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APPENDIX A. TOXICITY DATA

SAMPLE COLLECTION ACTIVITIES AND SEDIMENT TOXICITY TESTING RESULTS FOR THE WELLS G&H SUPEFUND SITE, WOBURN, MASSACHUSETTS

U.S. Environmental Protection Agency
New England Regional Laboratory
Office of Environmental Measures & Evaluation
Office of Ecosystem Assessment

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SAMPLE COLLECTION ACTIVITIES AND SEDIMENT TOXICITY TESTING RESULTS FOR THE WELLS G&H SUPEFUND SITE, WOBURN, MASSACHUSETTS

INTRODUCTION

EPA's Office of Ecosystem Assessment with the assistance of Lockheed's Environmental Services Assistance Team (ESAT) provided support for sediment sampling acitivties for the Wells G&H Superfund site in Woburn, Massachusetts, and performed acute sediment toxicity tests on sediments collected from seven locations within the Aberjona River watershed. Some of the samples collected were from the Aberjona River itself, while others were located in wetlands or surface water bodies associated with the river. Sampling was conducted by Metcalf and Eddy, Inc, under contract to the USEPA. During sampling, ESAT biologists observed physical and biological features of the area surrounding each sample location as well as the sediment itself, took readings of the latitude and longitude using Global Positioning System (GPS), and photographed the areas sampled. At selected stations, ESAT took split samples to the USEPA Office of Environmental Measurement and Evaluation (OEME) facility in Lexington, Massachusetts, for sediment toxicity testing.

MATERIALS AND METHODS

Field Activities

Sediment sampling took place between November 12, 1997, and November 20, 1997. At each sampling location, ESAT took a GPS reading, made observations on the biological features of the station and surrounding area, and took relevant photographs. The sampling schedule is presented in **Appendix A** of this report. All information related to field activities contained in subsequent appendices are in chronological order unless otherwise noted.

The field notes and GPS readings are summarized in **Appendix B.** GPS readings were taken at the time and location of sampling, except where otherwise indicated in the field notes. At the conclusion of field activities, the GPS readings were downloaded and corrected against a known position at the OEME facility in Lexington, Massachusetts. This correction is necessary to correct field readings, because the satellite signals are routinely scrambled for reasons of National security, and must be compared with readings from a known point to obtain maximum accuracy.

Each sampling station and the surrounding area was photographed. **Appendix C** contains the photographs of each sampling station, with the exception of station SD-15-01, for which no photographs of acceptable quality were produced. For this station, a summary of observations is presented in place of photographs.

Split samples were taken at fourteen locations, as indicated in **Appendix A**. Not all

samples collected were utilized in the sediment toxicity tests. The samples utilized in the sediment toxicity tests are shaded in the appendix. The two reference locations, station SD-25 and Fowle Brook, represent two different habitat types. Station SD-25 was selected as a reference area for pond samples or samples in wetland areas with standing water. Fowle Brook was selected as a stream reference area for samples taken in the Aberjona River itself. Table 1 presents the samples that are evaluated by each reference area.

Table 1. Reference Locations and Associated Samples

Toxicity Test Samples and Reference Locations	
Stream Samples with Fowle Brook as Reference	SD-10-02
	SD-12-03
	SD-18-02
Pond/Wetland Samples with SD-25 as Reference	SD-07-02
	SD-19-01

Samples that were split for sediment toxicity testing and chemical analysis were transported to the OEME facility in Lexington, Massachusetts. There the samples were refrigerated until the day the test was initiated. As specified in U. S. EPA (1994), the holding times did not exceed fourteen days. Chain-of-custody records were kept for all samples and are found in **Appendix D**.

Laboratory Activities

The toxicity tests were performed according to procedures detailed in the EPA OEME Biology Section Standard Operating Procedure (SOP) Number 2.7, which is included as **Appendix E**; and the EPA manual, *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates* EPA/600/R-94/024, June 1994 (U. S. EPA, 1994).

Test chambers consisted of 300-ml glass beakers. The test was covered with plexiglass to minimize evaporation and prevent airborne particles from interfering with the test. Eight replicates per treatment were used. Each test chamber received 100 ml of sediment, with 200 ml of overlying reconstituted culture water.

Ten organisms were exposed to each test chamber through randomized introduction. Test organisms were carefully pipetted, keeping the organism completely submerged in water from holding tray to test chamber. Only the most healthy and active organisms were used for the test. The organisms were maintained at 23 degrees Celsius ± 1 degree in an environmental control chamber with a 16:8 hour light/dark cycle using cool-white fluorescent lights.

Chemistry measurement of parameters such as pH, specific conductance, temperature, and dissolved oxygen (DO) were measured for each test treatment on a daily basis. Routine chemistry was performed on a composite of renewal waste water each morning, and also at the beginning and end of the test period (Day 0 and Day 10). Additionally, alkalinity, hardness, and ammonia were measured on each treatment tested at the beginning and end of the test (Day 0 and Day 10).

Statistical analyses were conducted on organismal survival and weight for *C. tentans* according to U.S. EPA (1994), using the Chi-square test for normality of data, and Bartlett's and Hartley's tests for the homogeneity of variance. If the data were determined to be non-normal, the Square Root and Arc Sine Square Root Transformations were run to normalize the data. Steel's Many-One Rank Test and the Wilcoxon Rank-Sum Test with Bonferroni Adjustment were then used to determine whether organism survival in each treatment was significantly different from survival in the controls.

RESULTS

Hyalella azteca Toxicity Test Results

After being exposed to sediments for ten days, the toxicity test measurement endpoint (measure of effect) for *H. azteca* was survival. Results of the *H. azteca* toxicity test are presented in **Table 2** below.

Table 2: *Hyalella azteca* Toxicity Test Survival Data

Wells G&H Sediment Toxicity Survival: Hyalella azteca									
	Number of Organisms Surviving at End of Test (out of 10 at test start)								
Replicate	Artificial Sediment	SD-06	SD-07	SD-10	SD-12	SD-18	SD-19	SD-25	Fowle Brook
1	8	10	10	9	10	3	10	10	9
2	7	9	7	9	9	4	10	10	10
3	9	10	7	10	10	10	10	10	10
4	5	9	10	10	6	9	9	10	6
5	6	10	8	9	9	8	10	10	10
6	9	10	10	8	10	9	8	10	10
7	8	9	8	8	9	7	8	8	9
8	9	10	7	8	8	9	8	10	9
% Survival	77%	96%	84%	90%	89%	73%	91%	98%	91%

Survival in the laboratory control (artificial sediment) was 77% overall, which does not meet the control recovery of 80% recommended in EPA guidance (U. S. EPA, 1994). However, the survival rate was considered sufficient to allow for interpretation of the remaining data. Both the pond/wetland and stream reference stations, SD-25 and Fowle Brook had high survival rates, 98% and 91% respectively. The low survival in two replicates of sample SD-18 is most likely attributable to an ineffective method for organism recovery and may not be due to a toxic effect.

The normality of the data was evaluated using the Chi-square test. The Shapiro-Wilkes test is the preferred test, however, this test cannot be used if the overall number of replicates exceeds 50, as is the case with this test. The data passed the Chi-square test for normality. The Harley's and Bartlett's tests for homogeneity were used to test for homogeneity of data. The data failed this test initially, but passed following arc-sine/square root transformation. Finally, Steele's Many-One Rank Test was used to determine whether any samples differed significantly from their respective reference sample.

The data for samples SD-10, SD-12, and SD-18 were compared with the Fowle Brook stream reference. No statistically significant difference in survival was found between test samples and the reference sample. The data for samples SD-07 and SD-19 were compared with the pond/wetland reference station SD-25. The two wetland samples were not found to differ significantly from the reference sample.

***Chironomus tentans* Toxicity Test Results**

The *C. tentans* test endpoints pertain to survival and growth. Specifically, evaluation of test data involves determining whether the percent survival and the mean organism weight at the end of the test differ significantly between each sample and an appropriate control. The *C. tentans* survival data are presented in **Table 3.**

Table 3: *Chironomus tentans* Toxicity Test Survival Data

Wells G&H Sediment Toxicity Survival: Chironomus tentans									
	Number of Organisms Surviving at End of Test (out of 10)								
Replicate	Artificial Sediment	SD-06	SD-07	SD-10	SD-12	SD-18	SD-19	SD-25	Fowle Brook
1	10	10	10	8	7	9	10	9	0
2	9	9	10	9	9	8	9	10	10
3	10	10	9	9	7	10	10	9	6
4	10	10	9	10	8	7	8	10	10
5	9	9	9	9	10	8	8	10	10
6	9	9	10	10	9	10	7	9	10
7	9	10	8	9	7	9	10	9	4
8	9	9	9	8	10	7	8	10	1
% Survival	94%	95%	92%	90%	84%	85%	88%	95%	66%

The *C. tentans* tests met the survival threshold of 70% for the laboratory control recommended in U.S. EPA (1994). The data for the *C. tentans* test were evaluated in the same manner as the *H. azteca* test. Overall, survival was high for this species. Fowle Brook had the lowest survival. Using this reference station as a control for samples SD-10, SD-12, and SD-18, no statistically significant difference was found between the reference and the other samples. Using SD-25 as a control for the pond/wetland stations, samples SD-7 and SD-19 did not differ significantly from the reference sample either.

In general, the *C. tentans* test produced survival results that conform to test acceptability standards. The survival data do not indicate an acute lethal effect associated with any of the sample locations. The reference stream station, Fowle Brook had variable survival among replicates. Whether this was due to a toxic effect or

to physical or chemical characteristics of the sediment, may become more clear when the analytical chemistry results become available. The *C. tentans* growth data are presented in **Table 4** below.

Table 4: *Chironomus tentans* Toxicity Test Growth Data

Wells G&H Sediment Toxicity Growth: Chironomus tentans									
	Artificial Sediment	SD-06	SD-07	SD-10	SD-12	SD-18	SD-19	SD-25	Fowle Brook
Replicate	Average (arithmetic mean) Weight of Organisms at End of Test (milligrams)								
1	0.33	0.76	0.78	0.68	0.79	0.93	0.57	1.07	0
2	0.39	0.61	0.92	0.64	0.53	0.80	0.66	0.98	0.92
3	0.34	0.58	0.90	0.70	0.58	0.66	0.62	1.16	1.18
4	0.49	0.70	0.92	0.51	0.71	0.83	0.54	0.75	1.08
5	0.62	0.69	0.80	0.56	0.70	0.70	0.66	1.30	0.88
6	0.64	0.61	0.92	0.53	0.73	0.86	0.96	1.32	0.97
7	0.53	0.52	0.78	0.60	0.74	0.88	0.58	0.77	1.38
8	0.61	0.60	0.52	0.66	1.12	0.94	0.64	1.03	1.0
Mean Weight for Sample (mg)	0.49	0.63	0.82	0.61	0.74	0.82	0.65	1.05	1.05

The growth data showed more variability than the survival data, (see Discussion section). The growth data were evaluated in the same manner as the survival data. Using Fowle Brook as a stream reference, sample SD-10 (one of three stream samples) had significantly lower growth than the reference station. Using SD-25 as a reference, Stations SD-6 and SD-19 (two of three pond/wetland samples) had significantly lower growth than the reference. It should be noted, however, that all samples except the laboratory control (artificial sediment) met or exceeded the minimum growth guideline of 0.60 milligrams for reference samples recommended in U.S. EPA (1994).

DISCUSSION

The criterion for test acceptance recommended in EPA (1994) for *C. tentans* survival is 70%. The laboratory control (artificial sediment) survival rate was 93.8%, while the pond/wetland field reference location SD-25 (Horn Pond) location exhibited a 95% survival rate. All other survival rates were greater than 80% at each location except the stream field reference, Fowle Brook, which had 66% survival. The cause for this lower survival rate for *C. tentans* is unknown. The results of chemical analyses for this sediment have not yet been compared to the survival rates since the chemical analyses were not available during the time in which this report was generated. The location was situated in a depositional area with no evident pollution sources and no visible disturbances to the brook and its associated habitat. Statistical analyses (**Appendix G**) were conducted on the results and it was found that there were no significant adverse effects when either the lab control (artificial sediment) or the field reference samples (SD -25 and Fowle Brook) were used as the control.

The growth data for *C. tentans* showed more variability than the survival data. The growth data were evaluated in the same manner as the survival data. Using Fowle Brook as a stream reference, sample SD-10 had significantly lower growth than the reference station. Using SD-25 as a pond/wetland reference, Stations SD-6 and SD-19 had significantly lower growth than the reference sample. Whether this lower growth constitutes a chronic effect is questionable considering that both samples slightly exceeded the minimum growth guideline recommended in U.S. EPA (1994) for a reference sample. Fowle Brook was a marginal location with respect to survival of *C. tentans*, however the growth rate was exceptional and equal to that of the pond/wetland field reference location SD-25 (Horn Pond) location.

It is possible that the significantly reduced growth noted is due to contaminants inhibiting the growth at these locations. It is also possible that there are physico-chemical characteristics of the sediment such as total organic carbon (TOC) and grain size influencing the bioavailability of sediment-contaminants and growth of these organisms. Although samples SD-6 and SD-19 showed significantly lower growth than the reference station, their averages of 0.63 and 0.61 milligrams per organism, respectively, still met the recommended minimum weight for a control sample according to EPA guidance (U. S. EPA, 1994). Therefore the chronic effect, if present, may be slight.

The lowest growth of C. tentans was exhibited in the artificial sediment treatment (laboratory control), may have been the result of low dissolved oxygen (DO) since the final day's DO reading was 2.5 mg/L which is below the 40% minimum saturation recommended by U. S. EPA (1994).

The criterion for test acceptance according to EPA 1994 for *H. azteca* is 80%.survival

The laboratory control (artificial sediment) survival rate was 77% and therefore slightly below this criterion. In comparison, the two field reference locations, SD -25 & SD-FB had survival rates of 98% and 91%, respectively. In fact, all other locations had survival rates greater than 80% except SD-18, with 73% survival.

It should be noted that the low recovery in certain replicates of sample SD-18 are probably attributable to an ineffective recovery method used on these replicates, rather than to toxicity. Also, the low recovery of *H. azteca* in the laboratory control may be attributable to a low (1.2 mg/L) DO concentration on Day 9 of the test. Feeding was suspended at this point and the DO rebounded but the drop in DO may have negatively affected the organisms.

CONCLUSIONS

The *H. azteca* test did not indicate any toxicity associated with the samples from the Aberjona River watershed. Although the laboratory control sample did not conform to test acceptability guidelines presented in the EPA sediment evaluation manual (U.S. EPA , 1994), its survival rate of 77% , rather than the required 80%, and the high survival rates for field reference samples provides justification for a full interpretation of results. None of the samples included in the toxicity test were acutely toxic to *H. azteca*.

Similarly, none of the samples had a lethal effect on *C. tentans*. For this species, however, the growth endpoint was evaluated in addition to the survival endpoint. Samples SD-10, SD-6, and SD-19 showed growth of *C. tentans* larvae that differed significantly in growth from their respective field reference samples. It is possible that the significant growth effects noted are due to contaminants inhibiting the organisms' growth at these locations. It is also possible that there are physico-chemical characteristics of the sediment such as total organic carbon (TOC) and grain size influencing the growth of these organisms. The growth average in the two reference samples was very high (mean of 1.05 mg per organism in both samples). The growth average in samples SD-6 and SD-19 had averages of 0.63 and 0.61 milligrams per organism, respectively, both of which exceed the minimum recommended weight of 0.60 mg for a control sample (U.S. EPA, 1994). Therefore the chronic effect, if present, may be minimal.

The possible inhibitory effect on growth of *C. tentans* from samples SD-10, SD-6, and SD-19 should be reevaluated when the analytical chemistry results become avaliable. Otherwise, no acute toxicity was observed to either species in this test.

REFERENCE

U.S. Environmental Protection Agency (U.S. EPA). 1994. Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates. EPA/600/R-94/024.

APPENDIX A

Sediment Sampling Schedule

Wells G and H, Woburn Massachusetts

November 11, 1997 through November 20, 1997

Wells G&H Sediment Sampling Schedule -November 1997				
SAMPLE STATION	DAY	ACCESS POINT	SPLIT FOR TOXICITY TESTING ?	DATE
24-03	1	Route 129 Woburn	NO	November 12, 1997
22-02	1	Dewey St. Woburn	NO	November 12, 1997
1-06	1	Beach Park Winchester	NO	November 12, 1997
1-07	1	Beach Park Winchester	NO	November 12, 1997
2-01	2	Beach Park Winchester	NO	November 13, 1997
2-02	2	Beach Park Winchester	NO	November 13, 1997
3-02	2	Beach Park Winchester	NO	November 13, 1997
5-03	2	Gauge Station Woburn	NO	November 13, 1997
4-02	3	Beach Park Winchester	NO	November 14, 1997
4-03	3	Beach Park Winchester	NO	November 14, 1997
21-01	3	Olympia Trucking Co Woburn	NO	November 14, 1997
11-01	3	Wildwood Avenue Woburn	NO	November 14, 1997
20-01	4	Olympia Trucking Co Woburn	NO	November 17, 1997
15-01	4	Olympia Trucking Co Woburn	NO	November 17, 1997
13-01	4	Olympia Trucking Co Woburn	NO	November 17, 1997
13-03	4	Olympia Trucking Co Woburn	NO	November 17, 1997
6-03	5	Rest Home Woburn	YES	November 18, 1997
25-02	5	Boat Launch Horn Pond Woburn	YES	November 18, 1997
Fowle Brook	5	Boat Launch Horn Pond Woburn	YES	November 18, 1997
18-02	5	Wildwood Avenue Woburn	YES	November 18, 1997
18-03	5	Wildwood Avenue Woburn	YES	November 18, 1997
10-01	6	Salem St. Woburn	YES	November 19, 1997
10-02	6	Salem St. Woburn	YES	November 19, 1997
07-10	6	Davidson Park Woburn	YES	November 19, 1997
19-01	6	Rifle Range Rd. Woburn	YES	November 19, 1997
12-01	7	Rifle Range Rd. Woburn	YES	November 20, 1997
12-03	7	Rifle Range Rd. Woburn	YES	November 20, 1997
07-02	7	Davidson Park Woburn	YES	November 20, 1997
07-05	7	Davidson Park Woburn	YES	November 20, 1997

NOTE: Shading indicates that the sample was utilized in the sediment toxicity test.

APPENDIX B

Field Notes Summary
and
Global Positioning System (GPS) Readings

Wells G and H, Woburn Massachusetts

November 11, 1997 through November 20, 1997

FIELD NOTES FOR WELLS G&H SAMPLING EVENT

The following Wells G&H field notes were compiled in an effort to detail the sampling activities from November 12, 1997 to November 20, 1997. These notes are organized in chronological order and the Geographical Positioning System (GPS) information i.e. the latitude and longitude coordinates have been corrected to account for routine scrambling of satellite signals for security purposes. These notes account for two ESAT Biologists in the field concurrently during the sampling event.

Project name: Wells G&H Sediment sampling
Sample location: SD-24-03
Date: November 12, 1997
Time: 0926 hrs
Weather: Sunny, approx. 40° F, with light wind
Latitude: 42° 26' 27. 43"
Longitude: 71° 08' 56. 02"
Elevation -21.38 M HAE
PDOP: 4.12
Filename: R111214A

Met M&E at trailer located at 60 Olympia Avenue in Woburn MA. Proceeded to the Rt 129 sampling location, station 24-03 with John Verban and Mark Gallagher of M&E. There was some difficulty identifying the exact sample location. The Aberjona river passes under Route 129 from the west and turns to the southwest, the main channel forming the eastern edge of an extensive cat-tail/loosestrife emergent wetland. The flow in the river was very slow, and the depth ranged from a few inches to approximately one foot. A sampling station was selected on the eastern side of Route 129, adjacent to a small garden center. Some debris, such as empty potting soil bags and plastic flower pots, was found in the water near the sampling station, probably originating from the garden center.

Station 24-03 is in shallow water, approximately one foot in depth, in the channel between the base of the slope near the garden center and the wetland. The sediment sample was taken using an Eckman dredge modified with an extension pole and a top-mounted release button. The sediment at this location was very dark brown, mucky, with sufficient plant matter to give the sediment a cohesive quality. The muck was deep and soft in this area.

Project name: Wells G&H Sediment sampling
Sample location: SD 22-02
Date: November 12, 1997
Time: 1310 hrs
Weather: Partly sunny, approx. 40° F, with light wind
Latitude: 42° 29' 54. 02"
Longitude: 71° 07' 48. 71"
Elevation 3.28 M HAE
PDOP: Not recorded
Filename: R111218B

In the afternoon station 22-02 was sampled. This station is off Dewey Street in Woburn. The station was located in a red maple swamp area to the south of Dewey Street, which at the time of sampling had no standing water. Sphaghnum moss, and the tops of skunk cabbage, were evident in the area, suggesting that the area may be seasonally flooded. The sediment was a rich black peat, crumbly and light, with many fine roots. Samples were taken with a bulb planter to a depth of approximately six inches. The holes left by the sampling filled with water within a few minutes Project name: Wells G&H sediment sampling
Sample location: SD-01-06
Date: November 12, 1997
Time: 1030 hrs.
Weather: Sunny and breezy, air temperature approximately 40 ° F

Latitude: 42° 26' 23. 94" N
Longitude: 71°08' 49. 15" W
Elevation: -25.32 M HAE
PDOP: 2.75
Filename: F111215B (disregard file F111215A as practice)

The first sediment location for the day was designated as SD-01-06, Mystic Lake in Beach Park in the town of Winchester, Massachusetts. The sampling location was approximately 100 feet to the right of the beach. Sampling was conducted by use of a boat and an Eckmann sampler. The designated location was to be 25 feet from the marker near the shoreline. A grab sample was attempted at this location, however, the substrate appeared to be mostly gravel. Further attempts were taken to locate a finer sediment sample within this general area, however, this was also unsuccessful. The sampling team moved straight out approximately another 9-10 feet, to a location some 34-35 feet from the marker. The first attempt at this location resulted in a successful grab of fine sediment. The depth of water was approximately seven feet at this location. The sediment was characterized as black and mucky. During the sampling, a GPU reading was taken by ESAT in another boat within the same general location. Several pictures were also taken of the sampling event and the location as it related to various landmarks. The first grab sample was dedicated to VOA analysis, and the subsequent grabs were composited in a five gallon bucket. The sediment sample was processed on shore. An attempt was made to use filter paper to de-water some of the sample. However, this proved unsuccessful as the filter paper absorbed so much water that it began to tear. Due to the excess amount of water in the sediment, Andy Beliveau (USEPA) decided that it would be better to use sieving trays. A single isopod was discovered in the sample during the processing.

Project name: Wells G&H sediment sampling
Sample location: SD-01-07
Date: November 12, 1997
Time: 1400 hrs
Weather: Sunny and breezy
Latitude: 42 ° 26' 23. 99" N
Longitude: 71° 08' 49. 35" W
Elevation: -26.88 M HAE
PDOP: 3.43
Filename: F111218A

The second sediment sample, designated as SD-01-07, was taken in the same general area. Sampling was conducted in the same manner has the first sample. This sample was taken approximately fifty feet from the marker and 14 feet straight out from the first sample. Sampling has conducted in eight feet of water, in the same manner as that of the first sample. The sediment sample was similar to that of the SD-01-07, except that it seem to retain more water. Processing was conducted in a similar manner as SD-01-06.

Project name: Wells G&H Sediment sampling
Sample location: SD 2-01
Date: November 13, 1997
Time: 0130 hrs
Weather: Sunny, approx. 35° F, with light wind
Latitude: 42° 26' 27.43"
Longitude: 71° 08' 56.02"
Elevation -21.38 HAE
PDOP: Not Recorded
Filename: R111314A

Station SD 2-01 was located approximately 24 feet from station SD-2-02, and approximately 16 feet from shore. The sample was similar in consistency to SD-2-02. At the time of sampling (approximately 10:30

am) ESAT attempted to do a real-time correction of the GPS reading in order to pinpoint the exact location of previous sampling, however the necessary U.S. Coast Guard signal could not be picked up by the GPS equipment. Therefore, a standard reading was taken for future correction. The sample was taken from an inflatable raft with the pole-mounted Eckman sampler, composited in a plastic bucket, and processed on shore.

Project name: Wells G&H Sediment sampling
Sample location: SD-2-02
Date: November 13, 1997
Time: 1000 hrs
Weather: Sunny, approx. 35° F, with light wind
Latitude: 42° 26' 27.88"
Longitude: 71° 08' 56.25"
Elevation -20.7 M HAE
PDOP: 5.53
Filename: R111314B

Sample SD-2-02 was taken in Upper Mystic Lake in Winchester, MA. Access to the sampling location was via Beach Park in Winchester. The sampling station 2-02 was taken approximately 40 feet from shore, in an area of Upper Mystic Lake near the entrance to the lower portion of Mystic Lake. Water lily leaves were still present in the area sampled. The sediment was a black muck with many sticks present. Samples were taken using the pole-mounted Eckman dredge described previously, from an inflatable raft. The sample was composited in a white plastic bucket and processed on shore.

Project name: Wells G&H sediment sampling
Sample location: SD-03-02
Date: November 13, 1997
Time: 0900 hrs
Weather Cold, sunny with a slight breeze
Latitude: 42° 26' 30. 45" N
Longitude: 71° 08' 48. 67" W
Elevation: -21.85 M HAE
PDOP: 5.11
Filename: F111314A

This sampling location was also in Mystic Lake, but east of the main body of water, in a cove where the lake first opens up. A stake was placed approximately 15 feet out from the shoreline (a relatively flat open area). A sediment sample was taken at a distance of 24 feet to the left of the marker, looking at the lake, in 1.5 feet of water. The shoreline at this location contained trees. The sediment sample was taken with an Eckman dredge, and was characterized as mucky with a lot of organic material, in particular submerged leaves. A large snail was found in the sample. This sample seemed to contain less water that either of the two samples taken in Mystic Lake on the previous day. The sediment sample was processed using filter paper.

Project name: Wells G&H sediment sampling
Sample location: SD-05-03
Date: November 13, 1997
Time: 1255 hrs
Weather: Cold, sunny with a slight breeze
Latitude: 42° 26' 50. 88" N
Longitude: 71° 08' 19. 40" W
Elevation: -11.07 M HAE
PDOP: 5.83

Filename: F111317A

The next sampling location was upstearn from Mystic Lake in a narrow section of the Aberjona River at the gauge station. Railroad tracks can be seen on the other side of the embankment. The sample was taken approximately fifty-seven feet upstearn from a small man-made dam. The width of the stream measured forty feet across. The sample was taken from a boat in approximately the middle of the stream, at a depth of 2.7 feet in slow slowing water. The shorelines bordering the stream were moderately sloped and heavily vegetated. The sediment at this location was much denser than previous sampling locations. As a result, the sampling team had trouble collecting a sufficient sample with the Eckman dredge. The sampling team deployed a core sampler which worked well. The sediment sample at this location was characterized as hard muck, with very little water content. As a result, no filter paper or sieving was found necessary for this particular sample. The sediment sample had a slight petroleum odor.

Project name: Wells G&H sediment sampling
Sample location: SD-04-02, Mystic Lake
Date: November 14, 1997
Time: Not recorded
Weather: total cloud cover, below freezing temps, sleet and snow.
Latitude: 42 ° 26 ' 35 . 20 " N
Longitude: 71 ° 08' 35. 35" W
Elevation: -24.76 M HAE
PDOP: Not recorded
Filename: F111415A

The lake is surrounded by residential area and a public park along the shoreline. Railroad tracks are located across the street and parallel to the road that is adjacent to the lake. The shoreline adjacent to these two sites is sparsely wooded shoreline and has relatively easy access.
Upon arrival at the Mystic lake site we found out that the samples had already been taken with an Eckmann dredge and were in covered buckets on the shore. The water seemed shallow as the sampling sites were staked when we arrived, with the florescent tape visible just below the surface of the water.

Project name: Wells G&H sediment sampling
Sample location: SD-04-03, Mystic Lake
Date: November 14, 1997
Time: Not recorded
Weather: total cloud cover, below freezing temps, sleet and snow.
Latitude: 42 °26 '34.80" N
Longitude: 71°08 ' 34.78" W
Elevation: -19.63 M HAE
PDOP: Not recorded
Filename: F111414A

The two sediment sampling locations on Mystic Lake were in close vicinity to each other, within 100 feet. It was realized by the sampling team that they did not have any VOA vials and had to return to the trailer to get some, whereupon it was found out that they had not been shipped and some would have to be prepared. Samples were split by the M&E team for analysis in the back of the van to protect them from the weather. The sediment was black and not very peaty.

Project name: Wells G&H Sediment sampling
Sample location: SD 21-01
Date: November 14, 1997
Time: 0900 hrs
Weather: Rain/sleet/snow mix, approx. 30° F, moderate wind
Latitude: 42° 29' 50. 73"
Longitude: 71° 08' 02. 36"

Elevation -9.94 HAE
PDOP: 4.03
Filename: R111414A

The sediment sampling station SD 21-01 was accessed from the trailer yard of the Olympia Trucking Company in Woburn. The station was located in a marsh approximately 75 feet to the east of the trailer yard, and on the opposite side of the railroad tracks that border the trailer yard. The sediment was taken in approximately four feet of water, in a small ponded area surrounded by a dense stand of common reed and cat-tails. There was a beaver lodge located approximately 20 feet from the sample station. The sample was taken from a john-boat using the pole-mounted Eckman corer. The water surface had a covering of floating vegetation (not identified). The sediment was a black peat with many root fragments. The sample was composited in a plastic bucket and processed in the trailer yard.

Project name: Wells G&H Sediment sampling
Sample location: SD 11-01
Date: November 14, 1997*
Time: Approx. 0900 hrs
Weather: Partly sunny, approx. 45° F, light wind
Latitude: 42° 29' 35.20"
Longitude: 71° 07' 54.80"
Elevation -12.14 HAE
PDOP: 3.42
Filename: R111813A

Note: Station 11-01 was sampled on November 14, 1997, in snow and sleet. ESAT was unable to reach the sampling location in time to observe sampling. Metcalf and Eddy brought ESAT to the location on November 18 to take the GPS reading and make observations.

Station 11-01 was located mid-channel in the Aberjona River. The water depth is approximately 6 inches. The sediment is a dark-brown peat. The current is slow, steady, and laminar. The shore on both sides of the river is a marsh consisting of a mix of loosestrife, cat-tails, and high spots with shrubs. Access to the sampling location is via a plank boardwalk that begins on a construction company property off Wildwood Avenue in Woburn.

Project name: Wells G&H Sediment sampling
Sample location: SD 20-01
Date: November 17, 1997
Time: 0934 hrs
Weather: Clear, approx. 30° F, no wind
Latitude: 42° 29' 41.03"
Longitude: 71° 07' 58.31"
Elevation -8.30 HAE
PDOP: 4.10
Filename: R111714A

Station 20-01 is located due west of Well G. Access to the sampling station was via the Olympia Trucking Company lot. Station 20-01 is in a dense cat-tail marsh that is bordered by Wildwood Avenue, Washington Street, and the Boston and Maine Railroad tracks. The cat-tail marsh had some loosestrife at the edges, and the main channel and a number of small tributary streams run through the marsh. A stake marking the original station 20-01 was found, and a sample taken within approximately one meter of the stake. The station was in a small ponded area in a tributary stream to the Aberjona River. A dense mat of an unidentified floating weed was on the water surface at this station. The water depth was approximately 2 to 6 inches in various parts of the ponded area. The sediment was a black muck, very fibrous, very wet material. The sample was taken with a pole-mounted Eckman sampler, and the sample had to punch through a layer of fine roots to obtain a sample. Amphipods were observed in sediment at this location.

Project name: Wells G&H Sediment sampling
Sample location: SD 15-01
Date: November 17, 1997
Time: 1049 hrs
Weather: Clear, approx. 30° F, no wind
Latitude: 42° 29' 41.25"
Longitude: 71° 07' 57.75"
Elevation -4.92 HAE
PDOP: 5.43
Filename: R111715A

Station 15-01 was located on the main channel of the Aberjona River approximately 45 feet downstream of the entry point of a tributary stream, and approximately fifty feet further into the center of the marsh (east) of Station 20-01. The river at Station 15-01 is shallow, approximately 4 to 14 inches deep, with a fairly swift current. This station is marked with a 2"x 4" board sunk into the sediment, marked "SW-15". The sediment at this location was dark brown, with less fibrous material than the sediment at Station SD-20-01. Muskrat tracks were observed near the sampling station.

Project name: Wells G&H Sediment sampling
Sample location: SD 13-01
Date: November 17, 1997
Time: 0845 hrs
Weather: Sunny, cold, and windy
Latitude: 42° 29' 48.91" N
Longitude: 71° 08' 01.75" W
Elevation -14.44 M HAE
PDOP: 5.17
Filename: F111713A

Access to the sediment sampling locations was off of an industrial park located on Wildwood Avenue. Sampling equipment was carried over the Boston commuter railroad tracks and down a steep, but small, decline. The location was about 75 feet from the railroad tracks and about 6 feet from the shoreline. This particular location was outside the main river channel. Nearby was a rather extensive wetland consisting mainly of common reed and cat-tail in the standing water portion while along the shoreline was mostly oaks, hemlocks, etc. There was evidence of beaver activity which included tracks and felled sapling trees. The sediment sample itself was very black and organic in nature. EPA Project Manager, Andrew Beliveau, commented that this location may have high metals concentrations from the Industri-plex Superfund site.

Project name: Wells G&H Sediment sampling
Sample location: SD 13-03
Date: November 17, 1997
Time: 0945 hrs
Weather: Sunny, cold, and windy
Latitude: 42° 29' 48.94" N
Longitude: 71° 08' 01.16" W
Elevation -5.67 M HAE
PDOP: 6.09
Filename: F111714A

Access to the sediment sampling locations was again at the rear of an industrial park located on Wildwood Avenue. Sampling equipment was carried over the Boston commuter railroad tracks and down a steep, but small, decline. The location was about 40 feet across the peninsula from the previous location SD 13-01 and located more in the main river channel. This sampling location was about 125 feet from the railroad tracks and about 8 feet from the shoreline. Just across the main river channel lies an unbroken wetland again consisting mostly of common reed and cat-tails. Similar to the previous location, there was evidence

of beaver activity which included tracks and felled sapling trees. The sediment sample itself was fibrous with roots and mucky. EPA Project Manager, Andrew Beliveau, noted that this location also may have high metals concentrations from the Industri-plex Superfund site.

Project name: Wells G&H Sediment sampling
Sample location: SD-06-03
Date: November 18, 1997
Time: 0855 hrs
Weather: Overcast 35°
Latitude: 42° 27' 18.12" N
Longitude: 71° 08' 05.77" W
Elevation: -21.81 M HAE
PDOP: 5.69
Filename: F111813A

The pond, which is fed by the Aberjona River, is located essentially in Winchester center and directly across the street from the High School. The sampling location was in close proximity to the eastern shoreline which had a narrow swath of cattails and other assorted wetland vegetation. All along the perimeter was evidence of suburban encroachment. The inlet to the pond lies to the north with a weir restricting water flow at the south end of the pond. Approximately 150 feet to the north of the sediment location was an outfall, most likely from the nearby street. The samplers commented on the "pudding-like quality" of the sediment. The sample was collected in 3 to 4 feet of water but as one moved towards the center the pond became noticeably shallower ~1 foot.

Project name: Wells G&H Sediment sampling
Sample location: SD-25-02
Date: November 18, 1997
Time: 1150 hrs
Weather: Overcast 35°
Latitude: 42° 28' 22. 41" N
Longitude: 71° 09' 29.11" W
Elevation: -14.88 M HAE
PDOP: 6.30
Filename: F111816A

The sediment sample was collected from Horn Pond in the town of Woburn. To the southeast, a small point juts into the pond and the sample was collected in a line from the maple and willow trees on shore. This was the previous location as noted by Foster-Wheeler. Water level was way down according to the residents that live nearby. Initial attempts to collect sediment in waders was fruitless as the substrate was rocky. Next, the sampling team elected to use the boat and move offshore slightly and this proved beneficial but still the collection was slow in comparison to earlier locations. The sample was exceptionally soupy and ESAT requested M&E to pour off some liquid before placing the sediment in the toxicity test jars. In addition, this location was designated as the pond/wetland reference location; however, just on the other side of the point there was much rusting metal debris and assorted garbage.

Project name: Wells G&H Sediment sampling
Sample location: SD-FB (Fowle Brook)
Date: November 18, 1997
Time: 1245 hrs
Weather: Overcast 35°
Latitude: 42° 28' 18.06" N
Longitude: 71° 09' 56.99" W
Elevation: -3.25 M HAE
PDOP: 3.75

Filename: F111817A

This location had not been previously sampled, but was a replacement reference location for SD-24. Previous analytical results showed that this SD-24 location was inappropriate due to elevated concentrations of PAHs. This location was selected after a discussion with Ken Munney, USFWS who had suggested sampling in Fowle Brook downstream of the foot bridge; and Patti Tyler, EPA-WAM. Reconnaissance of this area revealed areas where recent rains had scoured the banks and the sediment substrate was otherwise sandy and not appropriate as a benthic habitat. Instead, the sediment sample was collected just upstream of the foot-bridge in a depositional slough. This area had no noticeable suburban encroachment and the quality of the sediment was, at first glance, quite good. There was a good mix of sand, fines, and decomposed organic material with some plant matter intermixed. Please note that this location was not collected for chemical analyses by M&E, so the only chemical data that exists for this location was some XRF data which was collected previously by a researcher at MIT.

Project name: Wells G&H Sediment sampling
Sample location: SD 18-02
Date: November 18, 1997
Time: 1022 hrs
Weather: Partly sunny, approx. 45° F, light wind
Latitude: 42° 29' 34.80"
Longitude: 71° 07' 53.61"
Elevation -14.21 HAE
PDOP: 2.67
Filename: R111815A

Station 18-02 was located approximately 20 yards upstream of the point where the plank boardwalk ends on the Aberjona River, accessed from the Wildwood Avenue construction site. The sample station is in a small inlet located on a bend in the Aberjona River, in a depositional area with a water depth of approximately 6 inches. The station is approximately 30 yards downstream of Station 11-01. The marsh surrounds the river at this location, the plant communities varying with topography and drainage. Generally speaking, the eastern shore was dominated with loosestrife and sedges, and the western shore with cat-tails and phragmites. Both this station and Station 18-03 were difficult to locate because of the changes in vegetation since the previous sampling round.

Samples were collected using the pole-mounted Eckman sampler. A split sample was collected for sediment toxicity testing, from the plastic bucket used for compositing the sample. The sediment is a very dark brown, mucky, fibrous material with many reed parts and very little mineral matter. Two 2-liter jars were collected for sediment toxicity testing.

Project name: Wells G&H Sediment sampling
Sample location: SD 18-03
Date: November 18, 1997
Time: 1104 hrs
Weather: Partly sunny, approx. 45° F, light wind
Latitude: 42° 29' 32.84"
Longitude: 71° 07' 53.95"
Elevation -14.80 HAE
PDOP: 3.84
Filename: R111816A

Station 18-03 located approximately twenty yards downstream of the plank walkway to the marsh accessed from the Wildwood Avenue construction company property. The station is located on a transect formed by a series of tall 2"x4" boards sunk in the sediment of the marsh at intervals, starting from the construction property. The station is off the main river channel, in a back-water stream that meanders through sedges and loosestrife. Water depth is 2 to 4 inches, with no discernable current. The sediment is almost black

muck with fibers of roots, sedges, and deciduous tree or shrub leaves. A split sample consisting of two 2-liter jars was collected for sediment toxicity testing.

Project name: Wells G&H Sediment sampling
Sample location: SD-10-01
Date: November 19, 1997
Time: 0845 hrs
Weather: Sunny 35°
Latitude: 42° 29' 29.79"
Longitude: 71° 07' 45.20"
Elevation: -8.73 M HAE
PDOP: 5.22
Filename: F111913A

The sample was collected approximately 80 feet north of the Salem Street bridge. The water depth was about 2 feet and the location was slightly out of the main river channel. Nearby landmarks included a large willow on shore which was about 30 feet away. On the other side of the tree was some sort of automotive repair business. A small buffer of trees and shrubs lined the shoreline. Extensive wetlands consisting of common reed, cat-tails, and purple loostrife exist to the north and east. Waterfowl (Canada geese) foraged in this area. Sample consistency was mucky and the samplers noticed a slight sheen to the sample. A thick layer of ice had to be broken through in order to collect the sample. Unfortunately, this tended to stir the sediment into the water column.

Project name: Wells G&H Sediment sampling
Sample location: SD-10-02
Date: November 19, 1997
Time: 0905 hrs
Weather: Sunny 35°
Latitude: 42° 29' 29.97"
Longitude: 71° 07' 45.32"
Elevation: -11.55 M HAE
PDOP: 12.2
Filename: F111914A

The sample was collected exactly 24.2 feet north of SD 10-01 therefore the notes for SD 10-02 apply to this location as well.

Project name: Wells G&H Sediment sampling
Sample location: SD7-10
Date: November 19, 1997
Time: 0829 hrs
Weather: Clear, approx. 30° F, very light wind
Latitude: 42° 28' 08.22"
Longitude: 71° 07' 45.43"
Elevation -20.31 HAE
PDOP: 5.11
Filename: R111913A

Station 7-10 was located at the edge of the pond in Davidson Park in Winchester, Massachusetts. The station is approximately 2 feet from shore on the southern side of the pond, in approximately ten inches of water. The pond flows to the west to a small waterfall and a stream. The park is completely landscaped, with grass and concrete walkways. The vegetation surrounding the pond consists of regularly spaced, and

probably planted, red-osier dogwood, crabappple, weeping willow, and birch trees. A fringe of herbaceous vegetation is found at the edges of the pond. No emergent vegetation was evident. To the south of the pond is a residential area, and to the north is a railroad track. The sediment is black and mucky, with occasional spots of a sheen. No odor was associated with the sheen. Several large aquatic earthworms were encountered in the sample. A split sample consisting of two 2-liter jars was collected for sediment toxicity testing.

Project name: Wells G&H Sediment sampling
Sample location: SD 19-01
Date: November 19, 1997
Time: 1050 hrs
Weather: Clear, approx. 30° F, very light wind
Latitude: 42° 29' 38.89"
Longitude: 71° 07' 50.52"
Elevation -7.04 HAE
PDOP: 4.51
Filename: R111916A

Station 19-01 was located in a deciduous forested wetland to the west, and downhill of, Well G. Access to the station is via Rifle Range Road in Woburn. Standing water is a few inches deep in most of the wetland, except where sedges, loosestrife and red maple trees emerge. According to Jonathan Weir of Metcalf and Eddy, there was less standing water during previous visits to this station. A sheen is present in many areas of this wetland. The sheen is odorless, and breaks up when disturbed, suggesting that it does not have a petroleum origin. Emergent lily leaves are still present in the water in some places within the wetland.

The area staked as Station 19-01 proved to have too many sticks to allow for sampling. A location was selected to the north of the original location, in an area of standing water with sparse phragmites growth. The GPS reading is for the location actually sampled. A coring device was used to collect the sample due to the presence of sticks in the sediment. A split sample consisting of two 2-liter jars was collected for sediment toxicity testing.

Project name: Wells G&H Sediment sampling
Sample location: SD 12-01
Date: November 20, 1997
Time: 0834 hrs
Weather: Clear, approx. 25° F, no wind
Latitude: 42° 29' 45.12"
Longitude: 71° 07' 52.16"
Elevation -15.19 HAE
PDOP: 5.24
Filename: R112013A

Station 12-01 is located off Rifle Range Road, near Well H. The land slopes downward from Well H to a cat-tail marsh. The upland bordering the marsh has numerous aspen trees, many of which have been cut by beaver to fall into the marsh. A beaver lodge is visible near the main channel of the Aberjona River, about twenty yards from station 12-01. Several red-tailed hawks were circling the wetland near the sampling station. Birch, sweet pepperbush, and goldenrod also occur on this slope. Station 12-01 is approximately 20 feet from the base of the slope, in water approximately 8 to 12 inches deep. The sediment is a black muck, very fibrous, with leaves and sticks. The sediment was also very liquid. A split sample consisting of two 2-liter bottles was taken from the plastic compositing bucket for sediment toxicity testing.

Project name: Wells G&H Sediment sampling

Sample location: SD 12-03
Date: November 20, 1997
Time: 0911 hrs
Weather: Clear, approx. 30° F, very light wind
Latitude: 42° 29' 44.59"
Longitude: 71° 07' 52.84"
Elevation -11.30 HAE
PDOP: 4.11
Filename: R1112014A

Station 12-03 is located approximately 50 feet to the southwest of station 12-01 at the edge of the main channel of the Aberjona River. Access is via Rifle Range Road, and the station is near Well H. There is a bend in the river channel, and the station is a few feet off the channel, which is quite deep (not measured but over 5 feet deep). Water depth at the sampling station is approximately 3 feet. A beaver lodge is located downstream of the station. The sediment is firmer than the sediment at station 12-01, with a peatier, less wet consistency. The area around the sample is dominated by cat-tails, with some loosestrife. A split sample consisting of two 2-liter bottles was taken from the plastic compositing bucket for sediment toxicity testing.

Project name: Wells G&H Sediment sampling
Sample location: SD-07-02
Date: November 20, 1997
Time: 1030 hrs
Weather: Sunny, clear & cold
Latitude: 42° 28' 04. 37" N
Longitude: 71° 07 ' 49. 44" W
Elevation: -18.55 M HAE
PDOP: 2.61
Filename: F112015B

The next sediment location was in the same body of water in Davidson Park. The location, however, was near the east end of the pond near the small bridge that overhangs the inlet of the pond from which the stream discharges. The sediment sample was taken from a boat in approximately 3.4 feet depth of water. This location was approximately sixty-six feet from the small bridge and about forty feet from the north, south, and east shorelines. The sample was similar to the first sample collected in the middle of the pond. The sediment was characterized as soft muck, black in color, and inhabited by many worms. The sample, however, appeared to contain more water content than the previous sample, taken near the shoreline.

Project name: Wells G&H sediment sampling
Sample location: SD-07-05
Date: November 20, 1997
Time: 0930 hrs
Weather: Sunny, clear & cold
Latitude: 42° 28' 06. 26" N
Longitude: 71° 07 ' 48. 94" W
Elevation: -13.71 M HAE
PDOP: 2.73
Filename: F112015A

The SD-07-05 sediment sample was taken in a pond in Davidson Park. The entire shoreline of the pond was vegetated with scrubs. The first sample was taken four feet from the shoreline in 1.2 feet of water. This location was in the middle of the pond. The sediment was taken with an Eckman sampler. The sediment sample was characterized as soft muck, black in color, having a lot of water content, with very little organic matter. There were large numbers of worms found in this sample.

APPENDIX C

Photographs of Field Activities

Wells G and H, Woburn Massachusetts

November 11, 1997 through November 20, 1997

APPENDIX D

Chain-of-Custody Records

Wells G and H, Woburn Massachusetts

November 11, 1997 through November 20, 1997

ENVIRONMENTAL PROTECTION AGENCY

REGION 1

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
98070	Wells G+H

SAMPLERS: *(Signature)* John D. Veilan

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	[illegible]	Trinity [illegible]						REMARKS
12-01	11-20-97	0830		X		2	V	X						[illegible] + Eddy collected sample, ESAT received
12-03	11-20-97	0910		X		2	V	X						" "

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
John D. Veilan	11-20-97 12:00	[illegible signature]			
Relinquished by: *(Signature)*	**Date / Time**	**Received by:** *(Signature)*	**Relinquished by:** *(Signature)*	**Date / Time**	**Received by:** *(Signature)*
Relinquished by: *(Signature)*	**Date / Time**	**Received for Laboratory by:** *(Signature)*	**Date / Time**	**Remarks**	
[illegible signature]	11-25-97 2:06	Kathy Jorek	11/25/97 2:06 pm		

Distribution: Original Accompanies Shipment; Copy to Coordinator Field F[illegible]

1-[illegible]046

ENVIRONMENTAL PROTECTION AGENCY

REGION 1

CHAIN OF CUSTODY RECORD

PROJ. NO. 98070 | PROJECT NAME Wells G&H

SAMPLERS: (Signature) John D. Vetter

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Tox testing	REMARKS
~~SD-06~~	11/18	0900		✓	Judkins Pond	2	✓	Sediment
SD-05	11/18	1200		✓	Horn Pond	2	✓	Sediment
SD-FB	11/18	1245		✓	Fowle Brook	2	✓	Sediment
~~SD-10-01~~	11/19	0845		✓	Aberjona River @ Salem St.	2	✓	Sediment
~~SD10-02~~	11/19	0905		✓	Aberjona River @ Salem St	2	✓	Sediment ~~Sediment 004~~

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
John D. Vetter	11/19/97 0915	[illegible]			
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	
[illegible]		Kathy Janet	11/25/97 2:00pm		

Distribution: Original Accompanies Shipment; Copy to Coordinator Field File

ENVIRONMENTAL PROTECTION AGENCY

REGION 1

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
98070	Wells G+H Aberjona River

SAMPLERS: (Signature)

JONATHON WEIER M+E

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Sediment + Toxicity	REMARKS
18-02	11/17/97	10:15		X	Aberjona River wildwood property Station 18-02	2	X	Sample taken by M+E, received by ESAT for Sed. Tox.
18-03	11/17/97	11:00		X	Aberjona River wildwood property Station 18-03	2	X	Sample taken by M+E, received by ESAT for Sed Tox.

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
	11/18/97 12:09				
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	
	11/25/97 2:06 pm		11/25/97 2:06 pm		

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Fi

1-5045

ENVIRONMENTAL PROTECTION AGENCY

REGION 1

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
98070	Wells G+H Sediment Sampling 11/97

SAMPLERS: *(Signature)* x JONATHON WEIER [signature]

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CON-TAINERS	Sediment toxicity test - 2 species							REMARKS
TD-97-03	11-20-97	0830		X	Davidson Park Lake	2	X							Metcalf and Eddy collected sample - ESAT received split
TD-97-02	11-20-97	0930		X	Davidson Park Lake	2	X							" " "

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
x [signature]	11-20-97 0900	x George E. Balog			
Relinquished by: *(Signature)* [signature]	11-20-97 1000	**Received by:** *(Signature)* George E. Balog	**Relinquished by:** *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)* George E. Balog	11/21/97 2:10 pm	**Received for Laboratory by:** *(Signature)* [signature]	Date / Time: 11/25/97 2:06 pm	Remarks	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

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...ONMENTAL PROTECTION AGENCY

...N 1

CHAIN OF CUSTODY RECORD

...T NAME Wells G & H

...son Park

...S: (Signature) [illegible]

...A. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CON-TAINERS	Sediment + toxicity [illegible]						REMARKS
7-10	11/19/87	0815		X	Davidson Park Station 7-10	2	X						Samples taken by [illegible] + [illegible] received by ESRT for [illegible] testing
19-01	[illegible]	10:50		X	Near Well G off [illegible] Road 19-01	2	X						" "

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
[illegible]	11/19/87 1130	[illegible]			
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks
[illegible]	11-25-87 2:10pm	Kathe [illegible]	11/25/87 2:06pm	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Fil

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APPENDIX E

Sediment Toxicity Testing Standard Operating Procedure (SOP)

OMOE Biology Section SOP 2.7 Revision 1.0

Wells G and H, Woburn Massachusetts

STATIC BULK SEDIMENT TOXICITY TESTING PROCEDURES

Biology Section

New England Regional Laboratory

SOP number: 2.7
Revision number: 1
October 22, 1997
Filename:G:\allshare\bio-sops\busedtes.scp

1.0 Purpose of Method

This procedure is used to evaluate the toxicity of freshwater bulk sediments to the benthic community. A two species test is prescribed due to species sensitivity differences.

2.0 Summary of Method

Two species of benthic macroinvertebrates are exposed to sediments for a 10 day period. Sediment and overlying water are placed in each of 8 replicates/sample/species and allowed to settle overnight. The following day, after water renewal, test organisms are introduced to each test vessel. Test chemistry is performed on the overlying water on a daily basis for the duration of the test. The test is ended, determining the number of surviving organisms. Subsequent to test termination, survival and growth endpoints are examined statistically. Procedures follow those described in the EPA document, Methods For Measuring The Toxicity and Bioaccumulation of Sediment-associated contaminants with Freshwater Invertebrates, EPA/600/R-94/024, June 1994.

3.0 Apparatus/Materials

a. 300 ml lipless test vessels

b. turbulence reducers

c. aluminum pans

d. drying oven

e. muffle oven

f. analytical balance

g. pH/specific ion electrode meter, DO meter and conductivity meter

h. ammonia probe

i. pH probe

j. DO probe

k. environmental chamber

3.0 Apparatus/Materials (cont'd)

l. precleaned nalgene trays

m. precleaned spatulas

n. crystallizing dishes

o. 6.0 ml disposable transfer pipets

p. forceps

q. light table

r. # 35 sieves

s. Hyallela azteca, 3rd and 4th instar (<7 days old): 2-3 mm in length

t. Chironomus tentans, 2nd and 3rd instar larvae, 50% of which are 2nd instar

4.0 Reagents

a. laboratory control sediment (see artificial sediment SOP)

b. deionized water

c. pH buffers

d. conductivity standards

e. ammonium chloride standard

f. 0.02N H_2SO_4

g. calgamite

h. 10N NaOH

i. 0.01M EDTA

5.0 Procedure

5.1 SEDIMENT STORAGE

a. Solid-phase sediment will be stored at 4°C in air-tight containers in the dark. All samples must be accompanied with proper identification and sample tracking information. Storage of sediments will be for no longer than 2 weeks prior to testing.

5.2 ENVIRONMENTAL CONTROLS WHILE TESTING

See the EPA method referenced for environmental controls specified.

5.3 SAMPLE PREPARATION and DISTRIBUTION

a. The day before the toxicity test starts (Day -1), sediments are poured from the 2 liter nalgene containers and homogenized to a uniform distribution, in a large precleaned nalgene tray, making sure that complete mixing is achieved. Excess sediments will be returned to the sample containers and held in the biology trailer until testing is complete.

b. One hundred ml of each test sediment, reference sediment, and laboratory control sediment is added to each of 8 replicates per species. The sediment in each test vessel should be smoothed using a spoon or spatula. Next, carefully add 175 ml of overlying water to each vessel. The sediments are then allowed to settle for 12 ± 4 hours. Water quality parameters should be measured prior to the addition of the test organisms.

5.4 ORGANISM INTRODUCTION

a. Test organisms are randomly selected from the test population for inoculation into the test. Each replicate will receive [illegible] organisms. No more than 5 individuals should be placed in a vessel during a complete pass of all sample replicates. With a [illegible] disposable transfer pipet, test organisms are **very** carefully transferred from the test population into the test vessel, **being sure to release the organisms below the surface of the overlying water.**

5.4.a (cont'd)

Note: If the test overlying water hardness is 1/2 or less than the culture water, then acclimating with a 1:1 dilution of the test population with overlying water on a 2 hour schedule until the overlying water is approximated is required.

Note: Inspect the test chambers <2 hours after introduction to insure that organisms are not trapped in the surface tension of the water. If floaters are detected, replace with new organisms.

5.5 TEST CHEMISTRY (See test chemistry SOP for details)

a. Test chemistry will be performed on a daily basis and results will be recorded in the test chemistry log book.

1) Initial test chemistry is performed on an overlying water composite from each sample prior to the introduction of test organisms. Chemical analyses will consist of the determination of pH, temperature, conductivity, dissolved oxygen(DO), hardness, alkalinity and ammonia.

2) Daily test chemistry consisting of a DO, temperature and conductivity measurement of overlying water will take place in the morning after renewal.

3) Final test chemistry will be done on a composite of replicates for each sample per species. Parameters tested will be identical to initial parameters.

Note: In order to accurately measure chemical parameters under test conditions, beakers of water to be tested should be kept in the environmental chamber until ready to perform the analyses.

Note: If the DO concentration on any sample falls below 40% of saturation, that species specific set of replicates must be aerated.

5.6 Feeding

a. Feeding of each replicate is performed daily following the morning renewal.

5.6 a (cont'd)

1) C. tentans is fed 1.0 ml of Tetramin of a 20 g/L suspension daily. *Feeding for all replicates is suspended for a day or more if fungus appears on sediment.*

2) H. azteca is fed 1.5 ml of YAT daily. *Feeding for all replicates is suspended for a day or more if fungus appears on sediment.*

5.7 Renewal

a. A 50% renewal using turbulence reducers to minimize resuspension is performed in the early morning and late afternoon. Renewal water is transferred from the drum in the Wet Lab to the environmental chamber between renewal so that the water will be at the test temperature.

5.8 TERMINATING SEDIMENT TESTS

a. Removal of sediment from the test chambers will be handled with the same protective garb used in setting up the test.

b. There are various techniques that can be used for retrieval of test organisms. H. azteca are simple counted. C. tentans are counted and then are rinsed clean and placed on muffled, preweighted, and numbered aluminum pans.

The replicate #, species, sample ID and number of organisms recovered are documented on tally sheets. The retrieval process should take place in a white plastic tray on a light table for increased visibility. Approximately 50% of the overlying water is poured into a white translucent tray on the light table. Any organisms detected are counted and, in the case of C. tentans, placed on aluminum trays. Next, since the majority of organisms dwell in the upper few millimeters of sediment, the beakers can be swirled to lift this layer into water column and then poured into the sieve or translucent tray placed on a light table. Any organisms are retrieved as prescribed. This suspension process is repeated, adding additional water to the beaker if necessary, with a thin layer at a time being poured into the tray.

5.8 (cont'd)

c. Once all organisms are retrieved or the test vessel finished, and the total number of organisms tallied, the label can be removed, the vessel is rinsed, with the rinsate being poured into a waste bucket, and the vessel is placed on the wash table in the Wet Lab.

d. All tally sheets are to be copied and the copies stapled into the specific project section of the sample project log book.

5.9 ENDPOINTS and OBSERVATIONS

Endpoints for this test are survival (both species) and growth (C. tentans) as ash free weight. Make notes of behavioral changes during the conduct of the test i.e. floating on surface, sediment avoidance.

6.0 Safety

a. All workers involved with handling and testing contaminated sediment must undergo health monitoring annually.

b. Hands should always be kept away from the eyes and mouth ie. no fingernail biting. After removing gloves, and possibly contaminated lab clothing, dispose of it in a trash bag marked non-hazardous, and wash hands with soap.

c. Lab coats must be worn at all times when working with sediments. Tyvec may be worn during sediment manipulation and mixing. The sediment may be checked with an HNU to determine if respirator use is necessary. Gloves must be worn to avoid skin contamination. Latex, rubber and vinyl gloves however may not provide full protection. Wear latex liners with nitrile or other protective glove if necessary. Safety glasses must be worn during the manipulation of sediments. If mixing is messy, face shields may be worn.

d. Mixing of sediment will occur under a hood if the potential for generating toxic aerosols, fumes or dusts exist.

7.0 Waste

a. Overlying water waste can be placed in the "dirty tank" unless suspected of being toxic or otherwise hazardous. If suspected of being hazardous, the overlying water waste should be isolated in a properly labeled drum and the EIA. and chemistry groups contacted to schedule sampling of the drum and analyses. When the analytical data is made available, it is to be forwarded to the H&S officer for review and ultimate disposal.

b. Sediment waste should be collected in labeled drums put into the Wet Lab next to the "dirty tank" and the biology lab manager contacted when sed waste is available for disposal.

c. Chemical waste from test activities is disposed of as per ... test chem SOP (testchem.sop)

8.0 QA/QC

a. An artificial sediment is prepared and used as a labor... ...y control for each species during each test. The material used ... of high quality. Test eccceptability criteria for survival of ... species must be met on exposure to this control or the test may ... invalidated.

b. Facility QC is documented through the monitoring and reco... of temperature in the environmental chamber.

c. Organisms provided by this laboratory undergo water column ... reference toxicant testing for each tank of cultures to doc... the quality of the test organisms. Organisms from ou... laboratories have documentation of QC testing available ... request.

d. Test chemistry is performed on overlying waste water on a ... basis. Based on the results, response would include, aerat... all beakers associated with the specific sample and species ... problems indicated by the development of fungi, food wou... reduced or eliminated.

e. Calibration of instrumentation used during the test is pef ... and documented. If problems are identified they are corr... prior to test measurement being performed or so noted if inpos... to correct.

APPENDIX F

Toxicity Test Routine Chemistry Summary

Wells G and H, Woburn Massachusetts

Wells G&H Sediment Toxicity Test Chemistry - Day 0 (12/01/97) - C. tentans

	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)	pH (Units)	Alk. (mg CaCO3/L)	Hardness (mg CaCO3/L)	Ammonia (ppm)
Art.Sed.	23.1	6.7	319	7.1	78	104	0.2
SDFBRK	23.4	6.0	294	6.7	36	68	1.5
SD06	23.3	6.3	410	7.0	87	106	13.0
SD07-02	23.4	5.3	311	7.1	43	74	2.2
SD10	23.3	5.6	266	7.1	54	86	1.8
SD12-03	23.2	4.8	295	6.9	35	70	2.0
SD18-02	23.4	5.0	306	7.0	52	84	1.2
SD19-01	23.4	6.0	287	7.1	38	72	1.3
SD25	23.3	6.0	303	7.1	52	80	1.7

Wells G&H Sediment Toxicity Test Chemistry - Day 0 (12/02/97) - H. azteca

	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)	pH (Units)	Alk. (mg CaCO3/L)	Hardness (mg CaCO3/L)	Ammonia (ppm)
ART.SED	23.2	10.7	361	7.1	78	104	0.2
SDFBRK	23.3	10.3	310	7.2	36	68	1.5
SD-06	23.3	9.3	541	7.0	87	106	13.0
SD07-02	23.3	9.5	349	7.2	43	74	2.2
SD10	23.2	9.2	317	7.2	54	86	1.8
SD12-03	23.3	8.1	319	7.1	35	70	2.0
SD18-02	23.2	7.4	339	7.0	52	84	1.2
SD19-01	23.2	7.7	305	7.1	38	72	1.3
SD25	23.3	7.1	320	7.1	52	80	1.7

Wells G&H Sediment Toxicity Test Chemistry - Day 1 (12/02/97) C. tentans			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
Art. Sed.	23.0	8.8	322
SDFBRK	23.1	8.7	302
SD06	23.2	8.4	402
SD07-02	23.2	8.0	319
SD10	23.1	8.0	275
SD12-03	23.2	7.3	297
SD18-02	23.1	7.5	308
SD19-01	23.1	8.3	294
SD25	23.2	8.1	306

Wells G&H Sediment Toxicity Test Chemistry - Day 1 (12/03/97) - H. azteca			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED.	23.2	6.3	368
SDFBRK	23.2	5.3	308
SD06	23.1	5.4	490
SD07-02	23.1	5.2	335
SD10	23.2	5.3	321
SD12-03	23.1	5.1	318
SD18-02	23.2	5.2	342
SD19-01	23.3	5.4	300
SD25	23.4	5.2	321

Wells GAII Sediment Toxicity Test Chemistry - Day 2 (12/03/97) - C. tentans			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED	23.2	6.2	339
SDFBRK	23.3	5.6	292
SD06	23.4	5.6	401
SD07-02	23.4	5.2	313
SD10	23.3	5.0	291
SD12-03	23.4	5.5	323
SD18-02	23.4	5.7	289
SD19-01	23.3	5.3	310
SD25	23.3	5.4	301

Wells GAII Sediment Toxicity Test Chemistry - Day 2 (12/04/97) - H. Azteca			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED	21.9	6.0	353
SDFBRK	22.2	5.2	301
SD06	21.9	5.4	406
SD07-02	22.0	4.9	317
SD10	22.1	5.2	320
SD12-03	22.3	5.0	309
SD18-02	21.9	4.9	320
SD19-01	21.9	5.4	294
SD25	21.7	5.9	309

Wells G&H Sediment Toxicity Test Chemistry - Day 3 (12/04/97) - C. tentans			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED.	22.2	6.6	333
SDFBRK	22.0	6.0	288
SD06	22.2	5.1	374
SD07-02	22.1	4.5	306
SD10	22.1	5.1	316
SD12-03	21.9	5.0	282
SD18-02	21.9	4.0	301
SD19-01	22.0	5.3	283
SD25	22.1	5.4	296

Wells G&H Sediment Toxicity Test Chemistry - Day 3 (12/05/97) - H. azteca			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED	22.0	5.6	339
SD06	22.0	5.5	362
SD07-02	22.0	4.7	313
SD10	22.0	5.6	315
SD12-03	22.0	5.1	302
SD18-02	22.0	4.9	302
SD19-01	21.0	5.6	296
SD25	21.0	5.7	308
SDFBRK	21.0	5.9	299

Wells G&H Sediment Toxicity Test Chemistry - Day 4 (12/05/97) - C.tentans			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED	22.0	5.0	340
SD06	22.0	5.0	350
SD07-02	22.0	5.2	302
SD10	22.0	5.1	318
SD12-03	22.0	4.5	292
SD18-02	22.0	5.0	306
SD19-01	22.0	5.3	286
SD25	22.0	4.4	299
SDFBRK	22.0	4.1	287

Wells G&H Sediment Toxicity Test Chemistry - Day 4 (12/05/97) - H. azteca			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED	22.1	5.3	338
SD06	22.1	5.2	343
SD07-02	22.0	5.3	306
SD10	22.2	5.5	310
SD12-03	22.2	5.4	302
SD18-02	22.0	5.2	309
SD19-01	22.2	5.8	293
SD25	22.0	5.7	309
SDFBRK	22.2	5.9	297

Wells G&H Sediment Toxicity Test Chemistry - Day 5 (12/06/97) - C.tentans			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED	22.1	4.8	339
SD06	22.0	4.7	332
SD07-02	22.1	4.0	298
SD10	21.9	4.1	306
SD12-03	22.2	4.3	281
SD18-02	22.2	4.3	298
SD19-01	22.2	4.7	292
SD25	22.2	5.2	298
SDFBRK	22.2	4.6	286

Wells G&H Sediment Toxicity Test Chemistry - Day 5 (12/07/97) - H. azteca			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED	21.6	4.8	339
SD06	21.6	4.7	332
SD07-02	22.4	4.0	298
SD10	---	---	---
SD12-03	22.3	4.9	297
SD18-02	21.3	5.0	302
SD19-01	22.3	5.1	293
SD25	21.9	5.2	292
SDFBRK	22.5	6.3	297

Wells G&H Sediment Toxicity Test Chemistry - Day 6 (12/07/97) - C.tentans			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED	22.0	4.8	347
SD06	22.9	4.8	321
SD07-02	22.7	4.8	295
SD10	22.4	4.9	306
SD12-03	22.6	4.9	287
SD18-02	22.5	4.0	296
SD19-01	22.7	5.3	280
SD25	21.6	4.9	285
SDFBRK	22.3	4.7	275

Wells G&H Sediment Toxicity Test Chemistry - Day 6 (12/08/97) - H. azteca			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED	21.8	4.8	339
SD06	21.8	5.6	325
SD07-02	22.1	4.9	302
SD10	22.1	5.1	303
SD12-03	22.1	5.2	301
SD18-02	21.9	4.7	306
SD19-01	22.3	5.0	279
SD25	21.8	5.9	299
SDFBRK	22.7	5.0	296

Wells G&H Sediment Toxicity Test Chemistry - Day 7 (12/08/97) - C.tentans			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED	22.6	4.8	324
SD06	21.7	5.8	310
SD07-02	22.1	5.5	294
SD10	22.5	4.3	279
SD12-03	21.2	5.3	274
SD18-02	22.1	4.0	279
SD19-01	22.0	5.7	280
SD25	22.4	4.3	280
SDFBRK	22.1	4.3	272

Wells G&H Sediment Toxicity Test Chemistry - Day 7 (12/09/97) - H. azteca			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED	22.0	4.3	343
SD06	22.5	5.6	317
SD07-02	22.7	5.2	303
SD10	22.9	4.8	295
SD12-03	22.7	5.4	293
SD18-02	22.5	5.1	296
SD19-01	22.8	5.2	297
SD25	22.4	5.5	293
SDFBRK	22.9	5.0	298

Wells G&H Sediment Toxicity Test Chemistry - Day 8 (12/09/97) - C. tentans			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED	22.5	4.5	328
SD06	22.2	4.0	295
SD07-02	22.1	4.2	271
SD10	22.3	4.6	291
SD12-03	22.5	4.8	277
SD18-02	22.4	3.1	281
SD19-01	22.5	4.9	302
SD25	22.0	4.7	279
SDFBRK	22.0	4.7	272

Wells G&H Sediment Toxicity Test Chemistry - Day 8 (12/10/97) - H. azteca			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED	23.0	3.5	355
SD06	23.1	3.5	299
SD07-02	23.1	5.0	300
SD10	23.0	5.4	301
SD12-03	23.1	5.3	294
SD18-02	23.0	5.2	286
SD19-01	23.0	5.5	303
SD25	22.9	5.3	302
SDFBRK	23.0	5.4	283

Click Here to Continue with Toxicity Data

Wells G&H Sediment Toxicity Test Chemistry - Day 9 (12/18/97) - Chaetogaster			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED	23.0	4.0	328
SD06	23.2	4.4	310
SD07-02	23.2	4.4	285
SD10	23.3	4.7	293
SD12-03	23.2	4.8	283
SD18-02	23.3	4.8	289
SD19-01	23.1	5.3	276
SD25	23.2	4.3	291
SDFBRK	23.2	5.2	275

Wells G&H Sediment Toxicity Test Chemistry - Day 9 (12/11/97) - H. azteca			
	Temp. (Degrees)	DO (mg/l)	S/C (mhos/cm)
ART.SED	22.8	1.2	330
SD06	22.8	4.9	324
SD07-02	23.0	4.4	310
SD10	22.4	5.7	304
SD12-03	23.1	4.9	302
SD18-02	22.6	5.2	307
SD19-01	22.9	2.9	296
SD25	22.7	5.3	306
SDFBRK	22.9	4.6	300