39	1	2.6
Trinitrobenzene[1,3,5-]	39	1	2.6
Acetone	36	1	2.8
Methylene Chloride	36	1	2.8
Thallium	62	2	3.2
Nitrobenzene	60	2	3.3
Beryllium	62	3	4.8
Cadmium	62	3	4.8
Springs			
Dinitrobenzene[1,3-] 43	43	1	2.3
Nitrotoluene[3-]	43	1	2.3
Tetryl	43	1	2.3
Bromomethane	29	1	3.4
Di-n-butylphthalate	28	1	3.6
Selenium	46	2	4.3
Molybdenum	20	1	5
Alluvial Water			
Butanone[2-]	33	1	3
Cyanide, Total	24	1	4.2
Bis(2-ethylhexyl)phthalate	22	1	4.5
Trinitrotoluene[2,4,6-]	40	2	5
Active Channel Sediments			
Nitrobenzene	51	1	2
Nitrotoluene[3-]	51	1	2
Trinitrobenzene[1,3,5-]	51	1	2
Benzoic Acid	33	1	3
Fluoranthene	33	1	3
Phenol	33	1	3
Pyrene	33	1	3
Benzyl Alcohol	32	1	3.1
Cyanide, Total	45	2	4.4
Soils			
Nitrobenzene	30	1	3.3
Trinitrobenzene[1,3,5-]	30	1	3.3

Table 3. Summary of COPECs
That Exceed At Least One Screening Value
Unfiltered Water Data Used for Screening

	Surface Water	Springs	Alluvial Water	Sediment	Soil
1	Barium	X	X	X	X
2	Cobalt	X	X	X	
3	Copper	X	X	X	X
4	Manganese	X	X		
5	Lead	X	X	X	X
6	Nickel		X	X	X
7	Chromium	X	X		
8	Iron	X	X		
9	Selenium		X	X	
10	Zinc		X		X
11	Aluminum		X		
12		Silver	X	X	X
13		Cadmium	X		
14		Mercury	X		
15			Vanadium	X	
16			Beryllium		
17			Lithium		
18				HMX	X
19				RDX	X
20				Di-n-butyl phthalate	
21				Thallium	
22					Boron
23					TNT

Table 4. Surface Water COPECs

COPEC	Number of available endpoints	Pass Screen	Pass, available endpoints	Fail, #endpoints	Detects/ Total Samples
Iron	1			1	0/6/18
HMX	5		p		
RDX	5		p		
Amino-4,6-dinitrotoluene[2-]	5		p		
Amino-2,6-dinitrotoluene[4-]	5		p		
Trinitrotoluene[2,4,6-]	5		p		
Nitrotoluene[2-]	5		p		
Antimony	6		p		
Dinitrotoluene[2,4-]	6		p		
Arsenic	9	P			
Barium	9			1	18/18/18
Chromium,Total	9			1	0/3/18
Cobalt	9			1	4/4/18
Copper	9			1	1/4/18
Lead	9			1	5/5/18
Manganese	9			1	2/8/18
Nickel	9			1	1/1/18
Selenium	9			1	5/5/18
Uranium	9	P			
Vanadium	9	P			
Zinc	9			1	0/6/18
Bis(2-ethylhexyl)phthalate	9	P			
Aluminum	9			4	7/8/18
Fluoride	9	P			

[a]Full complement of endpoints equals 9.

Table 5. Springs COPECs

COPEC	Number of available endpoints[a]	Pass Screen	Pass, available endpoints	Fail, #endpoints	Exceeds/ Detects/ Total Samples
Cesium					
Rubidium					
Iron	1			1	2/15/21
Lithium	1		p		
HMX	5		p		
RDX	5		p		
Amino-4,6-dinitrotoluene[2-]	5		p		
Amino-2,6-dinitrotoluene[4-]	5		p		
Trinitrobenzene[1,3,5-]	5		p		
Trinitrotoluene[2,4,6-]	5		p		
Titanium	5		p		
Thallium	6		p		
Beryllium	6		p		
Strontium	6		p		
Dinitrotoluene[2,4-]	6		p		
Butanone[2-]	6		p		
Tetrachloroethene	6		p		
Trichloroethene	6		p		
Arsenic	9	P			
Barium	9			1	21/21/21
Cadmium	9			1	0/2/21
Chromium,	9			1	0/11/21
Cobalt	9			1	3/5/21
Copper	9			1	0/3/21
Lead	9			1	3/5/21
Manganese	9			1	2/16/21
Inorganic Mercury	9	P			
Organic Mercury	9			1	2/2/21
Nickel	9	P			
Silver	9			1	1/1/21
Vanadium	9	P			
Zinc	9			1	2/10/21
Acetone	9	P			
Aluminum	9	P			
Boron	9	P			
Fluoride	9	P			

[a]Full complement of endpoints equals 9.

Table 6. Alluvial Water COPECs

COPEC	Number of available endpoints[a]	Pass Screen	Pass, available endpoints	Fail, #endpoints	Exceeds/ Detects/ Total Samples
Iron	1			1	5/11/19
Lithium	1			1	2/11/11
Molybdenum	1		p		
HMX	5		p		
RDX	5		p		
Amino-4,6-dinitrotoluene[2-]	5		p		
Amino-2,6-dinitrotoluene[4-]	5		p		
Antimony	6		p		
Thallium	6		p		
Beryllium	6			1	0/6/19
Toluene	6		p		
Strontium	6		p		
Arsenic	9	P			
Barium	9			1	19/19/19
Cadmium	9			1	0/1/19
Chromium,	9			1	1/5/19
Cobalt	9			1	6/9/19
Copper	9			1	2/9/19
Lead	9			1	5/7/19
Manganese	9			1	10/18/19
Mercury	9			1	3/3/19
Nickel	9			1	1/11/19
Selenium	9			1	3/3/19
Silver	9			1	2/2/19
Vanadium	9			1	2/8/19
Zinc	9			1	5/15/19
Acetone	9	P			
Aluminum	9			6	10/13/19
Boron	9	P			
Fluoride	9	P			

[a]Full complement of endpoints equals 9.

Table 7. Sediment COPECs

COPEC	Number of Availbable endpoints[a]	Pass screen	Pass, available endpoints	Fail, #endpoints	Exceeds /Detects/ Total Samples
HMX	1			1	5/15/51
RDX	1			1	1/11/51
Amino-4,6-dinitrotoluene[2-]	1		p		
Amino-2,6-dinitrotoluene[4-]	1		p		
Trinitrotoluene[2,4,6-]	1		p		
Thallium	1			1	11/11/51
Toluene	2		p		
Di-n-butylphthalate	3			1	26/27/33
Barium	3			BKG	48/51/51
Cobalt	2			BKG	22/49/51
Copper	3			1	7/49/51
Lead	3			1	7/51/51
Nickel	3			1	3/46/51
Selenium	3			3	5/11/51
Silver	3			1	16/25/51
Vanadium	2			BKG	7/51/51
Bis(2-ethylhexyl)phthalate	3	P			
Acetone	3	P			

[a]Full complement of endpoints equals 3.

Table 8. Soil COPECs

COPEC	Number of Availbable endpoints[a]	Pass screen	Pass, available endpoints	Fail, #endpoints	Exceeds/ Detects/ Total Samples
HMX	4			3	19/27/30
Amino-4,6-dinitrotoluene[2-]	5		p		
Amino-2,6-dinitrotoluene[4-]	5		p		
RDX	5			1	1/21/30
Trinitrotoluene[2,4,6-]	6			1	3/16/30
Barium	10			5, BKG	29/30/30
Silver	10			4	28/28/30
Boron	10			1	1/5/30
Copper	11			5, BKG	22/30/30
Lead	11			2, BKG	23/30/30
Nickel	11			1	8/30/30
Zinc	11			2, BKG	7/30/30

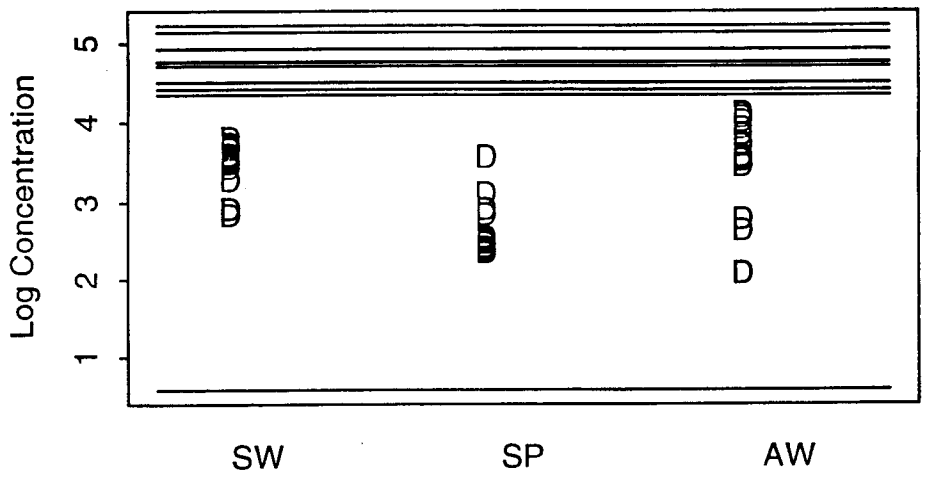
[a]Full complement of endpoints equals 11.

Table 9. Summary of Problem Formulation COPECs
Unfiltered Water Data Used for Assessment

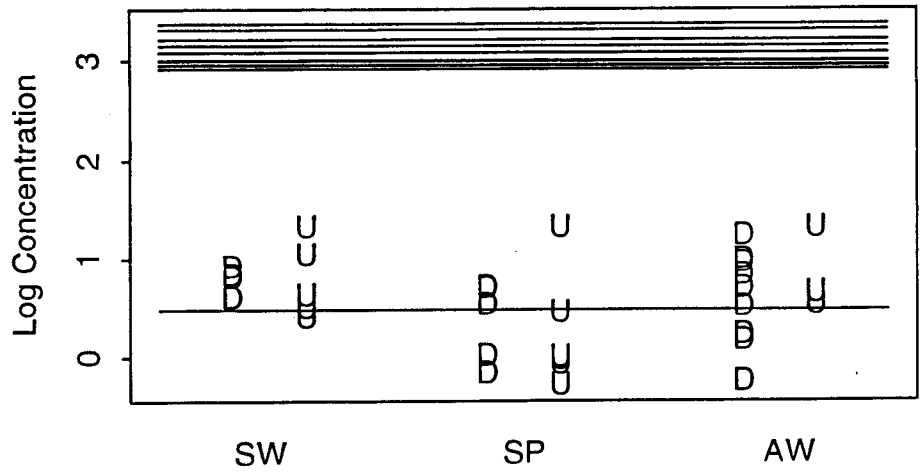
	Surface Water	Springs	Alluvial Water	Sediment	Soil
1	Barium	X	X	X	X
2	Cobalt	X	X	X	
3	Manganese	X	X		
4	Aluminum	X	X		
5		Silver	X	X	X
6		Cadmium	X		
7		Mercury	X		
8				Lead	X
9				Copper	X
10				Vanadium	
11				HMX	X
12				RDX	X
13				Di-n-butyl phthalate	
14				Thallium	

Figure 1. Log Filtered CdV Water Data
SW = Surface Water; SP = Spring; AW = Alluvial Water
D = Detects; U = Undetects

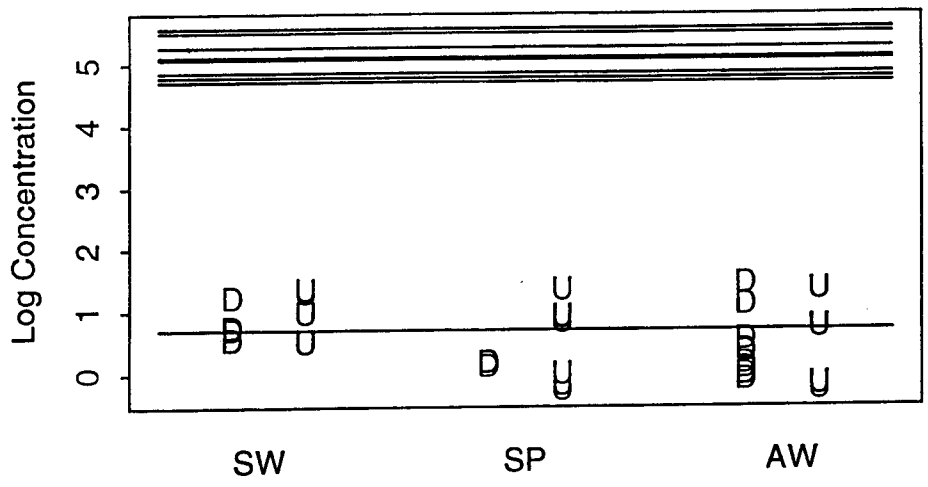
1. Filtered Barium D=58 U=0
Order of Endpoints
Kestrelw > Robinw > Swalloww > Foxw > Cottontailw > Batw > Deermousew > Shreww > Aquacomw



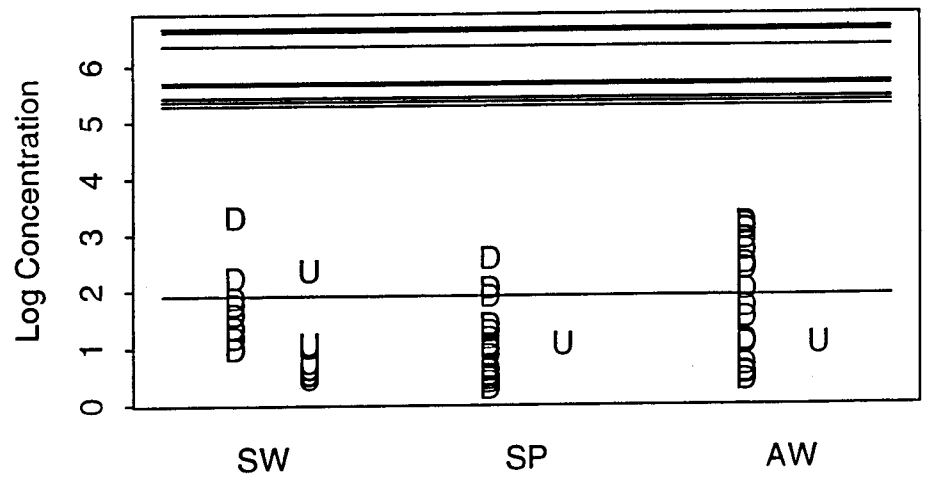
2. Filtered Cobalt D=18 U=40
Order of Endpoints
Foxw > Cottontailw > Kestrelw > Robinw > Batw > Deermousew > Shreww > Swalloww > Aquac



3. Filtered Copper D=15 U=43
Order of Endpoints
Kestrelw > Robinw > Swalloww > Foxw > Cottontailw > Batw > Deermousew > Shreww > Aquacomw



4. Filtered Manganese D=42 U=16
Order of Endpoints
Kestrelw > Robinw > Swalloww > Foxw > Cottontailw > Batw > Deermousew > Shreww > Aquac

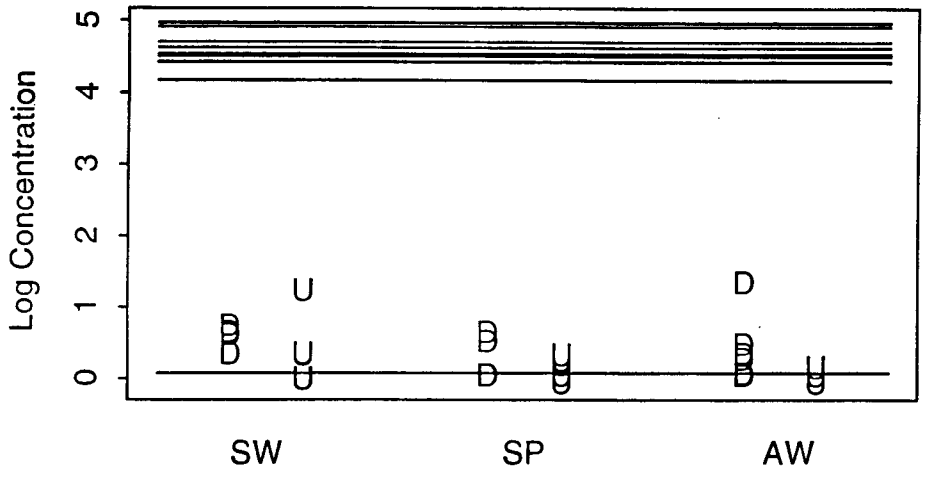


Log Water exceed plt summary fn

Figure 1. Log Filtered CdV Water Data
SW = Surface Water; SP = Spring; AW = Alluvial Water
D = Detects; U = Undetects

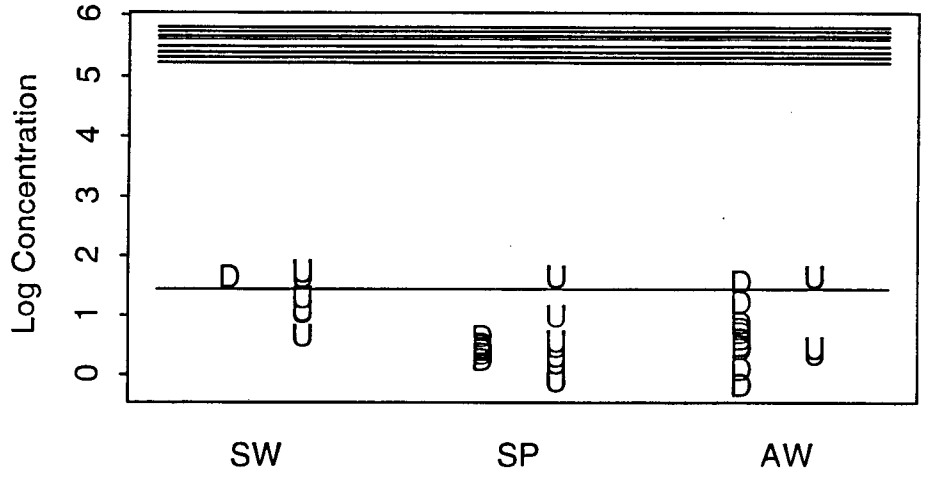
5. Filtered Lead D=17 U=41
Order of Endpoints

Foxw > Cottontailw > Batw > Deermousew > Shreww > Kestrelw > Robinw > Swalloww > Aquacomw



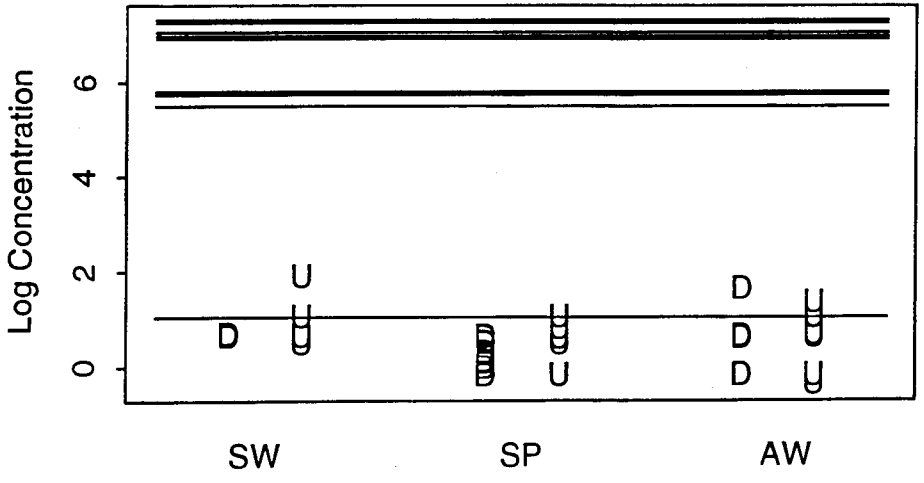
6. Filtered Nickel D=19 U=39
Order of Endpoints

Kestrelw > Robinw > Foxw > Cottontailw > Swalloww > Batw > Deermousew > Shreww > Aquac



7. Filtered Chromium, Total D=19 U=39
Order of Endpoints

Foxw > Cottontailw > Batw > Deermousew > Shreww > Kestrelw > Robinw > Swalloww > Aquacomw



8. Filtered Iron D=32 U=26
Order of Endpoints

Aquacomw

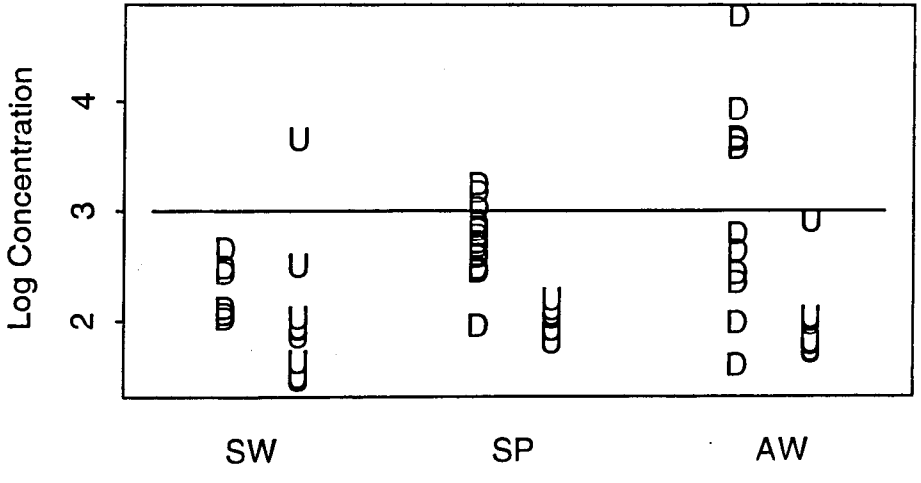
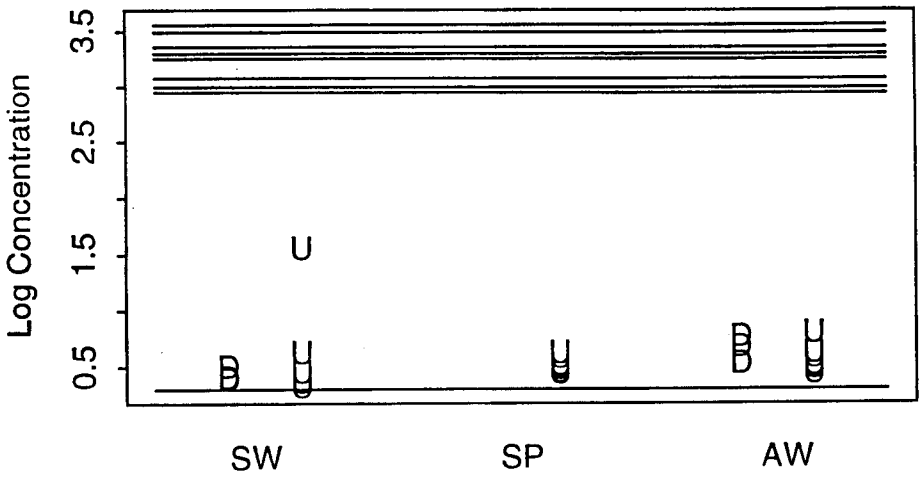
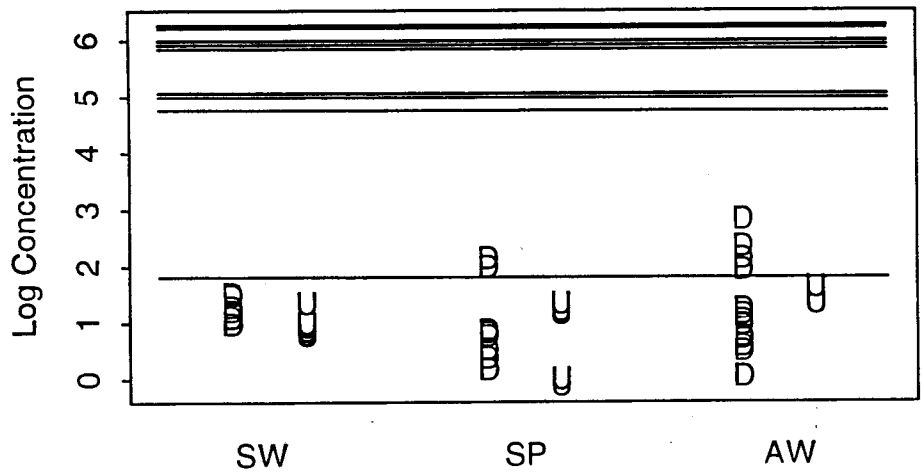


Figure 1. Log Filtered CdV Water Data
SW = Surface Water; SP = Spring; AW = Alluvial Water
D = Detects; U = Undetects

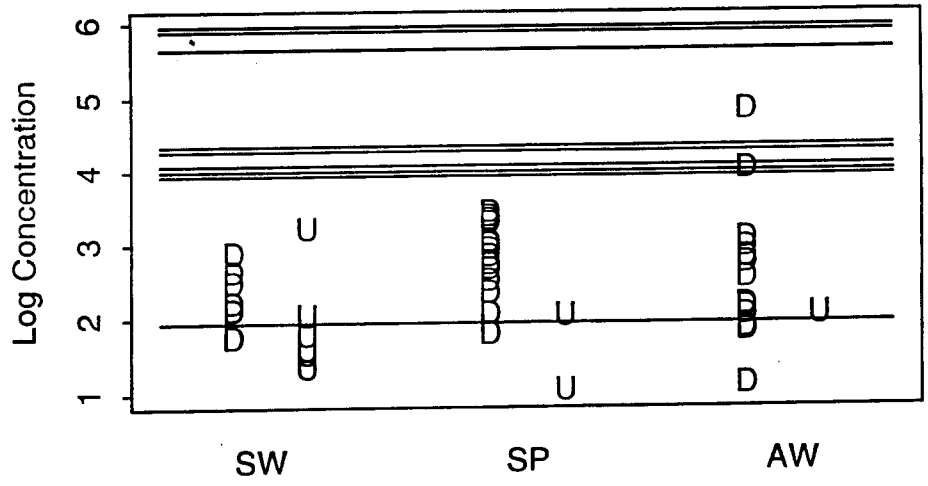
9. Filtered Selenium D=8 U=50
Order of Endpoints
Kestrelw > Robinw > Foxw > Cottontailw > Swalloww > Batw > Deermousew > Shreww > Aquacomw



10. Filtered Zinc D=31 U=27
Order of Endpoints
Foxw > Cottontailw > Batw > Deermousew > Shreww > Kestrelw > Robinw > Swalloww > Aquacc



11. Filtered Aluminum D=37 U=21
Order of Endpoints
Kestrelw > Robinw > Swalloww > Foxw > Cottontailw > Batw > Deermousew > Shreww > Aquacomw



12. Filtered Silver D=3 U=55
Order of Endpoints
Foxw > Cottontailw > Batw > Deermousew > Shreww > Kestrelw > Robinw > Swalloww > Aquac

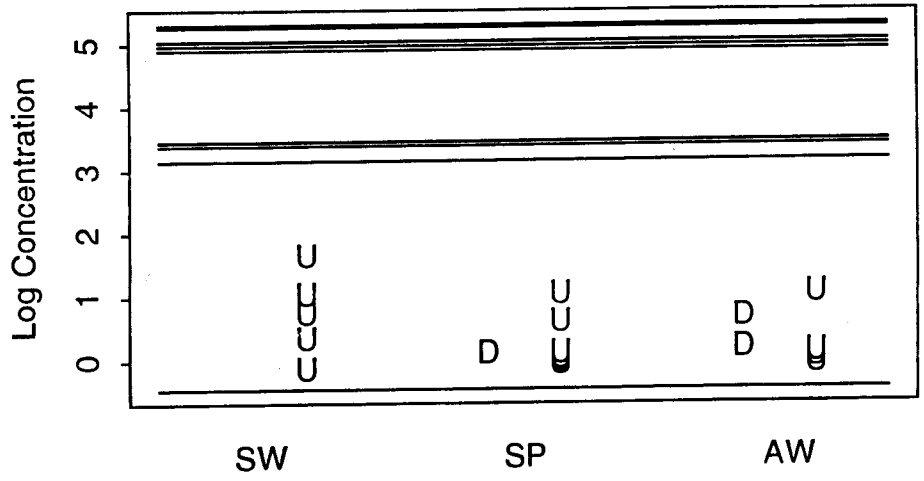
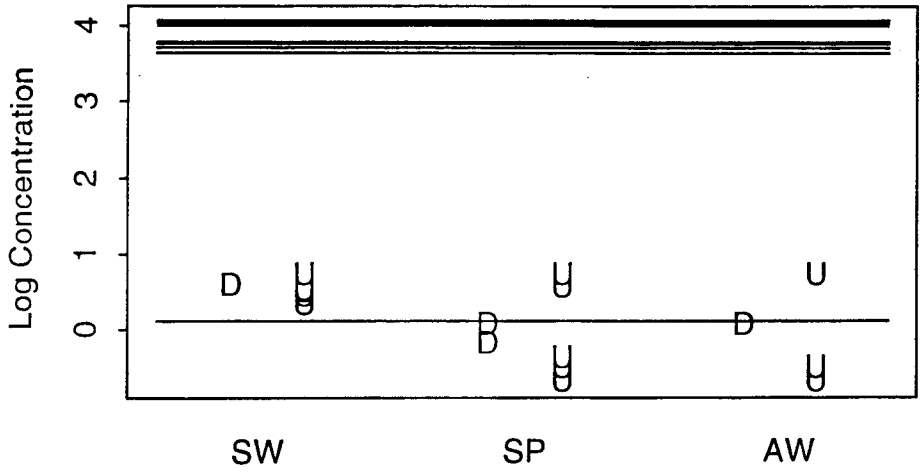
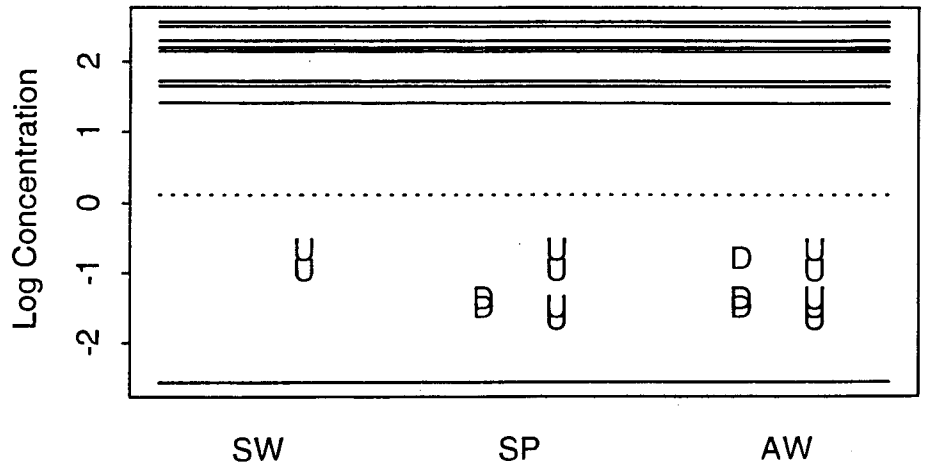


Figure 1. Log Filtered CdV Water Data
SW = Surface Water; SP = Spring; AW = Alluvial Water
D = Detects; U = Undetects

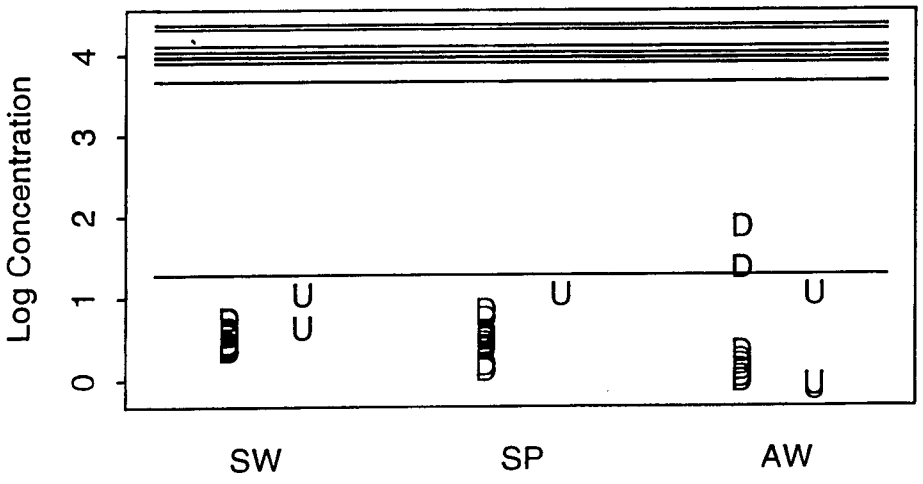
13. Filtered Cadmium D=4 U=54
Order of Endpoints
Kestrelw > Foxw > Cottontailw > Robinw > Batw > Swalloww > Deermousew > Shreww > Aquacomw



14. Filtered Mercury D=5 U=50
Order of Endpoints
Foxw > Cottontailw > Batw > Deermousew > Shreww > Kestrelw > Robinw > Swalloww > Aquacc



15. Filtered Vanadium D=35 U=23
Order of Endpoints
Foxw > Cottontailw > Batw > Deermousew > Kestrelw > Shreww > Robinw > Swalloww > Aquacomw



16. Filtered Beryllium D=10 U=48
Order of Endpoints
Foxw > Cottontailw > Batw > Deermousew > Shreww > Aquacomw

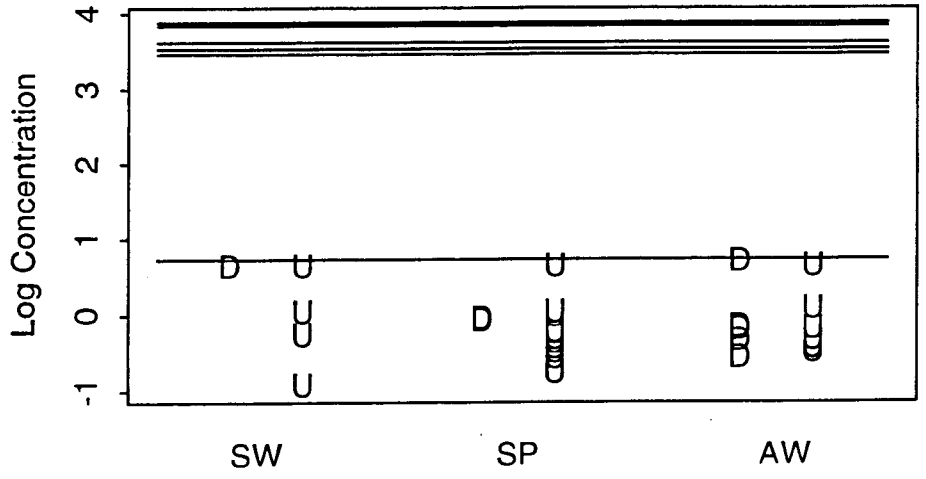


Figure 1. Log Filtered CdV Water Data
SW = Surface Water; SP = Spring; AW = Alluvial Water
D = Detects; U = Undetects

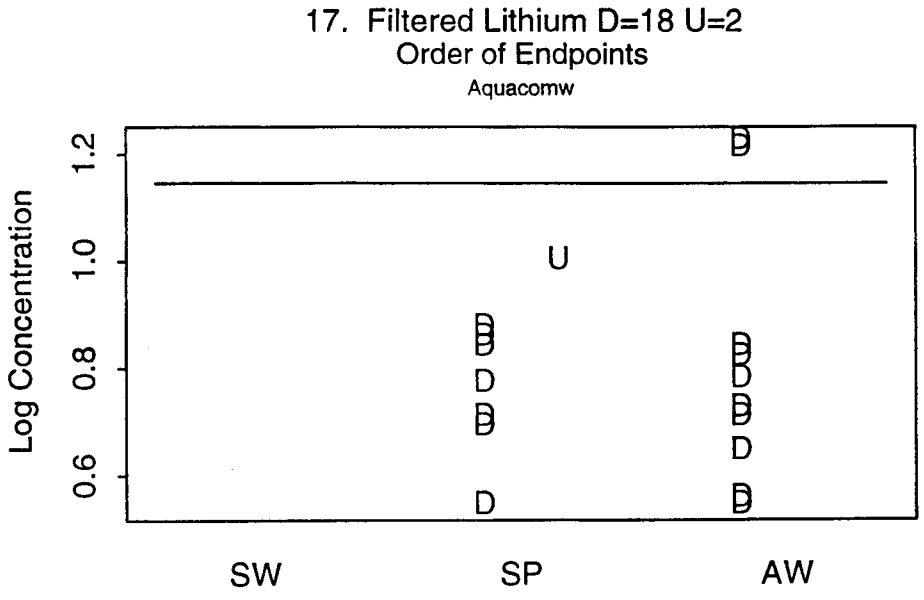
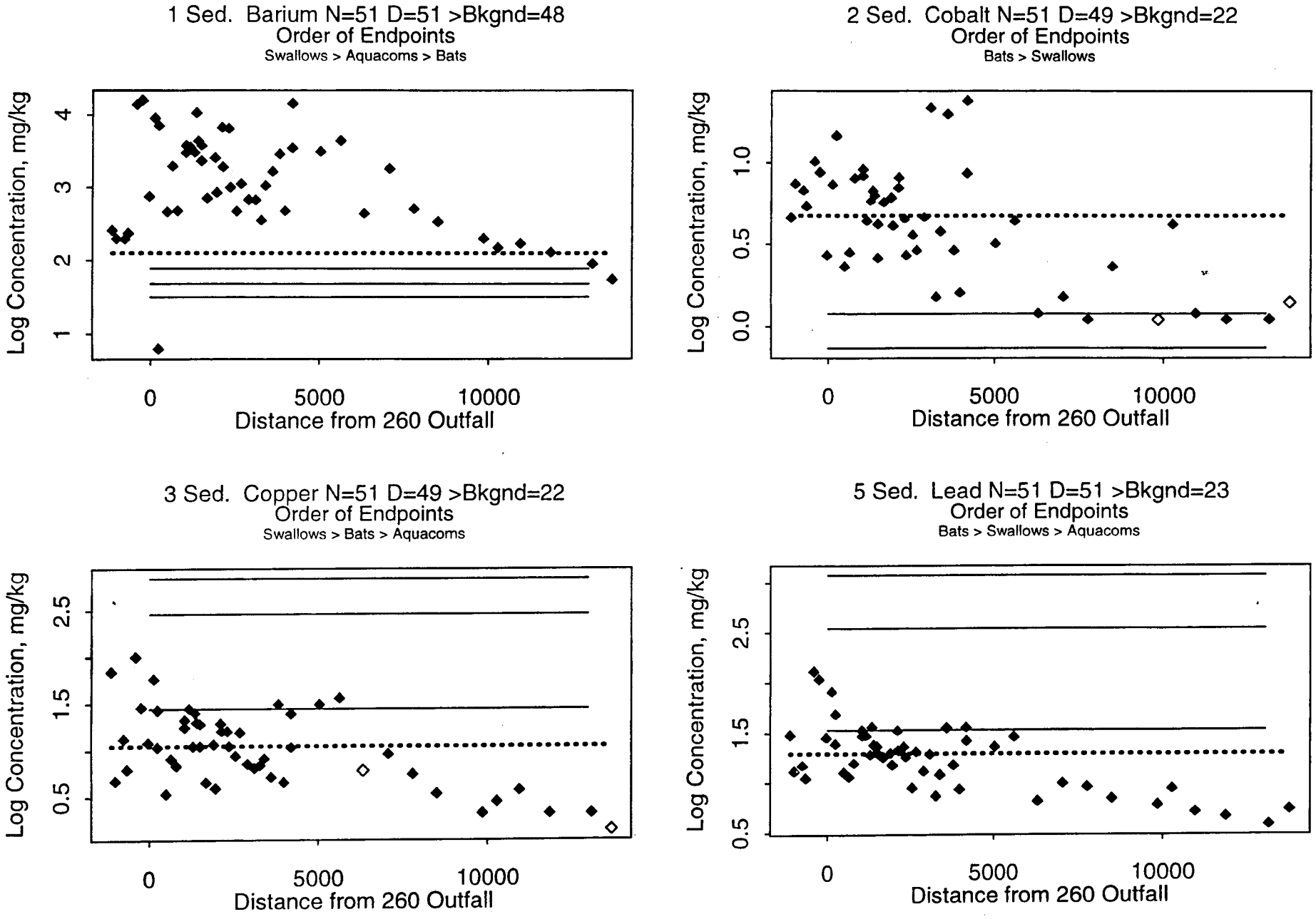


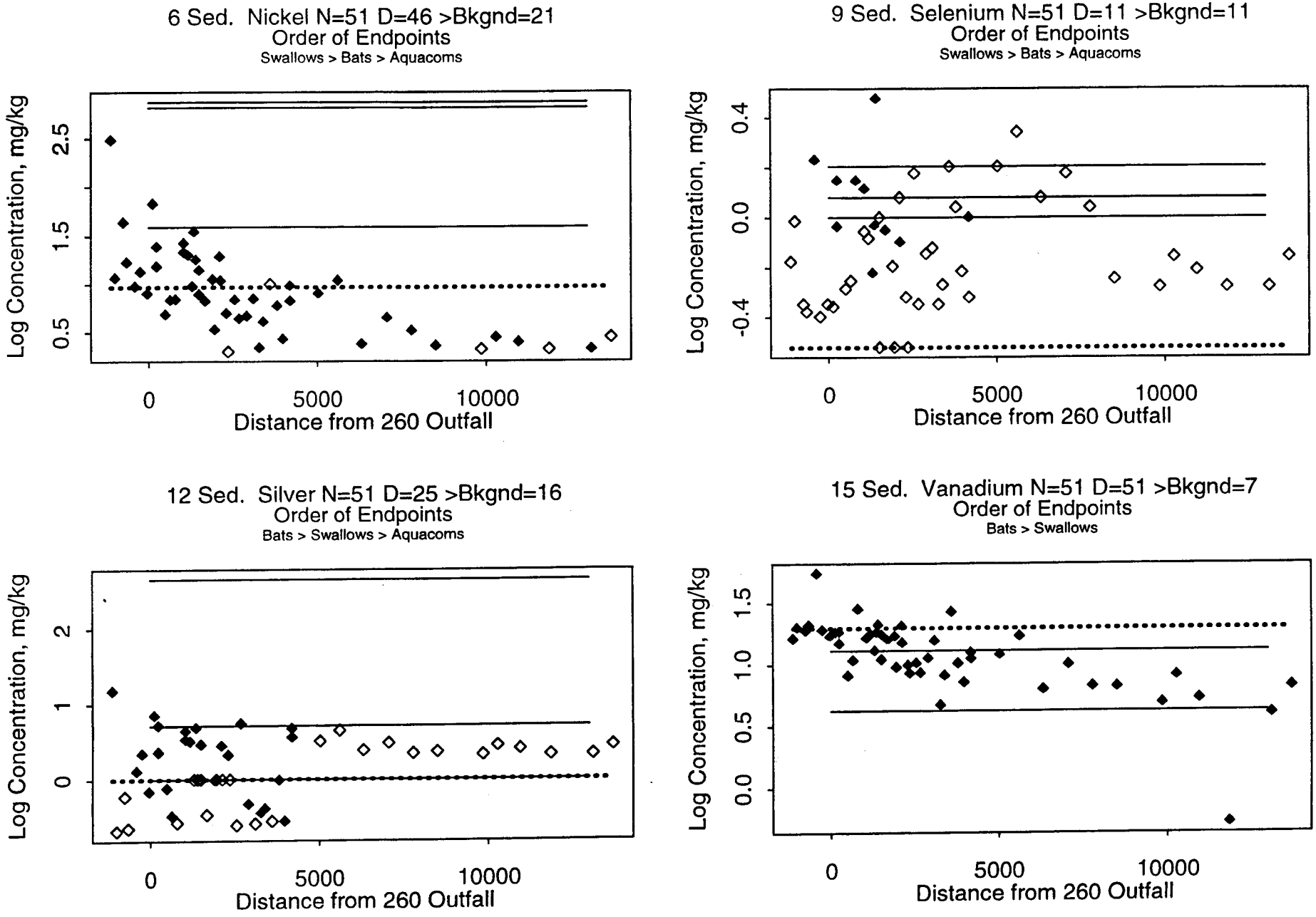
Figure 1. CdV Sediment Data
Active Channel
LANL Sediment Background UTL = Dashed Line



Apr 18 2000

Log.Sediment.exceed.fn

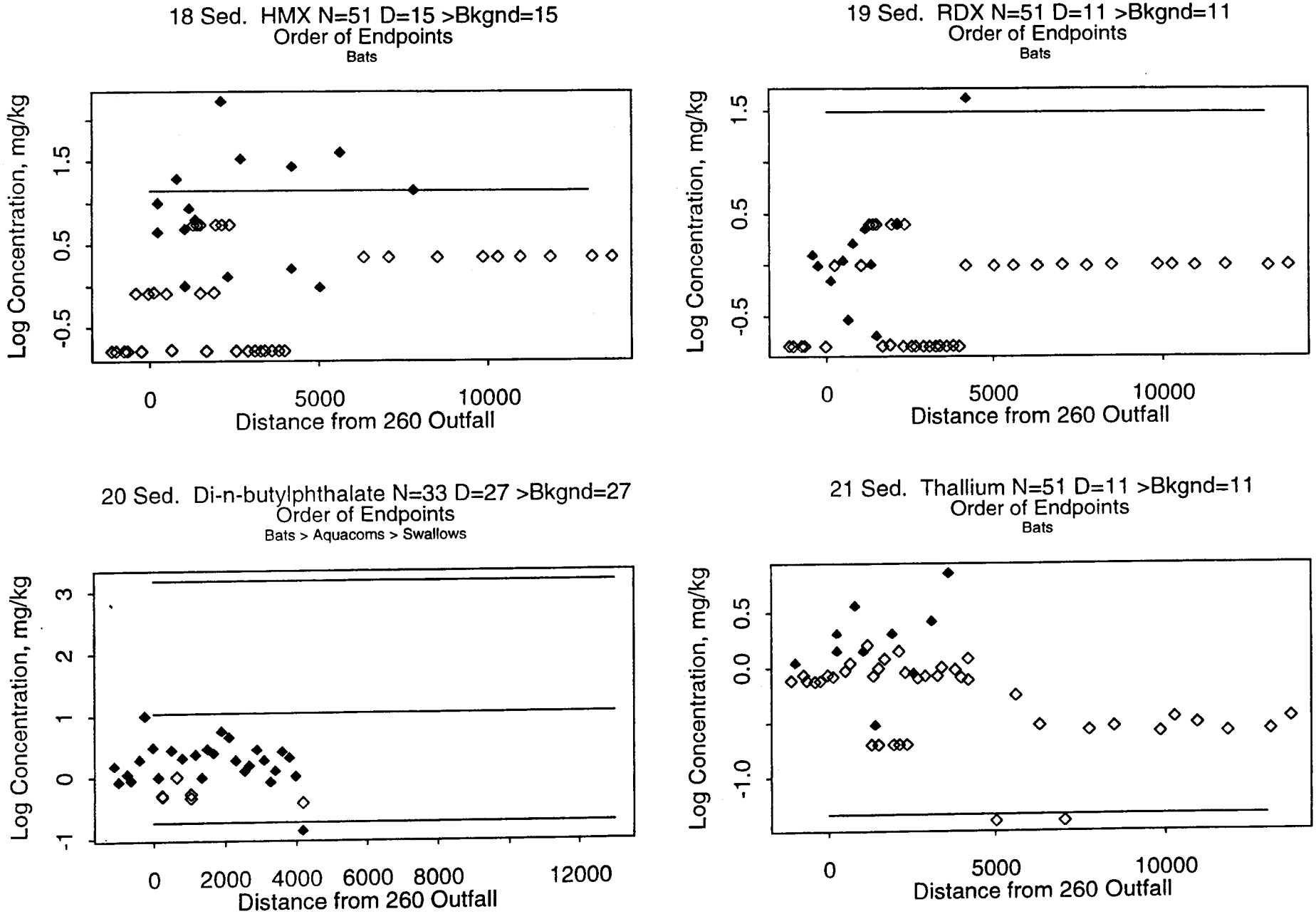
Figure 1. CdV Sediment Data
Active Channel
LANL Sediment Background UTL = Dashed Line



Apr 18 2000

Log.Sediment.exceed.fn

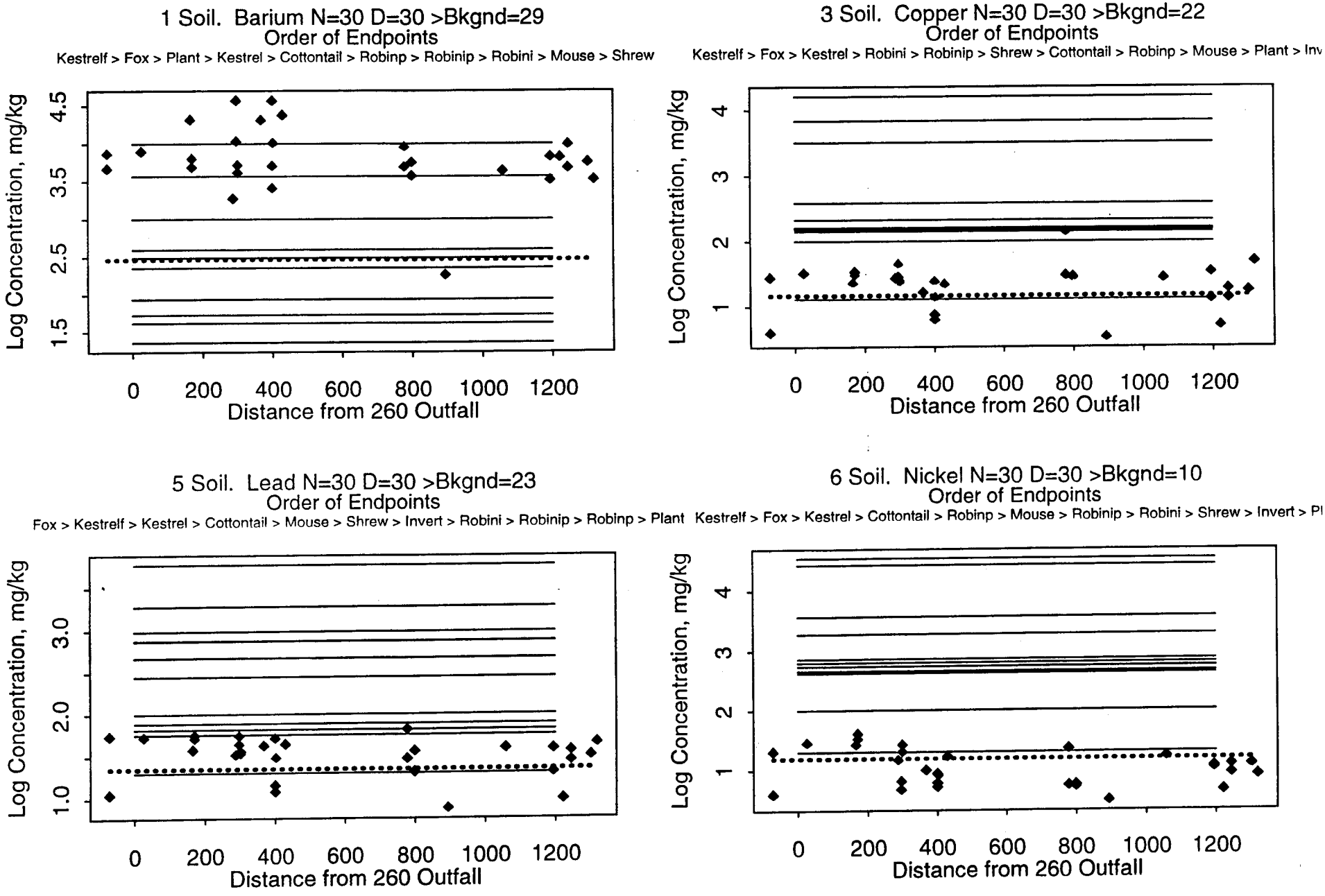
Figure 1. CdV Sediment Data
Active Channel
LANL Sediment Background UTL = Dashed Line



Apr 18 2000

Log.Sediment.exceed.fn

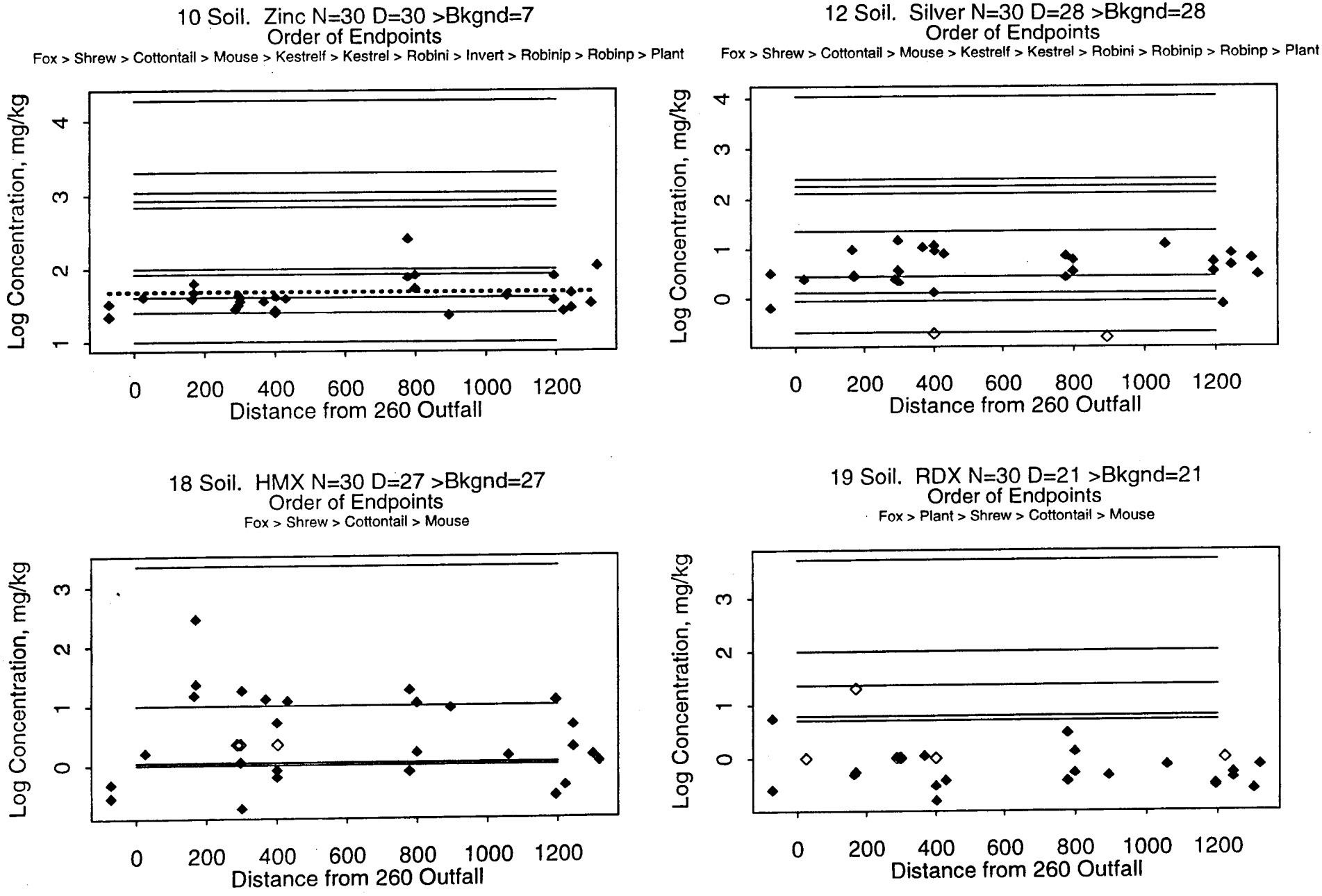
Figure 1. CdV Soil Data
Geomorphic Survey Results
LANL Soil Background UTL = Dashed Line



Apr 18 2000

Log.Soil.exceed.fn

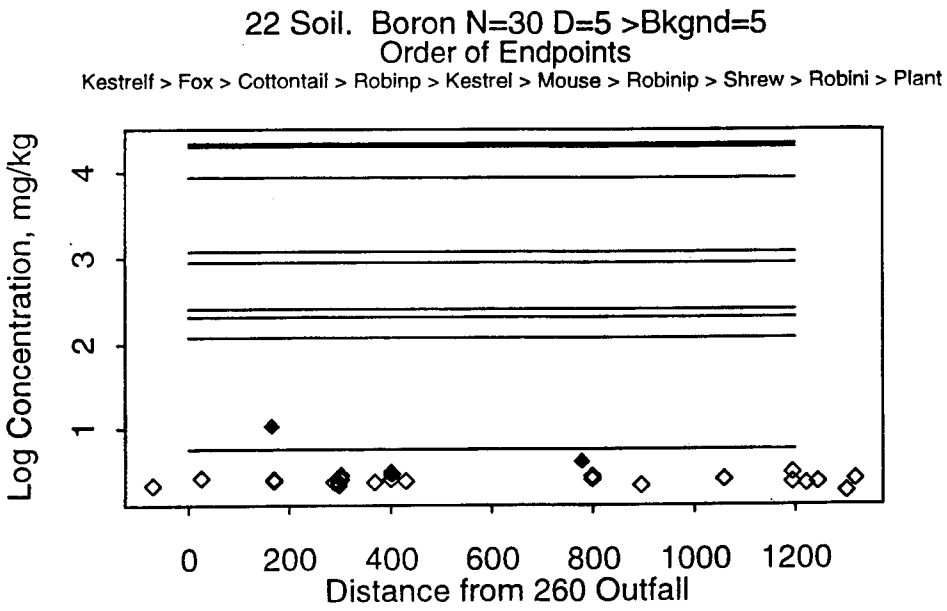
Figure 1. CdV Soil Data
Geomorphic Survey Results
LANL Soil Background UTL = Dashed Line

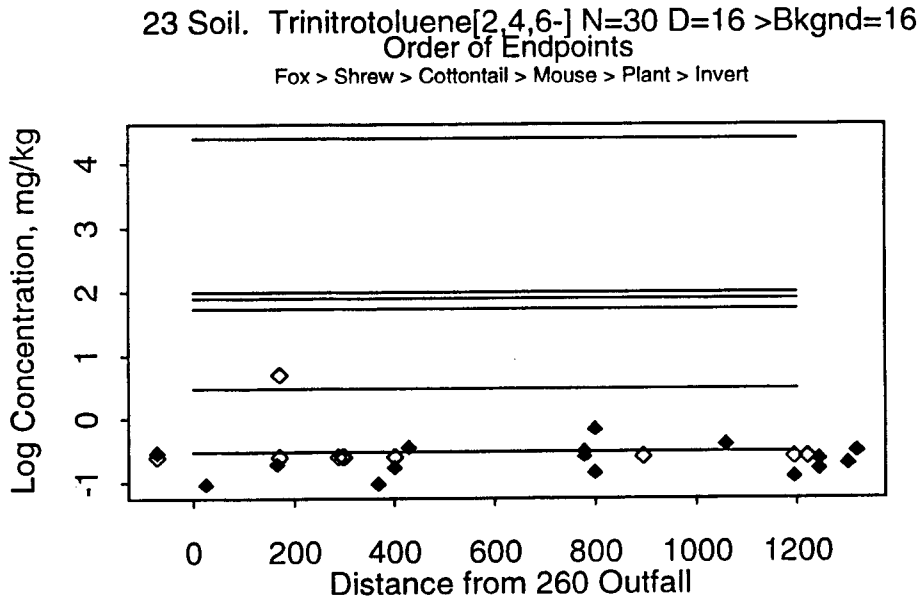


Apr 18 2000

Log.Soil.exceed.fn

Figure 1. CdV Soil Data
Geomorphic Survey Results
LANL Soil Background UTL = Dashed Line

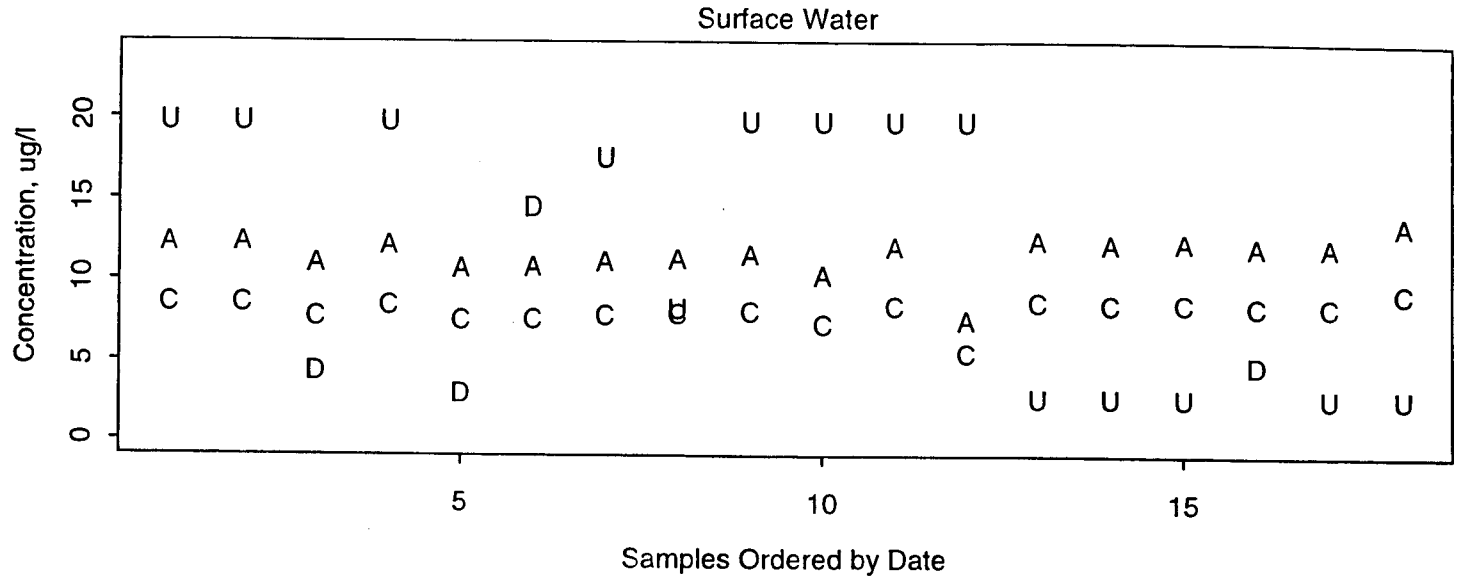


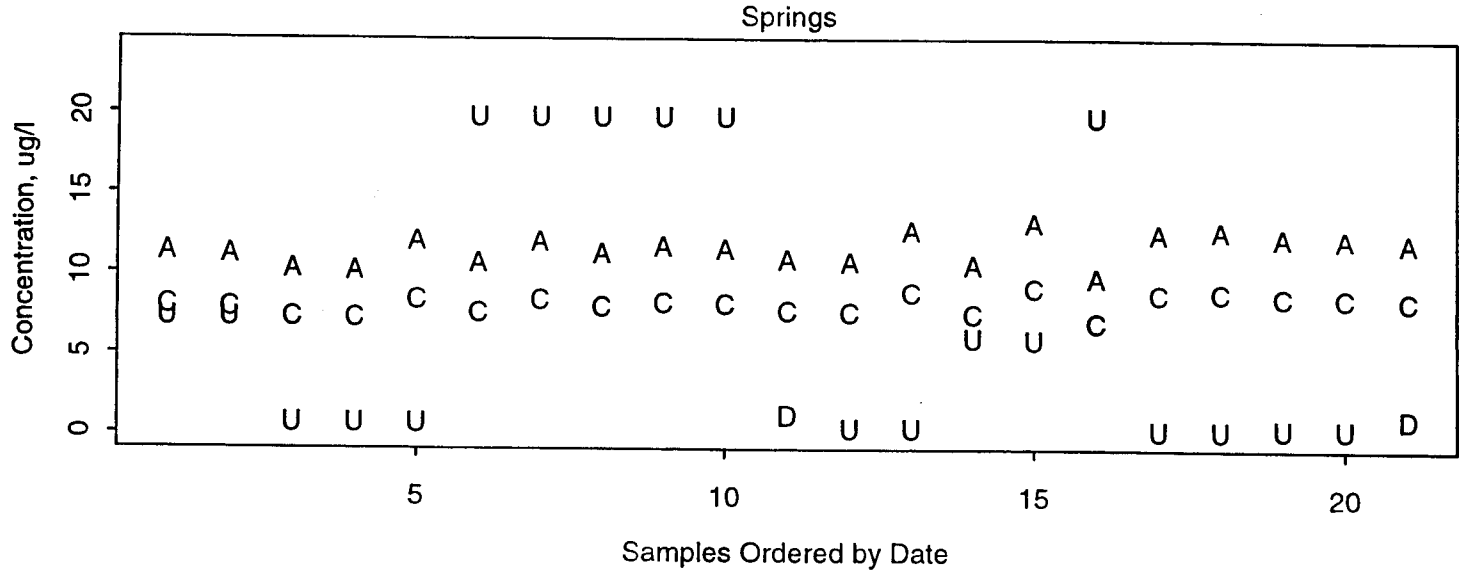


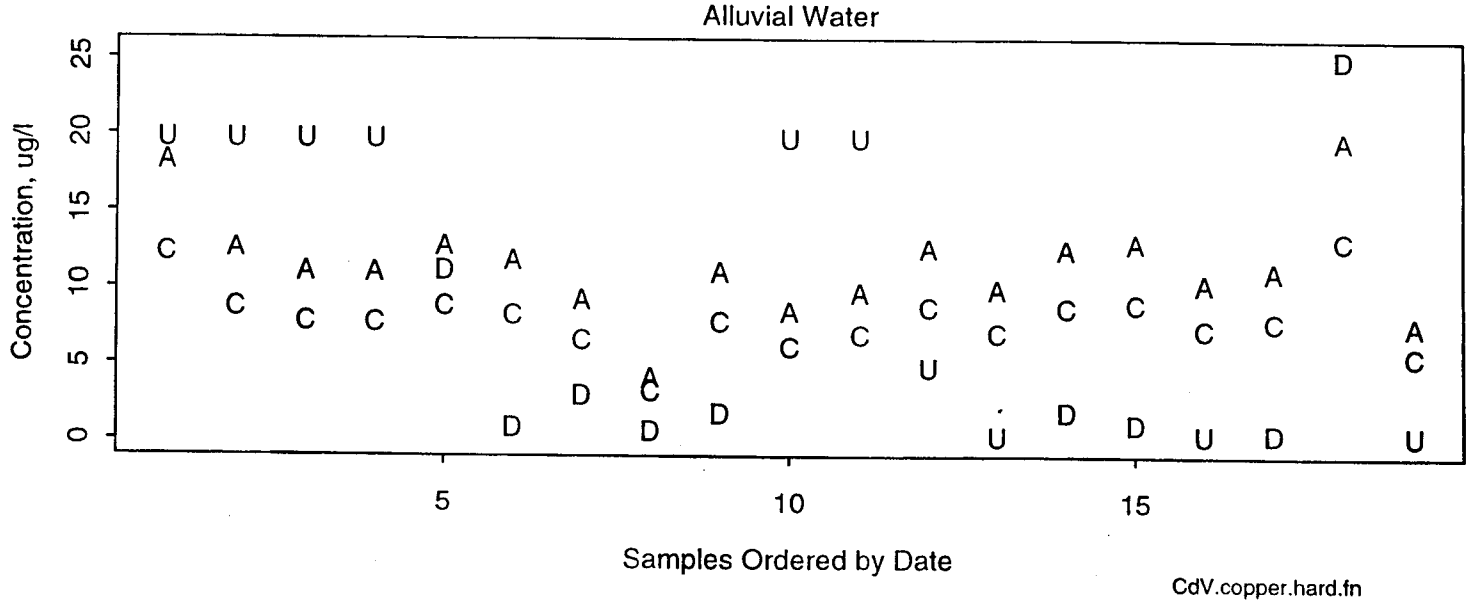
Apr 18 2000

Log.Soil.exceed.fn

# Water Hardness Based Criteria and Sample Results
A=acute, C=chronic, D=detect,U=non-detect

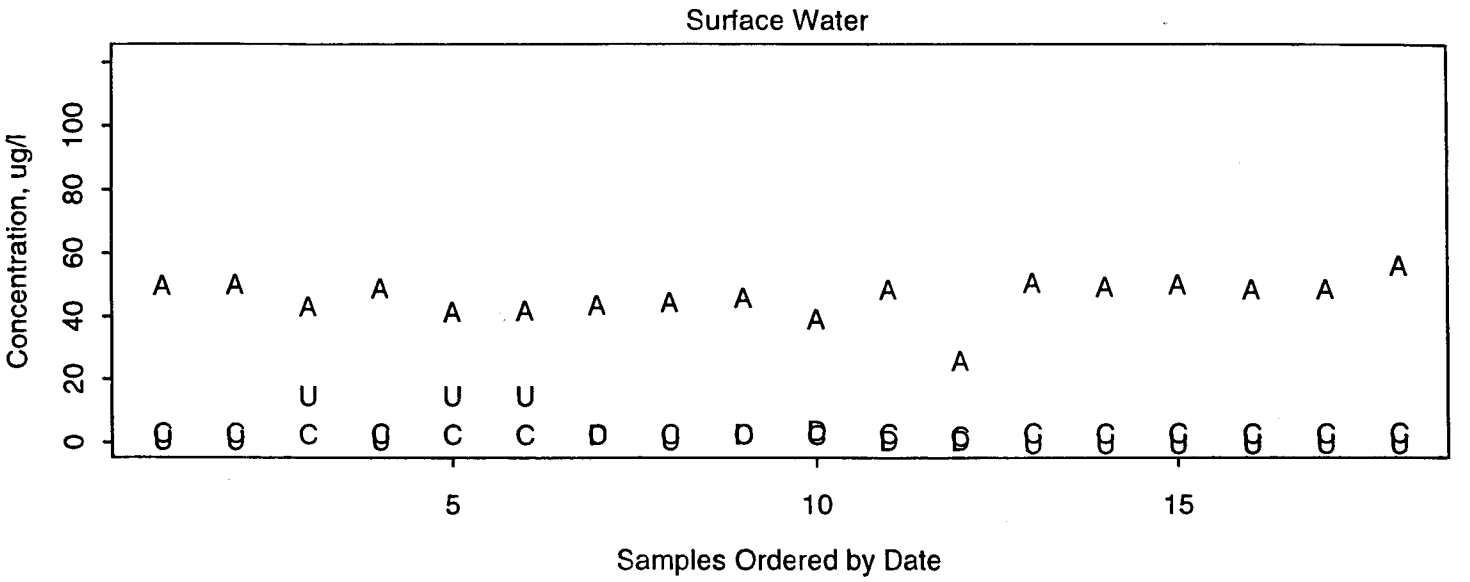


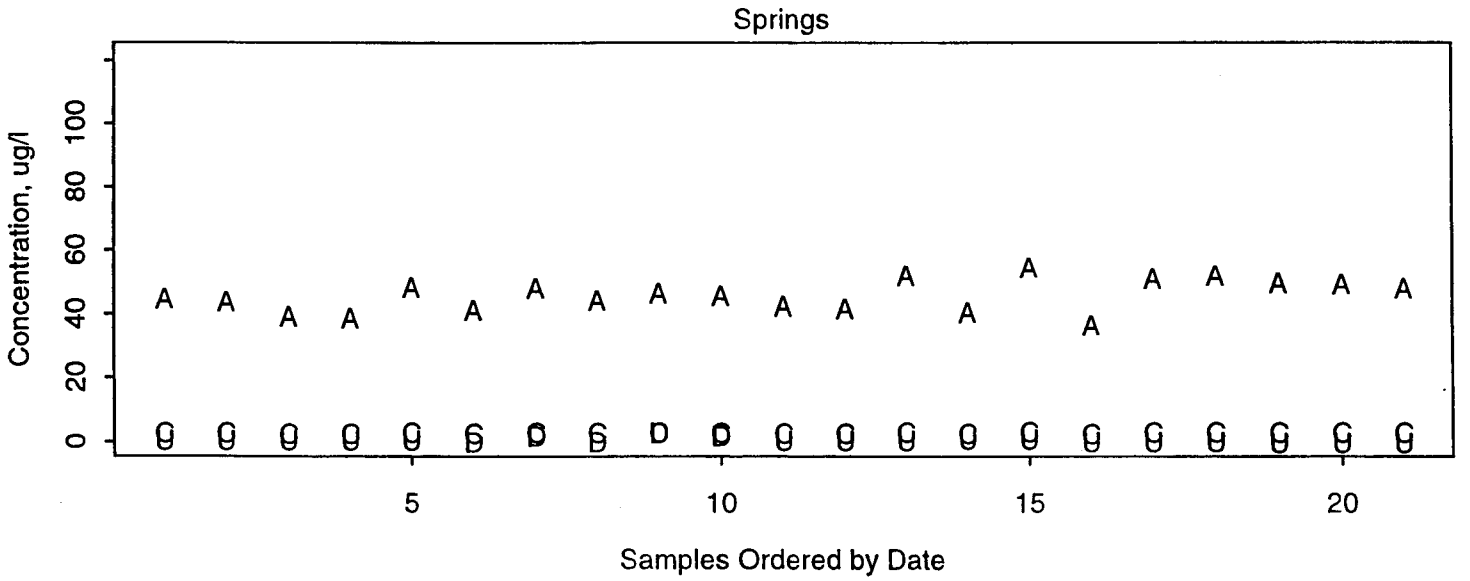


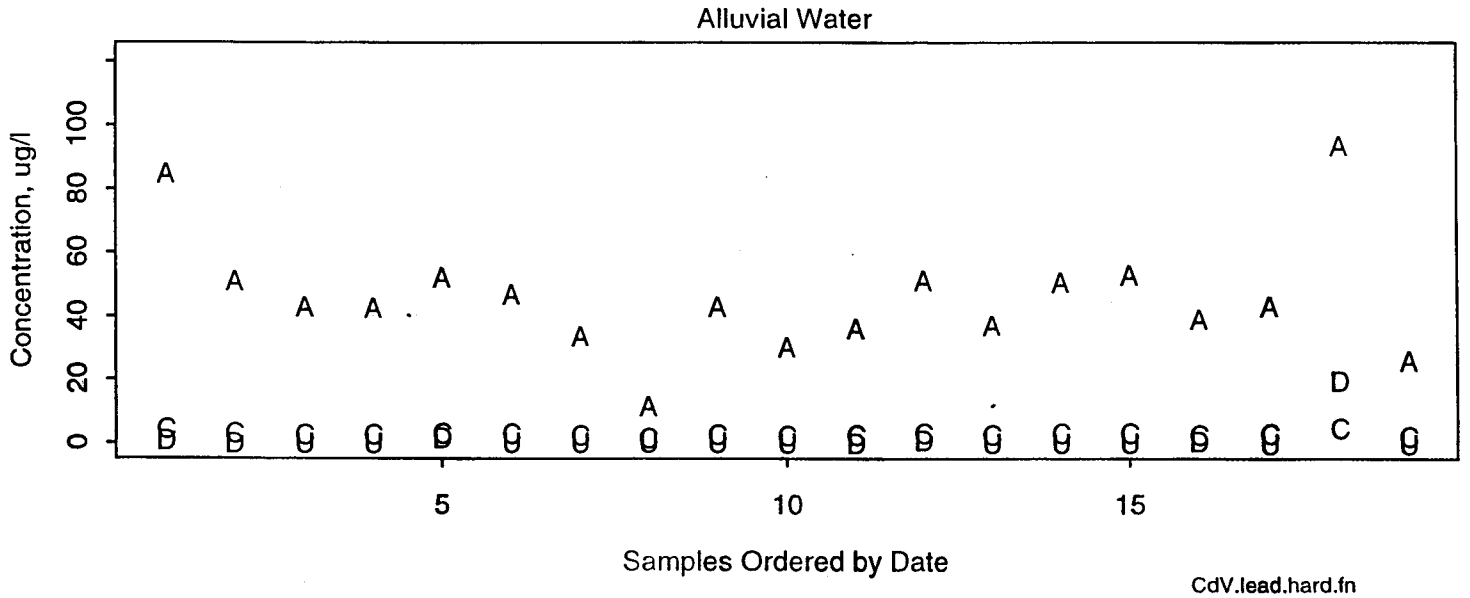


CdV.copper.hard.fn

# Water Hardness Based Criteria and Sample Results
A=acute, C=chronic, D=detect,U=non-detect

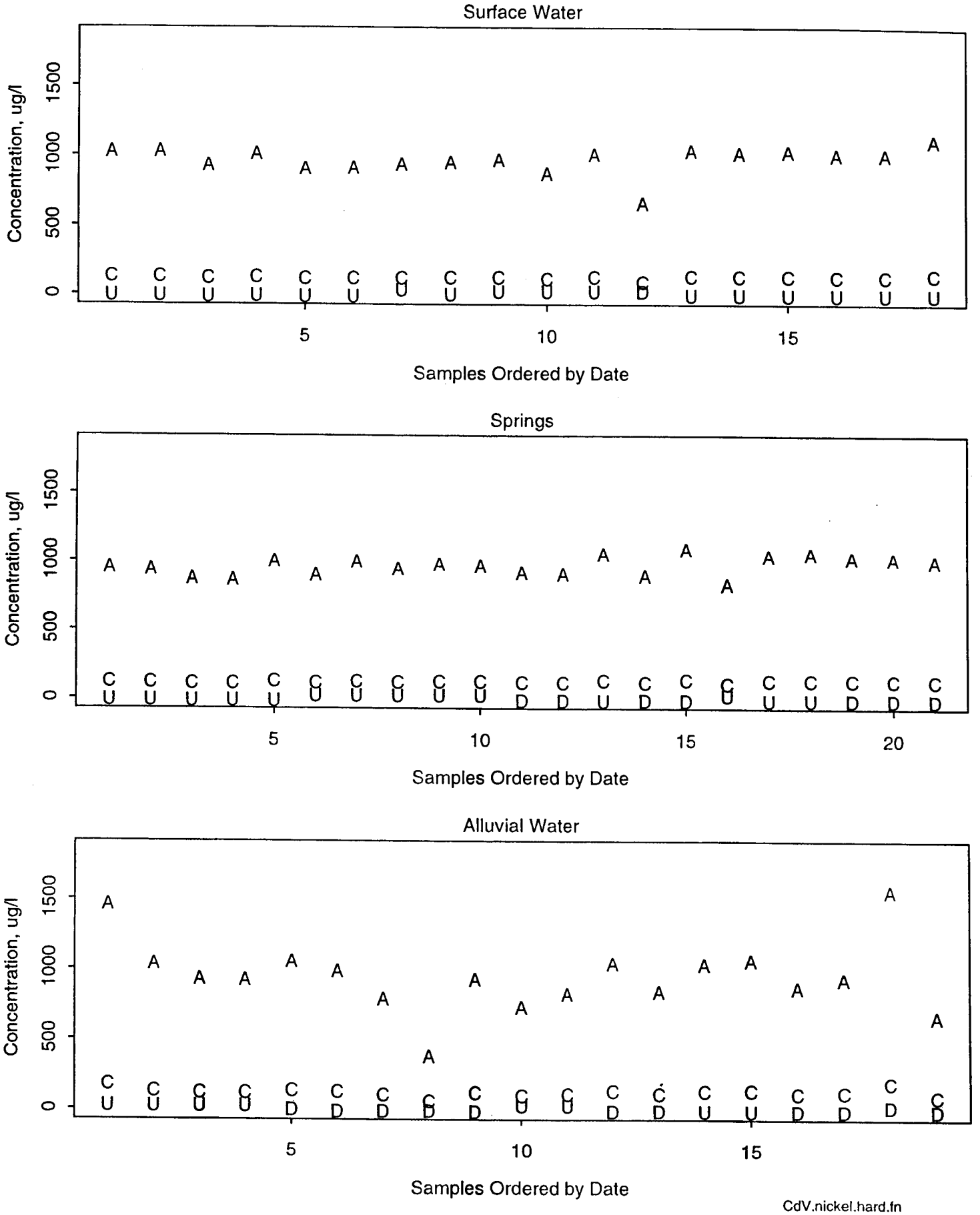






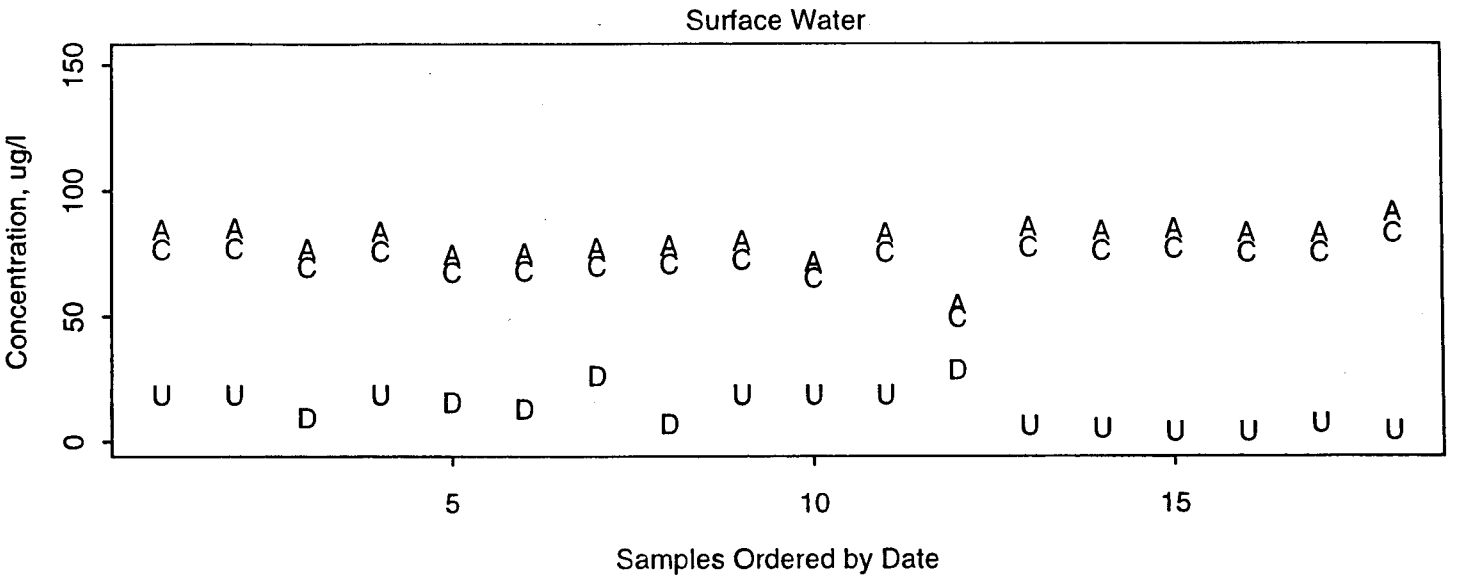
CdV.lead.hard.fn

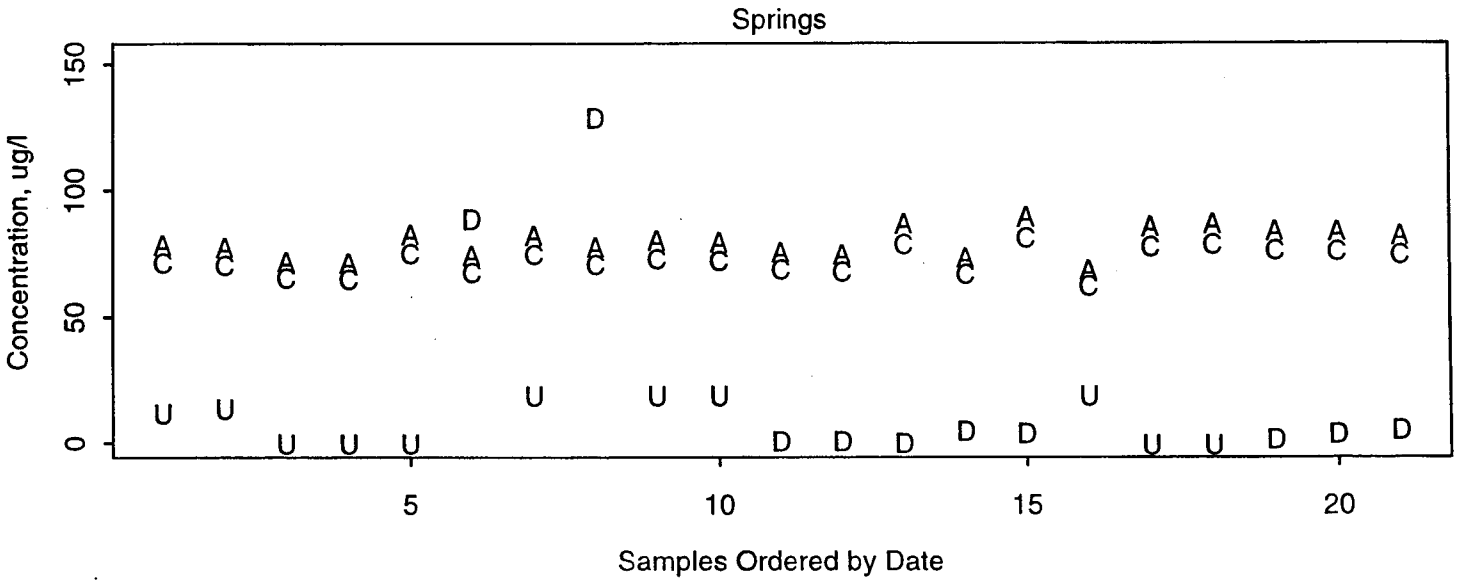
Figure 1: Dissolved Nickel:
Water Hardness Based Criteria and Sample Results
A=acute, C=chronic, D=detect,U=non-detect

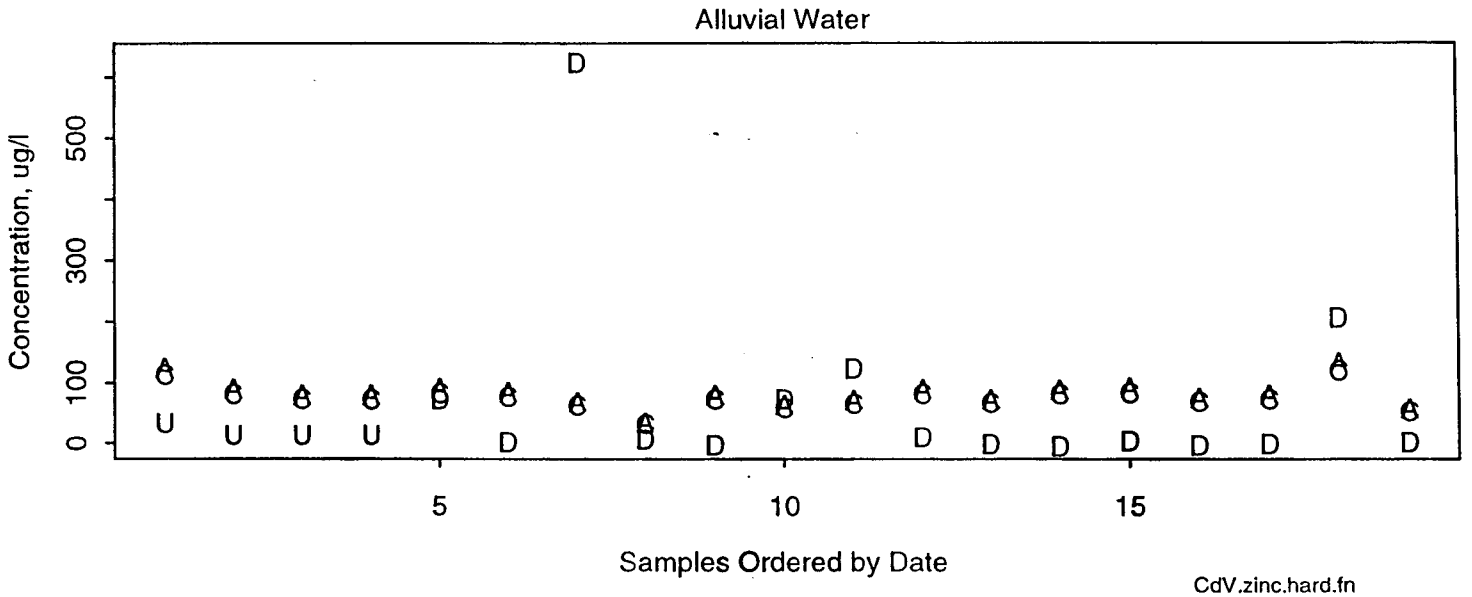


CdV.nickel.hard.fn

# Water Hardness Based Criteria and Sample Results
A=acute, C=chronic, D=detect,U=non-detect

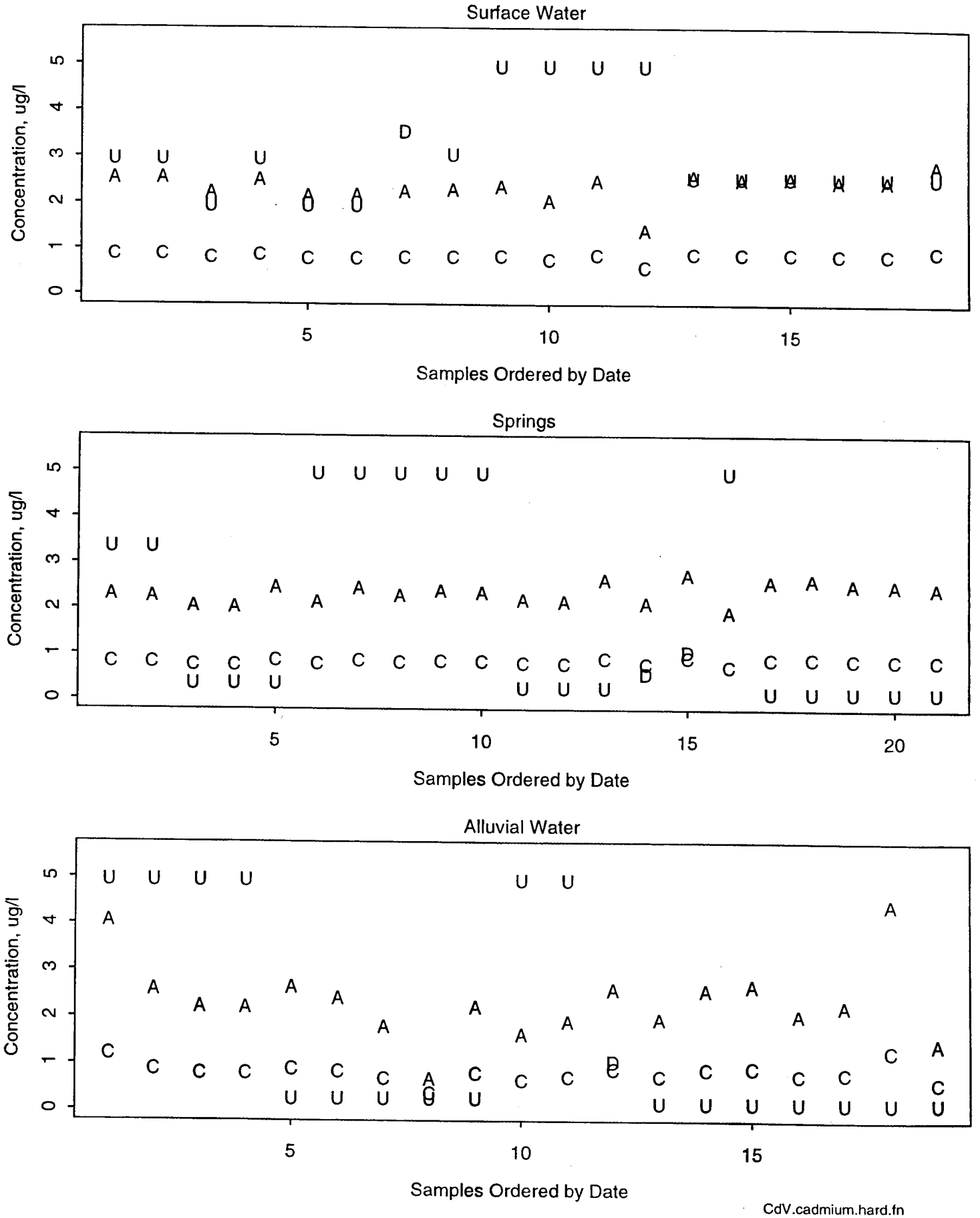






CdV.zinc.hard.fn

Figure 3. Dissolved Cadmium
Water Hardness Based Criteria and Sample Results
A=acute, C=chronic, D=detect,U=non-detect



Cañon de Valle
Ecological Risk Assessment Pilot
Step Four: Study Design

Introduction

The ecological risk assessment pilot for Cañon deValle is being conducted in accordance with USEPA, Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, (ERAGS). Steps one through three have been completed. These steps are screening level problem formulation, screening level exposure estimates and risk calculations, and baseline risk assessment problem formulation.

A field trip to Cañon de Valle was conducted on April 21, 2000 for members of the Environmental Restoration Program High Performing team for Ecological Risk Assessment. This trip coincided with comment resolution for the "Ecological Risk Assessment Pilot for Cañon de Valle, Status Report March 20, 2000." That report documents step three of ERAGS, baseline risk assessment problem formulation. The discussion that ensued after the field trip addressed the path forward for step four, the study design and data quality objectives.

Key information needs are empirical evidence that contaminants of potential ecological concern (COPECs) are impacting small mammal populations and not impacting top carnivores. The wildlife exposure models in "Screening Level Ecological Risk Assessment Methods, LA-UR-99-1405" (SLERA) have sufficient uncertainties to prevent resolution of these questions without data from biota sampling. The top carnivore question is particularly relevant to Cañon de Valle because the Mexican spotted owl, a threatened species, is a top carnivore in the system.

Cañon de Valle Conceptual Model

Effluent discharges from Technical Area 16, including the 260 outfall (PRS 16-021(c)-99), silver outfall (PRS 16-020), steam plant, roof drains, and parking lot runoff all served to augment the surface flow in Cañon de Valle and to transport contaminants into the natural systems of the canyon. Data from media samples collected in the canyon show high explosives and metals, especially barium, to be present in surface water, alluvial groundwater, soils and sediments.

With the elimination of discharges from the 260 outfall and the steam plant, the aquatic regime of the canyon is receding to pre-laboratory conditions. During the drought of year 2000 Burning Ground Spring continued to flow but the rest of the canyon was mostly dry.

The problem formulation phase of the ecological risk assessment pilot for Cañon de Valle identified potential adverse impacts to aquatic, riparian and terrestrial systems in the canyon. The results of that analysis are summarized in Table 1. With the exception of

Table 1. Summary of Problem Formulation COPECs and Receptors

Unfiltered Water Data Used for Assessment

COPEC	Surface Water	Springs	Alluvial Water	Sediment	Soil
Barium	AqComm[1]	AqComm	AqComm	Bkgnd	Cottontail, kestrel, plant, fox, kestrelf
Cobalt	AqComm	AqComm	AqComm	Bkgnd	
Manganese	AqComm	AqComm	AqComm		
Aluminum	AqComm	AqComm	AqComm, shrew, deer mouse, bat, fox		
Silver		AqComm	AqComm	AqComm, swallow	Plant, robinp, robinip, robini
Cadmium	AqComm	AqComm	AqComm		
Mercury		AqComm	AqComm		
Copper				AqComm	Bkgnd, plant
Lead				AqComm	Robinp, robinip
Vanadium				Bkgnd	
HMX				Bat	deer mouse, cottontail, shrew
RDX				Bat	deer mouse
Di-n-butyl phthalate				Swallow	
Thallium				Bat	

[1] Generic aquatic community, "Final Water Quality Guidance for the Great Lakes System; Final Rule," or from New Mexico water quality standards.

sed ESL

not detected

Bat Sed ESL

shrew ESL

350 — 268

44 — .32

E:\EcoRisk\Step 4 Study Design\Table 1 Small mammal.doc

aluminum all screening value exceedances for aquatic resources are associated with generic aquatic community criteria. These criteria originate from methods in "Final Water Quality Guidance for the Great Lakes System; Final Rule," or from New Mexico water quality standards. These values are designed to be protective of the resource, not predictive of potential adverse effects. Hence, they are conservative values that are based upon species assemblages that don't necessarily populate the canyon. The present-day extent and persistence of aquatic resources in the canyon is unknown at this point because of the combined effects of the drought and the elimination of facility discharges. The aquatic system recovery from the year 2000 drought will be evaluated in 2001 and a path forward for the effects characterization in the aquatic system will be developed with concurrence from NMED.

A geomorphic survey and map has been completed for 2500 m of the canyon from the Silver Outfall (16-020) to below MDA-P. Soil samples collected as part of the geomorphic investigation were analyzed for contaminants and the data were used to support the problem formulation assessment. The results indicate a potential for adverse effects to ten of the eleven terrestrial screening receptor species. The results are summarized in Table 1. The potentially effected receptor species range in trophic position in the food web from primary producer to top carnivore.

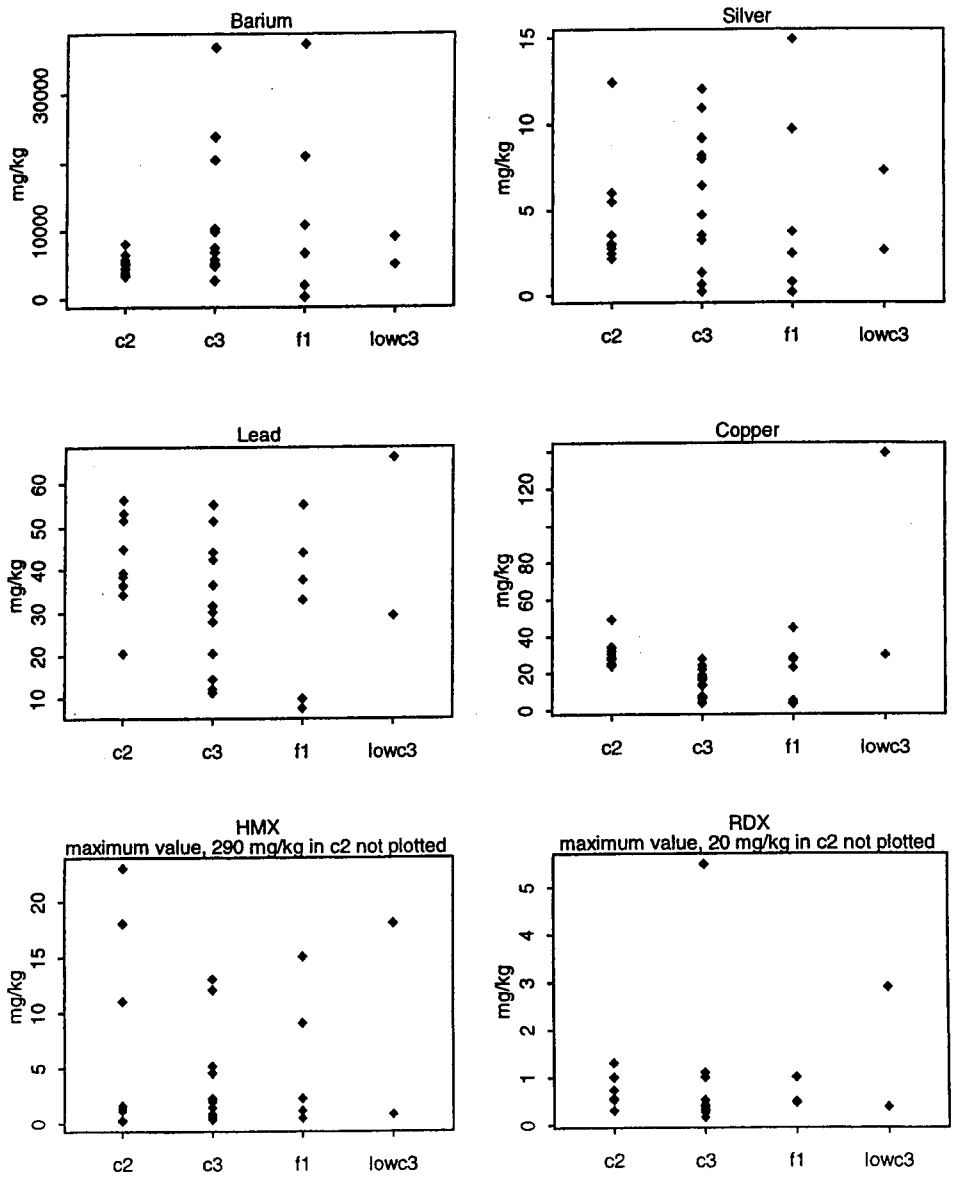
The distinction between soil and sediment in this work is a matter of location. Sediment refers to the active channel of the canyon. Soil is used to encompass the channel and floodplain sediment deposits as well as the terraces, fans, and colluvial slopes. The canyon bottom averages 23 m in width over the mapped reach. The overbanks that are influenced by contaminant transport and deposition average 6 m in width. The overbanks consist of sorted fine material. The highest COPEC concentrations are in the c3 and c2 units. These are packages that have been deposited since LANL commenced operations. The active channel is poorly sorted; indicating that transport in the system tends to occur under higher energy and short duration events. These events do not provide conditions that sort the transported material into deposits with different particle sizes. The balance of the canyon bottom area, nominally 75 percent, is made up of Quaternary terraces. These features are abandoned by channel incision and no longer experience flood flows. The distribution of contaminant concentrations across the geomorphic feature types is presented in Figure 1.

Status of the Ecological Risk Assessment Pilot

Completing the ecological risk assessment and making risk management decisions for Cañon de Valle will depend upon resolving open issues for the three affected media: water, sediment, and soil. Information for the canyon's water resources, beyond the screening assessment, has been produced by the United States Department of Interior Fish and Wildlife Service in the form of "The Los Alamos National Laboratory Use Study Report: A Water Body Survey and Assessment." This study includes bioassay investigations of waters from Cañon de Valle. This study also includes a synoptic survey of aquatic macro-invertebrates conducted by the New Mexico Environment Department. The bioassays and invertebrate surveys can be used as lines of empirical evidence for

Figure 1. COPEC Concentrations by Geomorphic Feature

Sample Sizes: c2=10; c3=12; f1=6; lowc3=2



CdV.contam.by.feature.plt

Table 2. Summaries of Soil Hazard Quotients for COPECs That Exceed One or More Screening Values

Bolded values exceed criteria; NA – Criteria Not Available

Diet suffixes on receptor names: i – invertebrate; p – plant; f - flesh

Barium
Soil HQ Summary

	Minimum	Maximum	MedUCL
Plant	0.18	**37.**	**7.9**
Invert	NA	NA	NA
Robini	**3.4**	**690.**	**150.**
Robinip	**2.1**	**420.**	**90.**
Robinp	0.80	**160.**	**34.**
Kestrel	0.46	**93.**	**20.**
Kestrelf	0.018	**3.7**	0.79
Cottontail	0.59	**120.**	**26.**
Mouse	**4.4**	**890.**	**190.**
Shrew	**8.0**	**1600.**	**340.**
Fox	0.050	**10.**	**2.1**

Silver
Soil HQ Summary

	Minimum	Maximum	MedUCL
Plant	**3.2**	**74.**	**36.**
Invert	NA	NA	NA
Robini	0.22	**5.3**	**2.6**
Robinip	0.48	**11.**	**5.6**
Robinp	0.71	**17.**	**8.2**
Kestrel	0.027	0.65	0.32
Kestrelf	0.0048	0.11	0.056
Cottontail	0.0035	0.083	0.041
Mouse	0.0048	0.11	0.056
Shrew	0.0025	0.060	0.029
Fox	0.000057	0.0014	0.00074

Copper
Soil HQ Summary

	Minimum	Maximum	MedUCL
Plant	0.033	**1.4**	0.28
Invert	0.25	**11.**	**2.2**
Robini	0.0087	0.37	0.074
Robinip	0.016	0.66	0.13
Robinp	0.024	0.99	0.20
Kestrel	0.001	0.043	0.0088
Kestrelf	0.00021	0.0087	0.0018
Cottontail	0.022	0.93	0.19
Mouse	0.033	**1.4**	0.28
Shrew	0.021	0.87	0.18
Fox	0.00049	0.02	0.0042

HMX
Soil HQ Summary

	Minimum	Maximum	MedUCL
Plant	NA	NA	NA
Invert	NA	NA	NA
Robini	NA	NA	NA
Robinip	NA	NA	NA
Robinp	NA	NA	NA
Kestrel	NA	NA	NA
Kestrelf	NA	NA	NA
Cottontail	0.17	**260.**	**11.**
Mouse	0.19	**290.**	**12.**
Shrew	0.019	**29.**	1.2
Fox	0.000086	0.13	0.0055

Lead
Soil HQ Summary

	Minimum	Maximum	MedUCL
Plant	0.38	**3.3**	**2.2**
Invert	0.076	0.66	0.44
Robini	0.097	0.84	0.56
Robinip	0.12	**1.0**	0.66
Robinp	0.13	**1.2**	0.77
Kestrel	0.0078	0.068	0.045
Kestrelf	0.0040	0.035	0.023
Cottontail	0.010	0.088	0.058
Mouse	0.016	0.14	0.093
Shrew	0.027	0.24	0.16
Fox	0.0013	0.011	0.0074

RDX
Soil HQ Summary

	Minimum	Maximum	MedUCL
Plant	0.0016	0.055	0.0072
Invert	NA	NA	NA
Robini	NA	NA	NA
Robinip	NA	NA	NA
Robinp	NA	NA	NA
Kestrel	NA	NA	NA
Kestrelf	NA	NA	NA
Cottontail	0.026	0.90	0.12
Mouse	0.031	**1.1**	0.14
Shrew	0.007	0.24	0.031
Fox	0.000031	0.0011	0.00014

evaluating adverse effects of COPECs upon the biota that reside in these media. With changes in the aquatic resources in the canyon due to eliminating effluent flow, this information needs to be evaluated for its applicability and relevance to completing the baseline assessment. The approach to addressing COPECs in soils, the third media, in the canyon is addressed in the balance of this document.

Problem Formulation Results Summary for Riparian and Terrestrial Systems.

The ERAGS step three results identified several COPECs in overbank soils that exceed the screening criteria. The COPECs are barium, silver, lead, copper, HMX, and RDX. Summary information for hazard quotients with minimum, maximum and the 95% upper confidence limit on the median are provided in Table 2. This table shows that copper and lead have a full complement of eleven screening values, barium and silver are missing the invertebrate endpoint, RDX is missing six endpoints and HMX is missing seven endpoints. Endpoints are missing because toxicology studies have not been included in the Ecorisk database for these contaminants. In some cases, such as avian endpoints for HMX and RDX, extensive searches of the literature have yet to identify relevant studies. This is consistent with Talmage, et al. which states that no subchronic or chronic feeding studies of high explosives compounds were found for avian species. The table also shows great variability in the extent to which the COPECs exceed screening values. A single screening endpoint value is exceeded by the maximum RDX concentration. All available screening endpoint values were exceeded by the maximum barium concentration and four of those endpoint values were exceeded by the minimum barium concentration.

Assessment Endpoints

The environmental values, or assessment endpoints, to be protected for Cañon de Valle consist of features of the canyon relative to the surrounding landscape and the resident threatened species. Cañon de Valle is one of many canyons incised into the Pajarito Plateau. This canyon has two perennial springs and an alluvial seep in the vicinity of the TA-16 facilities. The presence of water in the canyon is ecologically important to the viability of many species in this semi-arid environment. Additionally, the canyon supports a multi-leveled overstory of mixed conifer, aspen and oak with grasses and forbs on overbanks and terraces. The combination of perennial water and diverse vegetation make the canyon a relatively attractive location for endemic fauna. The Mexican spotted owl has a nesting site down canyon from the outfall and is likely to hunt in the canyon.

ERAGS Step Four: Study Design and Data Quality Objectives

Given that an unacceptable potential ecological risk persists through the evaluations in step three, the ERAGS process continues with a study design and data quality objectives. Step four generates the data needed to determine whether the potential risk is evident at the site.

Comparisons to Preliminary Remediation Goals

Some Department of Energy sites have calculated preliminary remediation goals (PRGs) as an alternative to conducting a baseline ecological risk assessment. PRGs are concentrations of COPECs that are considered protective against population level effects. As an example, Sandia National Laboratories published, "Predictive Ecological Risk Assessment Methodology." (1998, AL/7-98/WP/SNL: R4324.DOC) which provides an approach for developing preliminary remediation goals. A factor of ten is multiplied times the screening levels and compared to the upper confidence limit on the mean COPEC value. The factor of ten is derived from the assumed contaminant concentration difference between the "no observed adverse effects level" (NOAEL) and the "lowest observed adverse effects level" (LOAEL) for a chemical when one or the other is not available from a toxicity study. The Sandia approach then is to screen at the NOAEL level for the maximum sample contaminant value and to propose remediation goals at the LOAEL level compared to the upper 95th percentile on the mean for the contaminant data. A similar approach has been documented for the Oak Ridge Reservation, Oak Ridge, Tennessee in, "Preliminary Remediation Goals for Ecological Endpoints," ES/ER/TM-162/R2.

There are two difficulties with applying PRGs to Cañon de Valle. Screening values are not available for all species endpoints across the six COPECs in Table 2, and a species of concern for the site is the Mexican spotted owl. As a threatened species, individual effects to the owl must be evaluated. PRGs are intended to assess population level effects. Consequently, data collection to support a baseline risk assessment is the preferred path forward.

Comparing site data to nominal PRGs does provide a context for the potential severity of contaminant effects in Cañon de Valle, where screening levels are available. The 95th percentile upper confidence limit (UCL) on the medians are provided in Table 2 for this purpose. The upper bound on the median is given instead of the upper bound on the mean because the data are not normally distributed. If the values in the third columns for each of the contaminants are divided by ten to approximate a PRG ratio, then the values for copper, lead, and RDX are less than one for all available endpoints. Silver and HMX have values slightly exceeding one and the barium PRG ratios range from 0.079 to thirty-four.

Evaluating the same information from the perspective of the screening endpoints shows that the screening values for kestrel, as a flesh eater, is only exceeded by the maximum barium value. All of the median UCL values for kestrel are below the screening criteria and well below the PRGs. This endpoint is the closest surrogate for the Mexican spotted owl of the eleven endpoints used. Both the screening values and the PRGs for barium exceed the mouse and shrew endpoints. These are omnivore and insectivore endpoints. The robin endpoints show similar results. The kestrel PRG ratios are problematic for decision making because screening criteria are not available for HMX and RDX.

Field Investigation Conceptual Design

The screening receptors that are potentially effected by the contaminants are generic plant, cottontail, robin as an herbivore, robin as an omnivore, robin as an insectivore, deer mouse, shrew, kestrel as an omnivore, kestrel as a carnivore, and fox. In all cases the potential for effects is dependent upon the transfer of contaminants from soil to the effected species. In most cases there are multiple inferred transfers of contaminants from soils to the receptor species. An example is kestrel, as carnivore, which might consume an herbivore an omnivore, or an insectivore. Each of these prey groups has its own set of transport pathways from soil. The number of transfers and whether contaminant concentrations increase, stay the same, or diminish with each transfer determine the dose to the kestrel. This is all to say that estimating the intake of a contaminant by an endpoint species based upon soil concentrations is difficult and imprecise.

There is a limit in the extent to which screening results can be resolved by modifying exposure models and qualifying toxicological data. Multiple contaminants effecting multiple receptors through multiple food chain transfers results in a model where the outcome is largely driven by the modeling assumptions. The results of the calculations are essentially qualitative because of the uncertainties associated with each of the transfers. A more straightforward approach is to analyze biota collected at the site to determine to what extent adverse impacts are indeed occurring.

Options for Biota Sampling

The potentially effected endpoints for Cañon de Valle soils span trophic levels from producer to top carnivore. Uncertainty in the screening values increases up the food chain because the uncertainty for each food chain step is compounded with the subsequent steps. The higher up the food chain that biota sampling is conducted, the better able we are to evaluate the impacts of the site contaminants and concentrations on the ecological system in the canyon. The contradicting consideration is that higher trophic level organisms tend to have larger home ranges. The biota sampling is best conducted with species that are likely to reside in the effected area of the canyon for the duration of their life histories.

The relevant reach of canyon bottom in Cañon de Valle is nominally 23 meters wide and 2500 meters long. The overbanks with elevated COPEC concentrations average 6 meters in width. Good candidates for assessing the body burdens of contaminants are species with home ranges and habitat requirements that can reasonably be expected to be contained within the canyon and contaminated areas. Species that range over areas larger than the canyon or that have habitat requirements not met within the contaminated portion of the canyon will provide ambiguous information about body burdens because the extent of their activity within the canyon will be unknown. Additionally, the optimal species would reside in the canyon year-around and the population density would allow for collecting several individuals to support a population estimate of the contaminant body burdens. This last point is important because we are interested in population level effects. For threatened or endangered species, such as the Mexican spotted owl, biota sampling will be conducted on their prey species. A population level estimate of body burdens in the prey species can be used to estimate the contaminant dose to the owl.

The typical home ranges for the screening endpoint species are provided in Table 3 along with the relative size of these home ranges to the nominal size of the Cañon de Valle bottom. The relevant reach of the canyon is from the 260 Outfall downstream to Southward bend of the canyon, for a total length of 2500 m. The average width of the canyon bottom for this reach is 23 m, resulting in an area of 5.75 ha.

Table 3. Endpoint Species, Home Ranges
And Home Ranges Relative to the Size of Cañon de Valle

Endpoint species	Home range, ha.[1]	Relative to Cañon de Valle canyon bottom, 5.75 ha.
Deer Mouse	0.1 – 0.4	58 – 14
Dusky Shrew	0.06 – 0.5	96 – 12
Mountain Cottontail	0.4 – 6	14 – 1
Gray Fox	100 – 130	0.06 – 0.04
Kestrel	10 – 500	0.6 – 0.01
Robin	0.1 – 0.9	58 – 6.4

[1] from Fire Effects Information System (http://www.fs.fed.us/database/feis/)

The six endpoint species have home ranges from a 0.06 ha minimum for the dusky shrew to 500 ha maximum for the kestrel. The kestrel and gray fox are poor choices for contaminant body burden estimations because their home ranges far exceed the size of the relevant area of Cañon de Valle. The robin is a reasonable candidate from the perspective of home range size and it is a permanent resident of Los Alamos County. Two aspects of it natural history make the robin less desirable for our purposes. Robins are elevational migrants, moving to upper elevations in the spring and lower elevations in the fall. This behavior would interrupt the contaminant exposure pathways for part of the year. Additionally, robins are not a dominant prey species for carnivores on the Cañon de Valle system. This is especially important because Cañon de Valle is habitat for the threatened Mexican Spotted Owl. Biota sampling should address potential contaminant uptake for the owl.

The three remaining candidates from the endpoint species list are the deer mouse, dusky shrew, and the mountain cottontail. Deer mouse and dusky shrew have home ranges that are suitable to the purposes for biota sampling in the canyon. Mountain cottontail is marginal at the upper bound of its typical home range. Information on general food habits for the Mexican spotted owl documented in BISON-M indicates:

> "Mammals accounted for 73-96% of total prey and 91 - 99% of prey biomass. Owls consumed prey ranging in mass from beetles (Coleoptera) and moths (Lepidoptera) (ca 1 g) to adult cottontail rabbits (Sylvilagus spp.; ca 650 g). Mean prey mass ranged from 63 - 118 g in various regions. Woodrats, white-footed mice (Peromyscus spp.), and voles (Microtus spp.) accounted for 61 - 83% of the

> total prey and 59 - 88% of total biomass in various regions. Cottontails and pocket gophers (Thomomys spp.) accounted for another 3 - 14% of total prey and 7 - 36% of total biomass. Birds and reptiles contributed little to prey numbers or biomass except in Southeast Arizona. Insects were relatively common in the diet (3 - 16% of total prey) but contributed little to prey biomass. Diurnally active mammals such as squirrels and chipmunks (Sciuridae) accounted for <3% of total prey or biomass (Ganey, 1992)"

Small mammal populations were surveyed at outfalls and in the canyons at LANL and reported in Raymer, D.F. and J.R. Biggs, 1994. Generally, small mammals captured in canyons with natural surface water flow included long-tailed vole, montane vole, western harvest mouse, dusky shrew, water shrew, deer mouse and brush mouse. Dry canyons were populated by deer mouse and brush mouse. These results suggest that dusky shrew and deer mouse are likely to be present in Cañon de Valle and are viable candidates as measurement endpoint species.

Cañon de Valle is a mosaic of habitat types. It is likely that during wet periods the areas around the springs and the drainage channel will be populated by the species listed for canyons with naturally flowing waters. The dry site species are likely to inhabit the terraces and colluvial slopes of the canyon. During dry periods the flow in the canyon recedes to the vicinity of the springs. Under these conditions the canyon is still likely to support wet-site and dry-site species, with changes in relative abundance. These species typically average four litters per year. This means that population responses to changing environmental conditions can be very rapid.

Small mammals are a viable option for biota sampling in Cañon de Valle. They reside in the canyon year-around. The populations are sufficiently abundant to provide multiple individuals for population estimates of body burdens. Even if small mammal populations are not reduced due to contamination in the canyon, they are dominant prey species for the carnivores active in the canyon, including the Mexican spotted owl. Using body burden data from small mammals will provide the information necessary to make direct estimates of contaminant intake by carnivores, obviating most of the assumptions in the contaminant transfer models. Several species are likely to be available including herbivores, omnivores, and insectivores.

The trophic level of a small mammal species generally influences the rate of accumulation of contaminants relative to soil concentrations. Sample, et al. found that bioaccumulation is highest in insectivores and lowest in herbivores. These results are corroborated by three other studies cited by Sample, et al. For the three endpoint species under consideration, mountain cottontail is an herbivore, deer mouse is an omnivore and dusky shrew is an insectivore. Based upon home range, potential for bioaccumulation, and prey size preferences of the Mexican spotted owl, the dusky shrew and deer mouse populations are well suited to our purpose for assessing contaminant transfers to top carnivores. Given the propensity for higher body burdens, these species are also likely to reveal population responses to COPECs if those responses are occurring. If necessary, the differences in diet can be used to differentiate body burdens associated with trophic

levels. Finally, the reproductive rate of these species is such that individuals removed for analysis will be quickly replaced. Negative consequences to the food chain from sampling are very unlikely.

The Cerro Grande fire impacted Cañon de Valle to varying degrees in the relevant reach of the canyon. Fire effects literature documents multiple studies where the investigators found either intact small mammal populations or rapid colonization after wildfires, (e.g., DeBano, L.F, et al. 1998, Fire Effects Information System). Some species, such as deer mouse, show increases in population densities after fires. Evidently, they prefer more open areas caused by fire and are considered a disturbance species. All of this is to say that the impact of the Cerro Grande fire upon small mammal populations in Cañon de Valle is likely to be minimal during 2001.

Study Objectives and Proposed Measurement Endpoints

Biota sampling can serve multiple purposes. First, biota sample data can provide direct estimates of COPEC concentrations that are consumed by the next higher trophic level. As an example, chemical analysis of vegetation can provide estimates of COPEC concentrations consumed by herbivores. This is a more reliable estimate of uptake than modeling transfers from soils to herbivores because site-specific variables such as soil type, chemical form of the COPECs and plant species characteristics have their influences upon the COPEC concentrations in vegetation. Second, biota trap and recapture sampling can be performed to estimate densities of organisms to evaluate COPEC influences on populations. A third purpose for biota sampling is to establish transfer factors from soils to the sampled animal species. This is less definitive for assessing effects because pharmacokinetic models are needed that depend upon knowing chemical forms of COPECs, estimates of assimilation efficiencies, and biological half-lives in order to associate body burdens with soil concentrations.

There are two objectives for biota sampling in Cañon de Valle. First, the problem formulation results indicate that contaminant transfers to top carnivores are at concentrations below concern, with HQ ratios ranging from 0.023 to 0.79 for the median UCLs. Unfortunately, screening values are not available for the COPECs HMX and RDX. Also, the screening problem formulation results are more appropriate to the protection of populations rather than individuals. With the Mexican spotted owl in the canyon, protection of individuals is a relevant issue. Estimating the COPEC body burdens in dominant prey species for the Mexican spotted owl, gray fox, and kestrel will provide an empirical basis for estimating dose and assessing potential effects to the top carnivores in the canyon system.

The second objective for biota sampling in Cañon de Valle is to characterize the effects of the COPECs upon the small mammal populations in the canyon. The soil hazard summary in Table 2 shows a range of median HQ ratios from 0.029 to 340 for shrew and 0.056 to 190 for deer mouse. These results indicate a need for collecting data to assess impacts at the site. It is quite possible that viable populations occupy the site and that the

high screening values result from conservative models for contaminant transfers from soils to small mammals via plants, invertebrates, and direct ingestion.

Small mammal population studies are proposed as the measurement endpoints for assessing the potential adverse effects for all of the screening endpoints below top carnivore. The list of screening endpoints not directly measured includes plant; invertebrate; robin as herbivore, omnivore, and insectivore; and cottontail. Vegetation in the canyon does not show signs of stress. Indeed the overbanks and floodplains in the canyon are heavily vegetated with grasses and forbs. Plants and invertebrates are food sources for the measurement endpoint species. Adverse population effects to plants or invertebrates would in turn influence the populations of small mammals.

As described above, the literature indicates that herbivorous small mammals, such as cottontail, will have lower body burdens than the proposed measurement species. The data base toxicity reference value (TRV) for barium and HMX are 0.55 mg/kg/d and 75 mg/kg/d respectively. These TRVs are used across cottontail, deer mouse and shrew. Hence, dose response associated with trophic level has yet to be differentiated in the toxicology literature reviewed to date. Using omnivorous and insectivorous measurement endpoints assures that higher body burdens are represented in the data. If herbivores dominate the small mammal community in the canyon, then these body burdens will also be estimated because they would represent a substantial component of the owl diet.

The avian endpoints represented by robin as herbivore, omnivore, and insectivore have PRG ratios greater than one for barium and do not have criteria for HMX or RDX. Two factors modify the potential for adverse impacts upon the robin population. First, they are elevational migrants, thereby reducing their potential site exposures to the warm months of the year. Second, the TRVs for the robin endpoints include a conservative multiplier of ten because the toxicity study was of sub-chronic duration. The basis for the small mammal TRV is a study that determined a NOAEL for chronic exposure. This value does not require a conservative multiplier. Given the migratory behavior of the robin versus the permanent resident status of small mammals and the conservatism built into the avian screening values, it is very likely that field study results for small mammals will be a protective proxy for birds.

Trapping Design Options.

Three general types of small mammal trapping studies can be considered. The simplest is a study designed to determine the presence of species. Trapping arrays are set in different habitat types and individuals are collected and identified. The result of this approach provides a species list for the area and qualitative information about population densities.

The second type of study is a population study. Two different approaches are available. Populations can be estimated through removal trapping or through live trapping and the capture, mark, and re-capture of individuals. In removal trapping the decreasing number of individuals captured for the same effort over time is used to estimate the initial

population size. In mark and recapture methods the ratio of total captured individuals to recaptured individuals is used to estimate the population size. With mark and recapture designs, traps are set for successive nights and captured individuals are marked in order for the investigators to recognize re-captured individuals. Statistical methods are available to estimate population densities based upon the area of the trapping array and the rate of recapture of individuals. The individuals collected on the final night of trapping would be sacrificed and used for body burden analysis.

The third type of design is a comparative population study. Either removal trapping or mark and recapture trapping is applied at two or more locations. The purpose is to discern differences in population densities at the different sites. This approach is often used to assess population responses to contamination gradients. While the statistical approach for this work is well developed, assigning causality to differences in populations is not always straightforward. Small mammal populations often go through large changes in densities for reasons that are not apparent to the investigators. Spatial trends in populations over contamination gradients should be confirmed with repeated surveys.

The age structure of small mammal populations is also a useful line of evidence in assessing effects. Viable populations consist of juvenile and sexually mature individuals. The age structure of a population infers the birth rate and loss rate for the species. If the populations consist of a single age class, this may be evidence of non-reproducing assemblages of immigrants from surround areas. The non-viability of the populations could be associated with the COPECs. Age structure information can be collected with any of the three study designs described above. If viable endemic populations become important to decision making, mark and recapture sampling that is conducted over an extended period of time can be used to assess survival.

Trapping Design and Approach

Reconnaissance Sampling for Initial Population Information

Reconnaissance trapping is the most efficient way to get preliminary estimates of the number of species and their relative abundances at the trapping sites to support a final trapping design. This information will be used to identify species that are in common across the trapping locations for body burden analysis. The reconnaissance results will also indicate whether the abundant species are herbivores, omnivores or insectivores. Body burden analyses are best carried out with the same species across the sampled sites to remove confounding factors associated with differences in life histories. It is also desirable to separate body burdens results by trophic level because of differences in transport pathways. At most, three species representing insectivores, omnivores, and herbivores would be analyzed for COPECs. It's possible that only omnivores and herbivores will be common across trapping sites because shrew species (insectivores) are dependent upon water, which is available only intermittently in most of the canyon.

Reconnaissance trapping will also indicate the relative and absolute abundances of species. The relative abundances of species will help determine how many species need to be analyzed for body burdens. Rare species are unlikely to be common prey for the owl or other top carnivores and therefore would not be included for body burden analysis. Absolute abundance information is necessary in the event that population density estimates are needed for comparing sites with different COPEC soil concentrations. As seen in Table 3, the home ranges of small mammals can vary up to tenfold. Additionally, home ranges for individuals typically overlap. The home range size and the degree of overlap determine the density of a population. The variance of a population estimate goes down in a mark and re-capture study with higher rates of re-capture. An optimal design is large enough to get high recapture rates without being too large and wasting effort for no improvement in the results. The trapping array can be made more efficient with site specific abundance information.

Design Options after Reconnaissance

After reconnaissance trapping, sampling will be conducted according to one of the approaches described below. Preference will be given to insectivores and omnivores for contaminant analysis because they are likely to have the highest body burdens. If herbivores are dominant species in the small mammal community, then herbivore body burdens will also be estimated because of their likely dominance as prey species for owls. All trapping will be conducted at night to coincide with the diel activity pattern of Mexican spotted owls. The number of nights that will be needed to estimate populations will depend upon the rate of recaptures for the trapping grids. The more individuals that are recaptured relative to the total number of captured individuals, the better the population estimate.

The results of the body burden analyses will be influenced by the amount of time individuals spend in contaminated areas, also known as the area use fraction (AUF). The contaminated sediments mapped in the geomorphic survey for the canyon averaged 6-m in combined width for the c1, c2, c3, and f1 sediments. This is one fourth of the average width of the canyon bottom. One option is to record the trap location for each individual in order to determine how cosmopolitan the individual small mammals are within a trapping array. If individuals have small home ranges relative to the trapping array, they are likely to be recaptured in the same or an adjacent trap. For species with small home ranges, choices regarding the compositing of individuals for biota samples can be guided by their trapped locations. The location information would be carried forward as meta data that supports the analytical results.

Up to three trapping arrays will be used for this investigation, depending upon the information that is necessary to support site decisions and available resources. The following descriptions are arranged from simplest to most complex.

Single Trapping Array

The simplest and least expensive approach is a single trapping array in the highest contamination area. Reconnaissance sampling would identify the species present and their relative abundances. The trapped individuals would also provide information on the age structure of the populations. Individuals of the prevalent species representing different trophic levels would be analyzed for COPEC body burdens.

The lines of evidence resulting from this design are body burdens in prey species for top carnivores and age classes as an indicator of population viability. This design will not answer questions about changes in body burdens with changes in soil concentrations, or body burdens at uncontaminated locations.

Two Trapping Arrays

This approach uses two trapping arrays, one at the location of highest COPEC concentrations and one at a reference site. One candidate area for a reference site is Water Canyon. The reconnaissance sampling will identify the species present at each site and their relative abundances. Body burden analysis would be performed on species common to both sites. In the event that a species is a community dominant in the contaminated site but not present in the reference site, that species would also be analyzed for body burdens because it is likely to be a prevalent prey species in the contaminated area. Age structures and sex ratios will also be collected for species in both locations and compared to evaluate sub-lethal effects of the COPECs upon the population dynamics.

The lines of evidence resulting from this design are:

- Comparisons of body burdens of prey species for top carnivores from contaminated and uncontaminated sites. This is useful because the metals COPECs are naturally occurring elements.
- Age structure of the populations as an indication of each population's viability.
- Comparisons of age structure and sex ratio for the species in common. This information might indicate sub-lethal effects from the COPECs.
- If mark and recapture trapping is performed, the population densities of the two sites can be compared. These results should be confirmed with additional trapping at a later date because of the intrinsic variability in small mammal populations.

These data will not provide for an assessment of how body burdens change with soil concentrations in the canyon.

Three Trapping Arrays

Three trapping arrays, with two along a concentration gradient in the canyon and one at a reference site will provide information on the highest body burdens, changes in body burdens with changes in soil concentrations, reference body burdens, and age structure influences associated with COPEC concentrations. If population effects or body burdens are unacceptable then these data will support an assessment of how pervasive the effects are in the canyon.

Lines of evidence from this design are:

- Estimates of the highest COPEC body burdens for prey species.
- Trends in body burdens with changes in soil concentration
- Age structure as an indication of population viability
- Age structure of populations and changes with soil concentrations of COPECs. This is a more robust indicator of sub-lethal effects than the two-site design because effects associated with COPEC should appear as spatial trends.
- If population effects or body burdens are unacceptable, the association of effects with soil concentrations will provide estimates of how pervasive the unacceptable effects are in the canyon.
- If mark and recapture trapping is performed, the population densities across the sites can be compared. These population estimates can be used to relate body burdens at a trapping sites to the relative likelihood of predation based upon the relative population sizes. These results should be confirmed with additional trapping at a later date because of the intrinsic variability in small mammal populations.

Proposed Trapping Array Locations

The area of highest COPEC concentrations, based upon the geomorphic survey samples, is in the vicinity for Burning Ground Spring from 200 feet above the confluence with the main drainage to 500 feet below that confluence. The second location in Cañon deValle, for the three-array design, is 3200 feet down canyon from the monitoring well pair 16-2659 and 16-2660. This is 7800 feet downstream from the 260 outfall in the vicinity of sampling point 16-2674. This location has sediment barium concentrations that are two orders of magnitude below the barium concentrations in the vicinity of the 260 outfall. A geomorphologic survey has not been conducted in this reach of the canyon. Using this reach as part of a three-array design would make the implicit assumption that soil concentration differences are similar to the sediment differences. The proposed reference site is Water Canyon at an elevation that is equivalent to the trapping arrays in Cañon de Valle.

A reference trapping location that is outside of Cañon de Valle is recommended because the metals COPECs have background values and copper is a nutrient. It will be important to establish body burden values for these COPECs independent of the 260 outfall discharge influences in order to provide a context for the results from within the canyon. Water Canyon, upstream of the confluence with Cañon de Valle is an option that is accessible by vehicle and has water.

Sample Preparation and Analysis

Individuals will be analyzed whole in order to estimate the dose to the owl. A total of five samples are recommended for each sampling location. Multiple individuals will be combined as necessary to assure sufficient material for detection limits below reference

values. For each small mammal species involved, five samples at three locations will result in a total of fifteen samples for the study.

Sacrificed individuals will be screened for hanta virus before shipment to the analytical laboratory. Field weights will be recorded for each sample. These data will be used to get empirical estimates of wet weight to dry weight ratios. The samples will be analyzed for metals and high explosives, based upon the COPEC shortlist.

Study Design Recommendation

Making risk management decisions for the riparian and terrestrial systems in the canyon can be supported by the two-array design, with one array in the maximally contaminated reach of the canyon and the other array in a reference canyon. This approach will support lines of evidence regarding COPEC impacts to small mammal populations, COPEC doses to top carnivores, including the Mexican spotted owl, reference body burdens, doses to top carnivores from small mammals in reference areas, and small mammal population characteristics in a non-contaminated canyon.

The single array design leaves open the questions regarding body burdens in non-contaminated areas. This is likely to be significant because four of the six COPECs are naturally occurring and one of them is a nutrient. Without a reference site, information will be lacking on physiologically regulated body burdens of these COPECs in uncontaminated areas.

The three-array design depends upon concentration gradients inferred from the sediment data. Additionally, it is quite possible that small mammal population effects will not be evident in the reach near the 260 outfall. If that is the case, then trapping and analysis in a lesser-contaminated reach is not useful to decision making for Cañon deValle.

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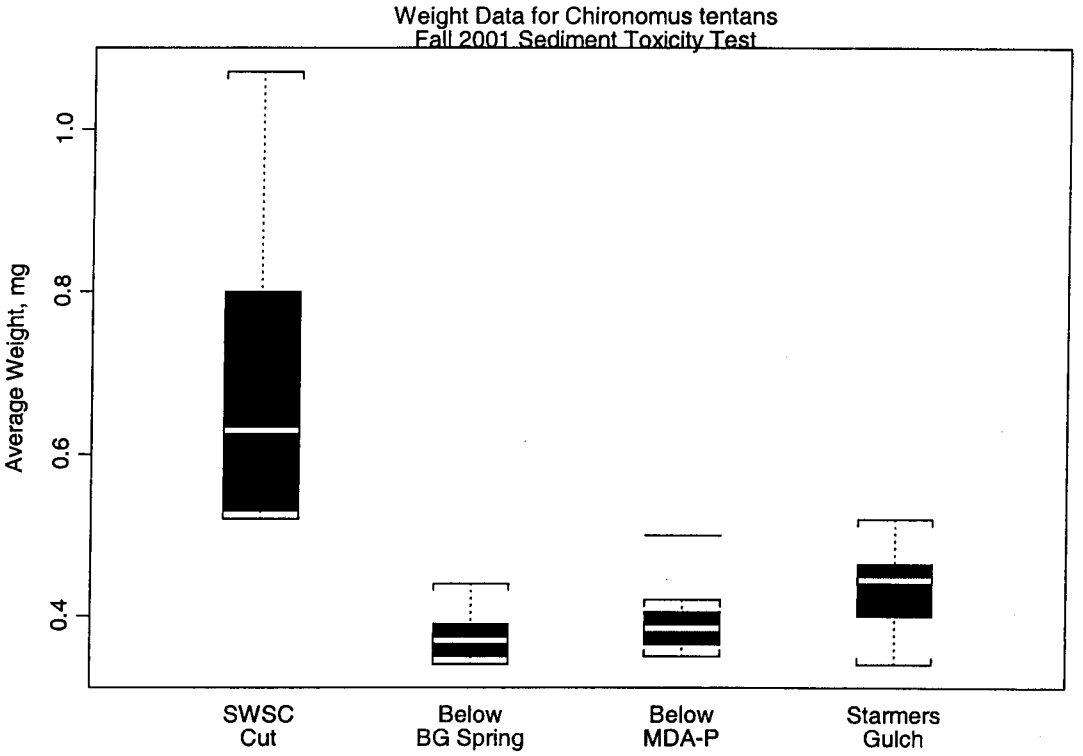
Cañon de Valle



Chironomus tentans weight data and summary
Fall 2001 Toxicity Test

Replicate	SWSC Cut, mg	Below Burning Ground Spring, mg	Below MDA-P, mg	Starmer's Gulch, mg
Rep A	0.58	0.37	0.39	0.37
Rep B	0.64	0.44	0.35	0.34
Rep C	0.80	0.34	0.39	0.45
Rep D	0.63	0.35	0.50	0.47
Rep E	0% Survival	0.37	0.37	0.52
Rep F	0.52	0.40	0.36	0.44
Rep G	1.07	0.35	0.42	0.43
Rep H	0.53	0.38	0.38	0.46
Average	0.68	0.38	0.40	0.44
95% Conf. Int.	0.18	0.025	0.037	0.044
CV	28.7%	9.2%	12.5%	11.1%

Plot Key

Aquatic Community ESL ▪▪▪▪▪▪▪▪▪▪▪▪

Sediment Background Value ▬ ▪ ▬ ▪ ▪

Detect ♦
NonDetect ◊

RPD – relative percent difference (max-min) / ((max + min)/2)