Final Report
Monticello Mill Tailings Site
Macroinvertebrate Sampling for 2005

September 2005
This page intentionally left blank
Office of Legacy Management

Final Report

Monticello Mill Tailings Site

Macronvertebrate Sampling for 2005

September 2005

This work was performed by Amoret L. Bunn, Ph.D., Pacific Northwest National Laboratory, for S.M. Stoller Corporation under U.S. Department of Energy contract number DE-AC01-02GJ79491.
Monticello Mill Tailings Site Macroinvertebrate Sampling for 2005

I. Introduction

Past water and sediment samples at the Monticello Mill Tailings Site (MMTS) wetlands and sediment pond indicated that the concentration of selenium (Se) exceeded ecological risk guidelines (FWS 1999). To satisfy the requirements of the Biomonitoring Plan of the Monticello Mill Tailings Site Operable Unit III Post-Record of Decision Monitoring Plan (DOE 2004), sampling was conducted in the spring of 2005 for macroinvertebrates at three constructed wetlands and a sediment pond associated with the MMTS to determine if Se concentrations exist in media that might impact fish and wildlife (DOE 2004).

Activities in the spring of 2005 included deployment of artificial substrate samplers (called Hester-Dendy samplers), collection of macroinvertebrates with kick nets, and retrieval of the Hester-Dendy samplers for collection of macroinvertebrates. This work was done in accordance with Program Directive MSG 05-03. Detailed procedures for collection activities are included in Appendix 1. All samples were analyzed with hydride generation flow injection atomic absorption spectroscopy (HGAA-FIAS).

This report summarizes the results of the 2005 macroinvertebrate sampling effort. Included in the report are:

- Summary of field sampling activities
- Analysis of Se in macroinvertebrates
- Discussion of Se results in comparison to ecological risk guidelines
- Recommendations for future activities

II. Field Sampling Activities

Field sampling was done in accordance with Program Directive MSG 05-03. Before the program directive was finalized, comments from the Biological Technical Assistance Group (BTAG) were incorporated. Detailed procedures were prepared from the program directive for use by field staff during sampling activities. Table 1 lists dates and the activities for sampling macroinvertebrates in spring of 2005. Figure 1 illustrates the sampling locations discussed in Table 1.

Light traps were deployed to try and collect terrestrial emergent, flying macroinvertebrates during the nocturnal period. Recovery of invertebrates at all the wetlands was less than the 3 g wet weight per sample desired for Se analyses. The light trap sample at the sediment pond was 5.9 g. These samples have been archived if analysis of composited material is desired at a later date.

Kick net collections of macroinvertebrates was conducted on May 23-25, 2005, and was very successful (Figure 2). At least three replicate samples were collected at each location, and all samples exceeded the desired mass of 3 g wet weight for Se analysis. A split sample was collected at wetland 2, and it was used for quality control of the analytical work.
Table 1: Summary of field sampling activities by location and date.

<table>
<thead>
<tr>
<th>Field Sampling Activity by Location</th>
<th>Dates</th>
<th>Conditions and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deployed of Hester-Dendy samplers at sediment pond</td>
<td>April 5, 2005</td>
<td>3 samplers were attached to cinder blocks and placed into the sediment pond</td>
</tr>
<tr>
<td>Collected at wetland 1 using kick nets; deployed light traps for overnight collection</td>
<td>May 23, 2005</td>
<td>Weather: Sunny, windy, air temp. ~84°F. Samples collected from 1400-1730. Water temp.: 9.2°C. Comment: Wetland divided into thirds with replicate 1 on the west side of the wetland and replicate 3 near the outlet. Water from Montezuma creek was entering wetland on east end, water muddy at the east end clear in the western half.</td>
</tr>
<tr>
<td>Collected at wetland 2 using kick nets; recovered light trap at wetland 1 &amp; 2</td>
<td>May 24, 2005</td>
<td>Weather: Sunny, calm. Samples collected from 0830-1000. Water temp.: 7.8°C near creek wetland interface and 16.1°C on N shoreline later in day. Comment: Wetland divided into thirds with replicate 1 on the west side of the wetland and replicate 3 near the outlet. Split samples were collected near southern part of wetland; consisted of large dragonfly nymphs. Water from Montezuma creek was entering wetland on east end, water muddy throughout, and more open water on south portion. Light trap collected only 0.51 g at wetland 1 and did not collect anything at wetland 2.</td>
</tr>
<tr>
<td>Collected at wetland 3 using kick net; deployed light trap for overnight collection</td>
<td>May 24, 2005</td>
<td>Weather: Sunny, breezy. Samples collected 1100-1230. Water Temp: 7.8°C near creek wetland interface. Comment: Wetland divided into thirds with replicate 1 on the west side of the wetland and replicate 3 near the outlet. Split samples were collected near north part of wetland; consisted of large dragonfly nymphs from replicates 1, 2 &amp; 3. Water from Montezuma creek was entering wetland on east end; water muddy throughout; more open water on south portion.</td>
</tr>
<tr>
<td>Collected at sediment pond using kick net; deployed light trap for overnight collection</td>
<td>May 24, 2005</td>
<td>Weather: Sunny, breezy. Samples collected 1500-1640. Water Temp: 8.4°C near inlet creek wetland interface. Comment: Samples were collected along the northern portion of the pond at the shoreline in water depths of 0-2 ft. Due to very high water; access to the southern portion of the pond was not possible. Most organisms were found near the inlet, including a few crayfish. Replicate 3 was collected near the same general vicinity as replicate 1. Water was muddy throughout pond, with high flow overflowing ~ 40 ft width across the inlet. Could not collect Hester-Dendy samplers due to high water depth and flow.</td>
</tr>
<tr>
<td>Collected light traps at wetland 3 and sediment pond</td>
<td>May 25, 2005</td>
<td>Recovery of materials from light traps at wetlands &lt; 3 g for wetlands 1-3. Sediment pond sample was 5.9g. Samples stored at -20°C.</td>
</tr>
<tr>
<td>Retrieved Hester-Dendy samplers at sediment pond</td>
<td>June 22-23, 2005</td>
<td>All 3 Hester-Dendy samplers were retrieved on June 22 according to procedure (Appendix 2). Samplers were shipped, in-tact, to Richland, WA. Area between plates was packed with fine sediment in all the samplers. Macroinvertebrates were collected from sediments on June 23.</td>
</tr>
</tbody>
</table>
Figure 1: Map of Monticello Mill Tailings Site with locations for macroinvertebrate sampling. Wetlands flow into Montezuma Creek (A), which then flows into the sediment pond (B).
Figure 2: Macroinvertebrate species composition for wetland 1 (a) and wetland 2 (b).
Hester-Dendy samplers were not able to be recoverable during May 23-25, 2005. The flow into the sediment pond was greater than the designed inlet (Appendix 1, Figures 2b and 3a). The water was flowing overland into the pond at a width of approximately 40 ft and there was excessive flooding around the outlet. For safety reasons, the field samplers focused only on entering the pond along the north and part of the west shoreline for kick net collections of macroinvertebrates. The water receded enough to allow field samplers to enter the sediment pond and retrieved the Hester-Dendy samplers on June 22, 2005. The samplers were packaged in zip lock bags, put on ice and sent to Richland, WA, for recovery of the macroinvertebrates.

Due to high sediment loads resulting from the flooding conditions the area between the plates of the Hester-Dendy samplers had become covered with sediment. The types of macroinvertebrates found in the samplers were different from those collected with the kick nets, and included more larval forms (i.e., gastropods and oligocheates) often found in sediment. Recovery of all the samples was less than the desired mass of 3 g wet weight for Se analyses. However, the samples were sent to the laboratory for further investigation.

III. Analysis of Se in Macroinvertebrates

The procedures for quantifying total Se in macroinvertebrate samples were in accordance with Program Directive MSG 05-03. Analyses were conducted at Battelle’s Marine Science Laboratory in Sequim, WA. All macroinvertebrate tissue samples and field blanks were received at the laboratory in good condition.

The tissue samples were freeze-dried and homogenized to determine percent dry weight prior to being analyzed for total Se. The homogenized samples were digested using nitric and hydrochloric acids (aqua regia) in a Teflon vessel and heated in an oven at 130°C (±10°C) for a minimum of eight hours. Digested samples were analyzed for Se using hydride generation flow injection atomic absorption spectroscopy (HGAA-FIAS) according to Battelle SOP MSL-I-030, Determination of Metals in Aqueous and Digestate Samples by HGAA-FIAS. The base method for this procedure is EPA Method 270.3. All results were determined and reported in units of mg/kg on a dry weight basis.

Field blanks were collected as part of the quality control plan as stated in the program directive. Blanks were prepared while collecting kick net samples and while harvesting macroinvertebrates from the Hester-Dendy samplers. Those samples were pre-reduced for total Se prior to analysis by HGAA-FIAS according to Battelle SOP MSL-I-030, Determination of Metals in Aqueous and Digestate Samples by HGAA-FIAS. The base method for this procedure is EPA Method 270.3. All results were determined and reported in units of µg/L.

In addition to field blanks, one field duplicate was also collected and one sample in the field was split for evaluation of quality control in the field. Both of these samples were collected in wetland 2. The duplicate and the split sample were analyzed in the same way as all the other macroinvertebrate samples.

The data quality criteria for the analysis of Se includes the method detection limit (MDL) and the reporting limit (RL). The reporting limit was determined as 3.18 times the MDL. For the macroinvertebrate tissues, the HGAA-FIAS analysis had an MDL of 0.0211 mg/kg dry weight.
and an RL of 0.0671 mg/kg dry weight. For the field blanks, the HGAA-FIAS analysis had an MDL of 0.0633 µg/L and an RL of 0.201 µg/L.

The laboratory quality control measures included a method blank, matrix spike, matrix spike duplicated and a laboratory control sample, as discussed in the program directive. These quality control measures were completed for the kick net samples and the Hester-Dendy samples. The method blank was used to determine if there was contamination associated with the laboratory storage of the samples, preparation or instrumentation. All the method blanks were below the MDL.

The matrix spike (MS) and matrix spike duplicate (MSD) were used to determine if there was any interference in the spike matrix and as a measure of the analysis’ accuracy and precision. For the kick net samples, the MS and MSD were 102 and 104% recovery, within the quality control requirement of 75-125% recovery. Analytical precision was measured for these samples by analyzing a duplicate sample and the MS/MSD pair. The relative percent difference (RPD) for the duplicate was 2% and the MS/MSD was 2%, which was within the quality control requirement of <20%.

The quality control for the Hester-Dendy samples was more difficult since the mass of macroinvertebrates recovered from the samplers was so low that there was not enough material to prepare MS and MSD samples. Instead, a laboratory control sample and a duplicate (LCS/LCSD) of that sample were prepared and analyzed. The percent recoveries were 96 and 101% respectively, within the quality control requirement of 75-125% recovery. The relative percent difference (RPD) for the LCS/LCSD pair was 6%, which was within the quality control requirement of <20%.

A laboratory control sample was used to determine the analytical accuracy by analyzing a standard reference material. For the kick net samples, the percent recovery was 88%, within the quality control criterion of 80-120%. For the Hester-Dendy samples, the percent recovery was 100%, within the quality control criterion of 80-120%.

Table 2 summarizes the results by location for the macroinvertebrate samples collected with kick nets. All the samples exceeded the 3 g wet weight mass desired for analytical purposes. To indicate the variability of the replicate samples, the mean and standard deviation at each location was included in Table 2. The analysis of samples from wetland 2 included both a duplicate sample collected in the field and a split of the sample in the laboratory. The percent composition by weight of the kick net samples was diverse across functional feeding groups for all but one sample (the split sample was 100% dragonfly nymphs). Further discussion of functional feeding groups by common name is included in Appendix 3.

Table 3 summarizes the results of the macroinvertebrate collected from the sediment pond with the Hester-Dendy samplers. Due to low recovery of macroinvertebrates from the sediment packed samplers, the macroinvertebrates from the second and third samplers were combined into one sample for analysis. The percent composition by weight of the Hester-Dendy samples included more organisms associated with the sediments (e.g., aquatic worms) than were found with the kick net samples.
Table 2: Results of Selenium analyses in macroinvertebrate samples collected with kick nets.

<table>
<thead>
<tr>
<th>Location</th>
<th>Sample Weight (g wet weight)</th>
<th>Se (mg/kg dry wt)</th>
<th>Mean (Standard Deviation) of Se (mg/kg dry wt)</th>
<th>Composition (based on % of total mass of sample)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetland 1</td>
<td>7.0</td>
<td>1.64</td>
<td></td>
<td>30% damselfly, 30% dragonfly, 30% gastropod, 10% coleopteran (larvae)</td>
</tr>
<tr>
<td></td>
<td>9.5</td>
<td>3.11</td>
<td>2.75 (0.984)</td>
<td>60% damselfly, 10% coleoptera (larvae), 20% gastropod, 5% diptera</td>
</tr>
<tr>
<td></td>
<td>5.3</td>
<td>3.51</td>
<td></td>
<td>50% damselfly, 30% dragonfly, 10% coleopteran (larvae), 10% diptera</td>
</tr>
<tr>
<td>Wetland 2</td>
<td>5.5</td>
<td>1.76</td>
<td>1.62 (0.143)</td>
<td>25% damselfly, 25% dragonfly, 40% gastropod, 10% diptera and amphipod</td>
</tr>
<tr>
<td></td>
<td>7.5</td>
<td>1.60</td>
<td></td>
<td>30% damselfly, 30% dragonfly, 30% gastropod, 5% chironomid, 5% notonectid</td>
</tr>
<tr>
<td></td>
<td>5.4</td>
<td>1.39</td>
<td></td>
<td>45% gastropod, 50% mix of dragonfly &amp; damselfly, 3% beetle, 3% diptera</td>
</tr>
<tr>
<td></td>
<td>7.5</td>
<td>1.69</td>
<td></td>
<td>Split sample for analytical quality control: 100% dragon nymph</td>
</tr>
<tr>
<td>Wetland 3</td>
<td>6.2</td>
<td>6.21</td>
<td>7.24 (2.73)</td>
<td>35% damselfly, 35% dragonfly, 20% notonectid, 5% trichoptera, 5% ephemeroptera, gastropod, beetle</td>
</tr>
<tr>
<td></td>
<td>6.1</td>
<td>10.3</td>
<td></td>
<td>45% damselfly, 35% dragonfly, 10% notonectid, 10% gastropod/amphipod</td>
</tr>
<tr>
<td></td>
<td>12.5</td>
<td>5.18</td>
<td></td>
<td>40% gastropod, 20% damselfly, 20% dragonfly, 5% notonectid, 5% trichoptera, 5% coleopteran (adult), 5% diptera</td>
</tr>
<tr>
<td>Sediment Pond</td>
<td>4.8</td>
<td>4.26</td>
<td>3.75 (0.561)</td>
<td>50% crayfish, 25% odonata, 15% notonectids, 3% ephemeroptera, 3% trichoptera, 4% coleopteran (adult)</td>
</tr>
<tr>
<td></td>
<td>5.0</td>
<td>3.15</td>
<td></td>
<td>70% notonectid, 15% odonata, 5% gastropod, 5% coleopteran (adult), 5% ephemeroptera</td>
</tr>
<tr>
<td></td>
<td>3.6</td>
<td>3.84</td>
<td></td>
<td>50% notonectid, 30% crayfish, 10% coleopteran (adult), 10% ephemeroptera</td>
</tr>
</tbody>
</table>
Table 3: Results of Selenium analyses in macroinvertebrate samples collected with Hendy-Dendy samplers.

<table>
<thead>
<tr>
<th>Location</th>
<th>Sample Weight (g wet weight)</th>
<th>Se (mg/kg dry wt)</th>
<th>Mean (Standard Deviation) of Se (mg/kg dry wt)</th>
<th>Composition (based on % of total mass of sample)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment Pond</td>
<td>0.83</td>
<td>3.52</td>
<td>3.94 (0.587)</td>
<td>50% odonata (1 dragonfly, 1 damselfly) 30% gastropod, 20% aquatic worm</td>
</tr>
<tr>
<td></td>
<td>0.46*</td>
<td>4.35</td>
<td></td>
<td>40% gastropod, 40% damselfly, 10% aquatic worm</td>
</tr>
<tr>
<td></td>
<td>0.12*</td>
<td></td>
<td></td>
<td>70% aquatic worm, 10% odonata, 10% chironmid, 10% gastropod</td>
</tr>
</tbody>
</table>

*Samples composited for analyses due to low recovery of macroinvertebrates.

IV. Discussion of Results

The purpose for biomonitoring at MMTS has been to determine if Se concentrations exist in media that might impact fish and wildlife (DOE 2004). The recommended ecological risk guidelines for Se in macroinvertebrates, water and sediment are listed in Table 4. The risk guidelines include a threshold for no effect, a range indicating a level of concern and a threshold concentration that is considered toxic to fish and wildlife that consume the macroinvertebrates.

Table 4: Recommended ecological risk guidelines based upon selenium residuals.*

<table>
<thead>
<tr>
<th>Matrix</th>
<th>Units</th>
<th>No Effect</th>
<th>Level of Concern</th>
<th>Toxicity Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal food chain (invertebrates)**</td>
<td>mg/kg (dry weight)</td>
<td>&lt; 3</td>
<td>3-7</td>
<td>&gt; 7</td>
</tr>
<tr>
<td>Water (total recoverable Se)</td>
<td>µg/L</td>
<td>&lt; 2</td>
<td>2-5</td>
<td>&gt; 5</td>
</tr>
<tr>
<td>Sediment</td>
<td>mg/kg (dry weight)</td>
<td>&lt; 2</td>
<td>2-4</td>
<td>&gt; 4</td>
</tr>
</tbody>
</table>

*Based on DOE 2004 and FWS 1999.

** The animal food chain guideline refers to hazards to birds. If food chain residues exceed 6 mg/kg then avian eggs should be monitored.

Figure 3 illustrates the results of the macroinvertebrates collected in the spring of 2005. Each replicate is represented by location as well as the mean of all the replicates from that location. The results for the wetlands are based all on kick net samples. The results for the sediment pond are shown separately for the kick net and Hester-Dendy samples. Gray lines on Figure 3 indicate the ecological risk guidelines for Se residues in macroinvertebrates: Level of concern = 3-7 mg/kg dry weight Se; and toxicity threshold > 7 mg/kg dry weight Se.

For wetland 1, two replicates and the overall mean exceed the level of concern for Se in macroinvertebrates. None of the samples from wetland 2 exceed the level of concern, and the variability in wetland 2 is the smallest of all locations. All the samples from wetland 3 exceed the level of concern, and one sample exceeds the toxicity threshold. This sample has the greatest concentration of Se, and as a result the mean also exceeds the toxicity threshold. Wetland 3 samples also had the greatest variability among the replicate samples. All of the samples from the sediment pond exceed the level of concern, but none of the samples exceed the toxicity.
threshold. The samples collected by kick net and in the Hester-Dendy samplers were very similar in Se concentration.

Figure 3: Results of macroinvertebrate samples and comparison to ecological risk guidelines for Se residues.

![Graph showing Se concentrations in different locations](image)

Notes: Error bars represent two standard deviations. Gray lines indicate ecological risk guidelines for Se residues in invertebrates: Level of concern = 3-7 mg/kg dry weight Se; and toxicity threshold > 7 mg/kg dry weight Se.

The composition of macroinvertebrates in each sample includes organisms that are acquiring the Se from the water, sediment and the food that they consume. The composition in each sample is included in Table 3 and further discussion of the types of organisms found in the samples is in Appendix 2.

The biomonitoring plan has also included sampling the water and sediment from each wetland and the sediment pond. A comparison of these results to the macroinvertebrate results is provided to illustrate how the media are indicating ecological risk in the area. Figure 4 shows the results from unfiltered water samples at each location for October 2004 and April 2005. Unfiltered water samples are shown because this concentration best represents the exposure to the macroinvertebrates. The mean of the samples from wetlands 1 and 3 and the sediment pond exceed the level of concern for total recoverable Se in unfiltered water. Similar to the macroinvertebrate results, there is one sample from wetland 3 collected in October 2004 that exceeds the toxicity threshold for Se in water. None of the samples from wetland 2 during October 2004 or April 2005 exceeded the level of concern, which is consistent with the macroinvertebrate results.
Figure 4: Results of selenium analyses from unfiltered water collected in October 2004 and April 2005.

Notes: Error bars represent two standard deviations. Gray and red lines indicate ecological risk guidelines for Se residues in water (total recoverable Se): Level of concern = 2-5 µg/L Se; and toxicity threshold > 5 µg/L Se.

Figure 5 shows the results for Se in sediment samples from at each location for October 2004 and April 2005. Only samples from the sediment pond exceed the level of concern for Se in sediment. None of the samples exceed the toxicity threshold for Se in sediment.

Figure 5: Results of selenium analyses from sediment samples collected in October 2004 and April 2005.

Notes: Error bars represent two standard deviations. Gray and red lines indicate ecological risk guidelines for Se residues in sediment: Level of concern = 2-4 mg/kg dry weight Se; and toxicity threshold > 4 mg/kg dry weight Se.
In comparing the Se concentrations of the macroinvertebrate samples to the water and sediment samples, it appears that the water samples may be a better indicator of higher Se levels in macroinvertebrates compared to sediment samples based on the locations were samples exceeded the level of concern for Se in that matrix. This may be due to the fact that the types of macroinvertebrates that were collected by the kick net samples were generally organisms living in the water column and not the sediments. The macroinvertebrate samples and the unfiltered water samples exceeded the level of concern in wetlands 1 and 3 and the sediment pond. However, the sediment samples only exceeded the level of concern in the sediment pond.

**V. Recommendation for future activities**

The design of the macroinvertebrate sampling program tested different methods for collecting the organisms. Two different collection techniques were used in the sediment pond: kick nets and Hester-Dendy samplers. Sufficient mass of macroinvertebrates for analysis of Se was collected using kick nets. However, the Hester-Dendy samplers were not able to collect the desired mass because of the accumulation of sediment between the plates of the samplers. The results indicate that there was no significant difference between the macroinvertebrates collected using the two different techniques. The option for using kick nets to collect macroinvertebrates should be considered if future samples are to be collected at MMTS.

Terrestrial macroinvertebrates were also collected with light traps during May 23-25, 2005. The light traps set up around the wetlands did not collect the desired mass of 3 g wet weight for analysis. Many of the organisms collected with kick nets and Hester-Dendy samplers have an adult life stage that has wings. If terrestrial macroinvertebrates are to be considered in the future, then collection of winged organisms with aerial nets should be considered.

The results of collecting macroinvertebrates from the constructed wetlands and the sediment pond at MMTS in the spring of 2005 represent a “snap shot” in time. The weather conditions during the winter of 2005 and the excessive water flow through MMTS during the spring was unusual for the area. Based on its geochemical behavior, Se increases in solubility in oxidizing waters and is sequestered in reducing conditions. This type of geochemical behavior is reversible and extremely dependant on the hydrologic conditions during sampling. The excessive water flows in 2005 may have contributed to lower Se concentrations in the water, sediment and the macroinvertebrates. Wetlands 1 and 3 and the sediment pond all have results that exceed the level of concern for ecological risk. These results do not conclusively indicate that there is a risk to fish and wildlife in the waters at MMTS. The results of the macroinvertebrate samples along with the results of the bird surveys should be considered by DOE and BTAG in determining if further investigations are warranted.
VI. References


Appendix 1: Monticello Mill Tailings Site

Macroinvertebrate Field Sampling Procedures

I. Purpose

Collect aquatic and terrestrial macroinvertebrates from four sites at the Monticello Mill Tailings Site to be analyzed for selenium content. The sites are three wetlands and a sediment pond. Each macroinvertebrate sample should have a wet weight of 3 g in order for the laboratory to perform and meet all quality assurance standards and desired detection limits.

The goal is to collect the following samples:

- 3 aquatic macroinvertebrate samples collected with kick nets in wetland 1;
- 3 aquatic macroinvertebrate samples collected with kick nets in wetland 2;
- 3 aquatic macroinvertebrate samples collected with kick nets in wetland 3;
- 3 aquatic macroinvertebrate samples collected with kick nets in sediment pond;
- 3 aquatic macroinvertebrate samples collected from Hester-Dendy samplers in sediment pond;
- 1 field duplicate from composited aquatic macroinvertebrate sample;
- 3 emergent, flying macroinvertebrate samples collected with light traps in wetland 1;
- 3 emergent, flying macroinvertebrate samples collected with light traps in wetland 2;
- 3 emergent, flying macroinvertebrate samples collected with light traps in wetland 3;
- 1 field duplicate from composited emergent, flying macroinvertebrate sample; and
- 3-4 water samples collected as field blanks (one per day) and deionized water used for any re-wetting of macroinvertebrate samples.

This procedure includes:

- Materials needed in the field and for shipment to the laboratory,
- Methods for:
  - Collecting aquatic macroinvertebrates using kick-nets;
  - Collecting aquatic macroinvertebrates using Hester-Dendy samplers;
  - Collecting terrestrial macroinvertebrates using light traps;
  - Preparing field blanks; and
  - Shipping samples.
- Schedule for activities

Attachments to the procedure include:

- Map of the Monticello Mill Tailings Site,
- Procedure for acid washing the field equipment,
- Sample of Chain-of-Custody (COC) form, and
- Deployment procedure for the Hester-Dendy samplers.
II. Materials

A. Monticello Field Supplies
   Kick nets and handles (6 extra bags) (acid washed)
   Forceps, scrapers, plastic trays, gloves (acid washed)
   Sample jars
   Mason jars for critters (light trap) (acid wash)
   Balance, with extra AA batteries
   GF filter paper
   Sieve or Buchner funnel to support filter paper and allow drainage
   Cooler for sample shipment
   3 light traps with photo sensors
   Extra bulbs
   Battery chargers (2)
   Chest waders/Hip boots/rubber boots
   Insect repellent/sunscreen
   Nitrile gloves
   100 m tape/flagging
   GPS
   Side cutters to remove Hester-Dendy (HD) samplers
   Digital camera
   Plastic bags/ziplocks
   Clipboards
   Write in rain paper
   Field data sheets
   Chain of Custody (COC) forms
   Sharpies/pencils
   Thermometer
   First Aid Kit
   Cell phone
   Battelle Health and Safety Plan

B. Purchase in Moab
   Dry Ice
   Deionized (DI) water
   12 v batteries (2) for light traps

C. Shipping to Sequim
   Cooler
   Dry Ice
   Mailing labels
   COC forms
   Samples (aquatic macroinvertebrates, terrestrial macroinvertebrates, field blanks)
III. Methods

A. Kick net Collection of Aquatic Macroinvertebrates

1. Kick-nets will be used to collect samples at each wetland and the sediment pond.
2. Each wetland should be visibly divided into three sections: surface water influent, middle and outlet. Note: the sediment pond should be visibly divided into influent edge, left and right of influent edge (ending at the outlet). Flag the edges of the three parts. Note in field notebook the three parts. The flags and a representative point or area should be recorded with the GPS.
3. Put on Nitrile gloves and appropriate footwear.
4. Open one of the pre-cleaned aquatic kick nets and use the net to collect aquatic macroinvertebrates around the edge of one section of the site (wetland or pond). Nets should also be used to collect in areas where there is open water between the emergent vegetation.
5. After collecting in a section at a site, empty contents of kick net into a pre-cleaned tray. Use DI water to rinse material out of net if needed.
6. Place filter paper onto SS sieve.
7. Set up electronic balance (Ohaus Navigator).
8. Tare the weight of the SPEX plastic container. Container should be labeled using a permanent pen with the appropriate field ID number (see Attachment 3).
9. Use pre-cleaned forceps to transfer invertebrates onto filter paper. The invertebrates should remain on the filter paper as long as needed to remove excess water from the organisms.
10. Using forceps transfer the invertebrates from the filter paper to the tared SPEX plastic container. Care should be taken to exclude any sediment or visible vegetation from the sample.
11. Collection of a replicate sample at a site will continue until a minimum mass of 3 g wet weight macroinvertebrates has been collected.
   - A single invertebrate should not exceed more than 20% of the entire 3 g replicate sample (i.e., should not exceed 0.6 g). This might happen if crayfish or large snails are collected. Large invertebrates could be segregated into a ziplock bag and may be chosen for analysis later. Bag should be labeled with site, collection technique, date, time, and initials of field sampler. The focus should be on invertebrates that can be consumed by birds.
   - If more than 3 g is collected from a single section at a site, then the invertebrates exceeding 3 g should be put into a new container. The new container will become the field duplicate (see step 18 below).
   - If less than 3 g is collected from a single section at a site, then note the weight collected for that day. On another day, try to collect more from the section at the site using kick nets and collecting with forceps aquatic invertebrate life stages found on submerged sections of the emergent vegetation. Organisms collected from a single section at a site on separate days can be consolidated into a single container and considered one replicate sample for analysis.
If the sample size can not be reached by sampling a section at a site over multiple days, then sections from the same site may be consolidated to achieve the 3 g sample size. Note in the field notebook the final weight of the replicate sample and the types of macroinvertebrates included in the sample container. Types of invertebrates are based on the functional feeding groups: detritivores and shredders (e.g., trichoptera, gastropods); predators (e.g., odonata, coleoptera, hemiptera).

12. Store sample container in cooler with ice.
13. Fill in Chain of Custody form (see Attachment 3).
14. Repeat collection of aquatic macroinvertebrates in the remaining sections of the wetland.
15. Repeat until 3 replicate samples are collected from each wetland and the sediment pond. A maximum of 12 samples should be collected.
16. Prepare one field duplicate if there are excess aquatic macroinvertebrates after preparing the 3 replicates per site. A field duplicate should come from one section at a site. However, this may not be possible and the field duplicate may represent multiple sections from a single site. Field notes should describe the site and sections used to prepare the duplicate.
17. All samples should be stored at 4°C or less. Overnight storage of a container may be in a refrigerator. Sample should be cooled and maintained at a temperature of 4°C or less.

B. Hester-Dendy (HD) Collection of Aquatic Macroinvertebrates

1. HD samplers were placed only in the sediment pond. The samplers were deployed on April 5 2005 (see Attachment 4).
2. To find a HD sampler, locate a tee-post in the pond. The tee-posts are located just beyond the emergent vegetation and along a submerged edge in the pond. A rope from the tee-post leads to the submerged cinder block holding the HD sampler.
3. Record location of cinder block with GPS.
4. Using side cutters, clip the pull tied holding the HD sampler to the cinder block. This can be done by removing the cinder block from the water with the sampler attached, or by clipping the pull ties under water.
5. Put HD sampler in pre-cleaned tray.
6. Using forceps or pre-cleaned spatulas, remove the invertebrates from the sampler and put them in DI water. This may require disassembling the sampler and picking the organisms directly from the individual plates of the sampler.
7. Place filter paper onto SS sieve.
8. Set up electronic balance.
9. Tare the weight of the SPEX plastic container. Container should be labeled using a permanent pen with the appropriate field ID number (see Attachment 3).
10. Use pre-cleaned forceps to transfer invertebrates onto filter paper. The invertebrates should remain on the filter paper as long as needed to remove excess water from the organisms.
11. Using forceps transfer the invertebrates from the filter paper to the tared SPEX plastic container. Care should be taken to exclude any sediment or visible vegetation from the sample.

12. Collection of a replicate sample from a HD sampler will continue until a minimum mass of 3 g wet weight macroinvertebrates has been collected.
   - Invertebrates from each sampler should be put in a separate container.
   - If less than 3 g is collected from a single HD sampler, then note the weight collected from that sampler. After invertebrates from all samplers have been segregated into respective containers, then the containers that have less than 3 g should have their contents consolidated. In this case, a container may have a weight greater than 3 g and this composite sample will be analyzed as one replicate sample.
   - If more than 3 g is collected from a single HD sampler, then the invertebrates exceeding 3 g should be put into a new container. The new container will become the field duplicate (see step 18 above for kick net samples).
   - A single invertebrate should not exceed more than 20% of the entire 3 g sample (i.e., should not exceed 0.6 g). This might happen if crayfish or large snails are collected. Large invertebrates could be segregated into ziplock bag and may be chosen for analysis later. Bag should be labeled with site, collection technique, date, time, and initials of field sampler. The focus should be on invertebrates that can be consumed by birds.

13. Note in the field notebook the final weight of the replicate sample.

14. Note in the field notebook the types of macroinvertebrates included in the sample container. Types of invertebrates are based on the functional feeding groups: detritivores (e.g., Tipulidae, Limnephilidae); predators (e.g., Aeshnidae, beetles); and filter feeders (e.g., Hydropsychidae, Simuliidae).

15. Store sample container in cooler with ice. Fill in Chain of Custody form (see Attachment 3).

16. Repeat collection of aquatic macroinvertebrates from the remaining HD samplers.

17. All samples should be stored at 4°C or less. Overnight storage of a container may be in a refrigerator. Sample should be cooled and maintained at a temperature of 4°C or less.

   Note: During May 2005 sampling event, the water level in the sediment pond was too high to safely remove the HD samplers. Attachment 5 discusses the removal of the HD samplers and shipment for removal of macroinvertebrates.

C. Light Trap Collection of Terrestrial Macroinvertebrates

1. Identify a location for placement of the light traps (Bioquip 22-watt). Suggest that the location be similar at each site. Light traps will collect emergent, flying macroinvertebrates.

2. Assemble light trap with pre-cleaned glass or plastic jar and pre-cleaned funnel. Ensure that battery is charged and photoelectric sensor is operating.

3. Record location of light trap with GPS.

4. Samples collected in jar at bottom of trap should be removed at first opportunity in the morning.
5. Set up electronic balance.
6. Tare the weight of the SPEX plastic container. Container should be labeled using a permanent pen with the appropriate field ID number (see Attachment 3).
7. Transfer invertebrates into the tared SPEX plastic container. Use pre-cleaned forceps to assist in transfer of organisms. The invertebrates should remain on the filter paper as long as needed to remove excess water from the organisms. Care should be taken to exclude any vegetation or abiotic material from the sample.
8. Collection of a replicate sample at a site will continue until a minimum mass of 3 g wet weight macroinvertebrates has been collected.
   • A single invertebrate should not exceed more than 20% of the entire 3 g sample (i.e., should not exceed 0.6 g). This might happen if a large moth is collected. Large invertebrates could be segregated into ziplock bag and may be chosen for analysis later. Bag should be labeled with site, collection technique, date, time, and initials of field sampler.
   • If more than 3 g is collected from a light trap over night or a series of nights, then the invertebrates exceeding 3 g should be put into a new container. The new container will become the field duplicate (see step 14 below).
   • If less than 3 g is collected from a light trap, then note the weight collected that night. Repeat collection of terrestrial invertebrates until 3 g is collected. Organisms collected from a light trap over several nights can be consolidated into a single container and considered one replicate sample for analysis.
9. Note in the field notebook the final weight of the replicate sample.
10. Note in the field notebook the types of macroinvertebrates included in the sample container. Types of invertebrates are based on the functional feeding groups: detritivores (e.g., Tipulidae, Limnephilidae); predators (e.g., Aeshnidae, beetles); and filter feeders (e.g., Hydropyschidae, Simuliidae).
11. Store sample container in cooler with ice.
12. Fill in Chain of Custody form (see Attachment 3). Date for sample should be the day the sample is put into the container (not the night that the trap was placed).
13. Repeat until 3 replicates samples are collected from each site. A maximum of 12 samples should be collected.
14. Prepare one field duplicate if there are excess invertebrates from the light traps after preparing the 3 replicates per site. A field duplicate should come from one light trap at a site. Field notes should describe the site and sections used to prepare the duplicate.
15. All samples should be stored at 4°C or less. Overnight storage of a container may be in a refrigerator. Sample should be cooled and maintained at a temperature of 4°C or less.

D. Field Blanks

1. Field blanks are used to verify that the sample collection and handling process has not affected the quality of the samples. They are used to measure the cleanliness of sampling equipment.
2. At the beginning of the day, set out a collection system. A collection system consists of a kick net, tray, and forceps, or a light trap, jar and forceps. The collection system
may be unpacked from the bags used to protect the equipment after it was acid washed, or after the equipment has been used on a previous day at a site.

3. Pour 100-500 mL of DI water through a net over the forceps and into a tray. The DI water should be the same water used to rinse the kick nets or HD samplers.

4. Pour the water from the tray into a 500 mL pre-cleaned bottle.

5. Store sample bottle in cooler with ice.

6. Fill in Chain of Custody form (see Attachment 3).

7. All field blanks should be stored at 4°C or less. Overnight storage of a container may be in a refrigerator. Sample should be cooled and maintained at a temperature of 4°C or less.

E. Shipping samples to Sequim for analyses

1. Samples need to be maintained at 4°C or colder for transport to Sequim.

2. Address for shipping to Sequim is:
   Pacific Northwest Division
   Marine Sciences Laboratory
   1529 West Sequim Bay Road
   Sequim, Washington 98382
   Attention: Jill Brandenberger (360-681-4564)

3. FedEx in Moab is 54 miles away from Monticello on Hwy 191. Hwy 191 is Main St. in Moab. There are two locations:

   City Market
   425 S Main St
   Moab, UT 84532

   Canyonland Copy Center
   59 S Main St
   Moab, UT 84532
### IV. Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wednesday, May 18</td>
<td>Ship field equipment to Monticello Mill Tailings Site.</td>
</tr>
<tr>
<td>Sunday, May 22</td>
<td>Arrive in Grand Junction, CO.</td>
</tr>
<tr>
<td>Monday, May 23</td>
<td>AM: travel to Moab and pick up supplies.</td>
</tr>
<tr>
<td></td>
<td>PM: travel to Monticello site and meet with Joe Slade and Todd Moon</td>
</tr>
<tr>
<td></td>
<td>for pre-job meeting; if time permits, start kick net collections; collect</td>
</tr>
<tr>
<td></td>
<td>field blank; set up light traps.</td>
</tr>
<tr>
<td>Tuesday, May 24</td>
<td>Collect from light traps.</td>
</tr>
<tr>
<td></td>
<td>Collect field blank</td>
</tr>
<tr>
<td></td>
<td>Kick net collections.</td>
</tr>
<tr>
<td>Wednesday, May 25</td>
<td>Collect from light traps.</td>
</tr>
<tr>
<td></td>
<td>Collect field blank</td>
</tr>
<tr>
<td></td>
<td>Pull Hester-Dendy samplers.</td>
</tr>
<tr>
<td>Thursday, May 26</td>
<td>AM: Collect from light traps; field blank; kick net collections.</td>
</tr>
<tr>
<td></td>
<td>PM: FedEx collected samples to MSL.</td>
</tr>
<tr>
<td>Friday, May 27</td>
<td>Finish collections with kick nets.</td>
</tr>
<tr>
<td></td>
<td>Package and ship field equipment to Richland, WA.</td>
</tr>
<tr>
<td></td>
<td>Return to Richland, WA.</td>
</tr>
</tbody>
</table>
Attachment 1

Map of the Monticello Mill Tailings Site
Attachment 2

Procedure for Acid Washing Field Equipment

1. Wear the following protective equipment: safety glasses, blue lab coat, nitrile gloves (tyvec sleeves are optional).
2. Clean a 30 L and a 10 L plastic bin with non-phosphate lab soap.
3. Prepare a 3 L of 5% Nitric Acid (v/v) solution.
4. Pour 5% Nitric Acid solution into 30 L bin.
5. Place field equipment into bin and ensure all surfaces of equipment are submerged in nitric acid.
6. Transfer the field equipment to 10 L plastic bin.
7. Rinse equipment 3 times with MilliQ water (>18 megohm-cm)
8. Towel dry equipment and place in ziplock bags for transport to field.
Attachment 3

Sample Chain-of-Custody (COC) Form
Field Sample Identification Information

The field sample ID is a 7 character code. The following describes the code recommended for use during the macroinvertebrate sampling at Monticello Mill Tailings Site.

First two characters identify the site of the sample at the Monticello Mill Tailings Site:
- W1 = wetland 1
- W2 = wetland 1
- W3 = wetland 1
- SP = sediment pond

The third and fourth characters identify the replicate number or that the sample is a field blank:
- R1 = replicate 1
- R2 = replicate 2
- R3 = replicate 3
- FB = field blank water sample*

The fifth character identifies the type of macroinvertebrate sample:
- A = aquatic macroinvertebrate
- T = terrestrial macroinvertebrate

The sixth and seventh character identifies the collection technique:
- KN = kick net sample
- HD = Hester-Dendy sample
- LT = light trap

*The sample ID for field blanks should have characters 5-7 that describe what was tested when the water was collected. For example, if the water was collected from a kick net set-up for wetland 1, then the ID should be W1FBAKN.

<table>
<thead>
<tr>
<th>Field Sample ID</th>
<th>Description</th>
<th>Field Sample ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1R1AKN</td>
<td>Wetland 1, rep 1, aquatic, kick net</td>
<td>SPR1AKN</td>
<td>Sediment pond, rep 1, aquatic, kick net</td>
</tr>
<tr>
<td>W1R2AKN</td>
<td>Wetland 1, rep 2, aquatic, kick net</td>
<td>SPR2AKN</td>
<td>Sediment pond, rep 2, aquatic, kick net</td>
</tr>
<tr>
<td>W1R3AKN</td>
<td>Wetland 1, rep 3, aquatic, kick net</td>
<td>SPR3AKN</td>
<td>Sediment pond, rep 3, aquatic, kick net</td>
</tr>
<tr>
<td>W1R1TLT</td>
<td>Wetland 1, rep 1, terrestrial, light trap</td>
<td>SPR1AHD</td>
<td>Sediment pond, rep 1, terrestrial, light trap</td>
</tr>
<tr>
<td>W1R2TLT</td>
<td>Wetland 1, rep 2, terrestrial, light trap</td>
<td>SPR2AHD</td>
<td>Sediment pond, rep 2, terrestrial, light trap</td>
</tr>
<tr>
<td>W1R3TLT</td>
<td>Wetland 1, rep 3, terrestrial, light trap</td>
<td>SPR3AHD</td>
<td>Sediment pond, rep 3, terrestrial, light trap</td>
</tr>
<tr>
<td>W2R1AKN</td>
<td>Wetland 2, rep 1, aquatic, kick net</td>
<td>SPR1TLT</td>
<td>Sediment pond, rep 1, terrestrial, light trap</td>
</tr>
<tr>
<td>W2R2AKN</td>
<td>Wetland 2, rep 2, aquatic, kick net</td>
<td>SPR2TLT</td>
<td>Sediment pond, rep 2, terrestrial, light trap</td>
</tr>
<tr>
<td>W2R3AKN</td>
<td>Wetland 2, rep 3, aquatic, kick net</td>
<td>SPR3TLT</td>
<td>Sediment pond, rep 3, terrestrial, light trap</td>
</tr>
<tr>
<td>W2R1TLT</td>
<td>Wetland 2, rep 1, terrestrial, light trap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W2R2TLT</td>
<td>Wetland 2, rep 2, terrestrial, light trap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W2R3TLT</td>
<td>Wetland 2, rep 3, terrestrial, light trap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W3R1AKN</td>
<td>Wetland 3, rep 1, aquatic, kick net</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W3R2AKN</td>
<td>Wetland 3, rep 2, aquatic, kick net</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W3R3AKN</td>
<td>Wetland 3, rep 3, aquatic, kick net</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W3R1TLT</td>
<td>Wetland 1, rep 1, terrestrial, light trap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W3R2TLT</td>
<td>Wetland 1, rep 2, terrestrial, light trap</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Attachment 4

Deployment Procedure for Hester-Dendy Samplers

**Purpose:** Hester-Dendy (HD) samplers will be used as a secondary method of collecting macroinvertebrates from the sediment pond. The samplers will be used to acquire three replicate macroinvertebrate samples. HD samplers are artificial substrate systems that allow water-column sampling of macroinvertebrates.

**Note:** Field notes on the actual deployment are included at the end.

**Materials** (* indicates materials to be procured prior to deployment):

- 3 HD samplers
- 12 plastic cable ties
- 3 cinder blocks (6 or 8” wide blocks)*
- 24 to 30 ft rope (to be cut into 3 lengths)*
- 3 wooden stakes*

**Procedure:**

1. Acquire 3 cinder blocks, at least 24 ft of rope, and three wooden stakes. Rope and stakes are for marking the location of the cinder block in the sediment pond. These items do not need to be sufficient to hold the

2. Attach HD samplers to the cinder blocks as shown in Figure 1. Place the sampler in the center of an 8” cinder block. Use plastic cable ties (2 for each side) to attach the sampler to the cinder block. Place one cable tie section through the eye bolt and the other cable tie section through the last spacing on the wooded plates.

3. Divide length of rope into three pieces. Tie 6 to 10 ft rope through one end of the cinder block.

4. Determine locations for HD samplers in the sediment pond. We suggest one near the road and the other two along the east and west shoreline. Consider accessibility and safety of the individuals entering the pond in placing the samplers. Samplers preferable would be at least 3 ft apart from each other, and preferably, equidistant around the pond. Samplers need to be located beyond the vegetation growing along the shoreline and not on a deep slope.

5. Place the block in the water so that there is ~ 6 – 8 in of water covering the top of the HD sampler, ensuring that the cinder block is laying flat on the substrate. Need to push the block into the soft sediment to ensure that the block does not roll over with time and to place the samplers close enough to the sediments to encourage colonization by the macroinvertebrates. Optimally, the bottoms of the sampler will be 2 – 3 in away from the top of the sediments.
6. Tie the other end of the rope from the cinder block to a stake or fixed object on land. The rope on shore will help to identify the location of the sampler for recovery later.

Figure 1: Hester-Dendy sampler attached to cinder block with cable ties. The cinder block shown is 10” wide.

Points of Contact for Questions:

If you have any questions about assembling or deploying the samplers, please contact:
Bob Mueller: 509-372-1344 (work)
            509-539-3230 (cell)
Amoret Bunn: 509-376-6300 (work)
            509-539-4548 (cell)

Field Notes:

Three Hester-Dendy samplers were placed in the Sediment Pond on April 5 2005 in accordance with the deployment procedure received from Amoret Bunn with the following exception:

    The cinder block substrate was placed against a tee-post to keep the block from slipping into deeper water (i.e., to keep it from slipping towards the center of the pond). The block was tied to the tee-post with a short piece of rope. The cinder blocks were not attached to stakes on the bank of the pond because it is feared that vandals may be attracted to something that visible. The Hester-Dendy samplers will be easily located because they are marked with the tee-posts.
Figure 2: These pictures of the sedimentation pond (a), the influent flow into the pond (b) and the deployment of the Hester-Dendy samplers (c) were taken on April 5, 2005.
Attachment 5

Retrieval Procedures for Hester-Dendy Samplers

V. Purpose

Collect aquatic macroinvertebrates from Hester-Dendy samplers in the sediment pond at the Monticello Mill Tailings Site to be analyzed for selenium content.

This procedure includes:
- Materials needed in the field and for shipment to the laboratory,
- Methods for:
  - Collecting aquatic macroinvertebrates using Hester-Dendy samplers;
  - Shipping samples.

Attachments to the procedure include:
- Chain of Custody Form
- Deployment procedure for the Hester-Dendy samplers.

VI. Materials

A. Monticello Field Supplies
   - 4 blue ice blocks, frozen
   - Cooler for sample shipment
   - Chest waders/Hip boots/rubber boots
   - Nitrile gloves (optional)
   - Side cutters to remove Hester-Dendy (HD) samplers
   - 6 zip lock bags (2 gal size)
   - Chain of Custody (COC) forms
   - Sharpies (permanent pen)

B. Shipping to Richland, WA
   - Cooler (hard sided, not styrofoam)
   - 4 large blue ice blocks, frozen or enough ice to cover all the bags of samplers
   - Duct tape
   - FedEx mailing labels
   - Chain of custody form (Attachment 1)
   - 1 zip lock bag for chain of custody form
   - Hester-Dendy samplers in bags
VII. Methods

A. Collection of Hester-Dendy (HD) Samplers

1. HD samplers were placed only in the sediment pond. The samplers were deployed on April 5 2005 (see Attachment 2).
2. To find a HD sampler, locate a tee-post in the pond. The tee-posts are located just beyond the emergent vegetation and along a submerged edge in the pond. A rope from the tee-post leads to the submerged cinder block holding the HD sampler.
3. Pre-label the bag that will hold the samplers. The label should include: date of collection, description of sampler location, and sample identification number. Sampler location should relate to the location in the pond, e.g., near inlet near outlet and north end. The sample identification number is SPR1AHD (Inlet) for the first sampler, SPR2AHD (north end) and SPR3AHD (outlet end) are for the second and third sampler, respectively.
4. Using side cutters, clip the pull tie holding the HD sampler to the cinder block. This can be done by removing the cinder block from the water with the sampler attached, or by clipping the cable ties under water.
5. Hold the sampler by the screw mount, not the plates, and put HD sampler in a plastic bag or zip lock bag. If gloves are available, then the sampler should be handled with gloves.
6. Add water from the pond to cover half of the sampler (when in horizontal position). Remove air from bag. Seal the bag. Place into second bag (does not need to be labeled) and seal that bag.
7. Store bags with samplers in cooler with blue ice blocks or ice cubes. Fill in Chain of Custody form (see Attachment 1).
8. Repeat collection of the remaining HD samplers.
9. All samples should be stored at 4°C or less. Overnight storage of a samplers may be in a refrigerator. Sample should be cooled and maintained at a temperature of 4°C or less.

B. Field Blanks

1. Field blanks are used to verify that the sample collection and handling process has not affected the quality of the samples. They are used to measure the cleanliness of sampling equipment.
2. Field blanks will be prepared during collection of the macroinvertebrates from samplers back in Richland, WA.

C. Shipping samples to Richland, WA for collection of macroinvertebrates

1. Samples need to be maintained at 4°C or colder for transport to Richland. Use either frozen blue ice blocks or ice cubes.
2. Place Chain of custody form in zip lock bag for protection.
3. Seal cooler with duct tape. If cooler has a drain port, put duct tape over port to prevent accidental opening during shipment.
4. Ship cooler with chain of custody form overnight via FedEx or UPS to Richland, WA.
5. Address for shipping overnight to Richland is:
   Battelle for the USDOE
   790 6th Street
   Richland, WA 99354
   Attn: Robert Mueller / SIGMA5 / 2623
   (509) 372-1344

Figure 3: These pictures show the sediment pond (a) when the water level was too high to retrieve the HD samplers on May 24, 2005 (as compared to Figure 2 b) and the sediment associated with the HD sampler (b) after the sampler was received in Richland, WA on June 23, 2005.
## Appendix 3: Macroinvertebrates Collected at MMTS in 2005 by Habitat, Feeding Style and Diet

<table>
<thead>
<tr>
<th>Macroinvertebrate</th>
<th>Habitat</th>
<th>Feeding style and diet</th>
</tr>
</thead>
</table>
| **Order: Odonata** | Surface water—  
Family: Zygoteera  
Common name: damselflies | Damselfly nymphs are engulfer predators (eating whole body). They begin life eating zooplankton, and, as they grow, the size of their prey grows. Smaller invertebrates of all eating styles comprise most of their diet. |
| **Order: Odonata** | Surface water—  
Family: Anisoptera  
Common name: dragonflies | Dragonfly nymphs are also engulfer predators, consuming the whole body of their prey. They begin eating very small prey and progress to larger prey, such as small fish, frogs and tadpoles. Their food could be organisms from any aquatic environment. |
| **Order: Hemiptera** | Surface water—  
Family: Notonectidae  
Common name: back swimmers | Back swimmers are piercer predators—they pierce their prey, inject enzymes to liquefy the contents and suck the fluid out. They eat aquatic insects, crustaceans, and snails as well as small vertebrates such as fish fry and tadpoles. |
| **Order: Trichoptera** | Mostly surface water—  
Common name: Caddisflies* | Most Caddisfly larvae are true omnivores, eating plant material and other macroinvertebrates, even other caddisfly larvae. They feed on dead or decaying matter, gather or collect organisms from the water column, scrape them from the aquatic surfaces, and some either engulf or pierce prey. |
| **Order: Ephemeroptera** | Surface water—  
Common name: Mayflies | Most mayflies are collector-gatherers or scrapers. This is a primary consumer role—plant-eating or micro-phyto-organisms. There is a rare species that are engulfer-predators eating mostly Chironomids—sediment dwellers. |
<table>
<thead>
<tr>
<th>Macroinvertebrate</th>
<th>Habitat</th>
<th>Feeding style and diet</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Order: Gastropoda</strong>&lt;br&gt;referred to as: gastropods&lt;br&gt;Common name: snails</td>
<td>Surface water dwelling—Aquatic snails live on rocks, sand, mud, vegetation, and plant detritus for their entire life.</td>
<td>Most snails are scrapers—primary consumers and detritus feeders. Some gather or sieve food from the water column, some shred plant or dead material from the bottom, and some are scavengers.</td>
</tr>
<tr>
<td><strong>Order: Coleoptera</strong>&lt;br&gt;Common name: beetles</td>
<td>Surface Water—Larvae and adults share the same habitat. They live in a variety of areas in the water—surface, just under the surface, on the bottom, in the detritus.</td>
<td>Beetles fill all the major feeding types; most are predators (engulfers and piercers).</td>
</tr>
<tr>
<td><strong>Order: Amphipoda</strong>&lt;br&gt;Order:: Malacostraca&lt;br&gt;Common name: scuds</td>
<td>Surface water—Scuds are totally aquatic. Scuds live on and near the the bottom and swim just above the substrates.</td>
<td>Scuds are omnivorous, eating mostly plant and other primary producer matter and detritus. They readily engulf dead organisms, and rarely have been known to capture live prey.</td>
</tr>
<tr>
<td><strong>Order: Diptera</strong>&lt;br&gt;Family: Chironomidae&lt;br&gt;Referred to as: diptera&lt;br&gt;Common name: midges</td>
<td>Sediment dwellers—Aquatic for three weeks to 3 months The most common chironomid larva live in soft sediment and detritus.</td>
<td>Midge larvae eat organic components of the sediments most of them live in. They swallow everything and digest what is useful to them, expelling the indigestible sediment.</td>
</tr>
<tr>
<td><strong>Class: Oligochaeta</strong>&lt;br&gt;Common name: earthworms</td>
<td>Sediment—Aquatic earthworms are totally aquatic. Aquatic earthworms are burrowers</td>
<td>Most aquatic earthworms are collector-gatherers, eating mud and organics as they burrow and expelling indigestible components.</td>
</tr>
<tr>
<td><strong>Order: Decapoda</strong>&lt;br&gt;Common name: crayfish</td>
<td>Surface water—Crayfish live two to eight years and are totally aquatic. They hide under rocks and debris at the bottom of the water or within aquatic plants.</td>
<td>Crayfish belong in various feeding groups depending on their family, genus and species, but their main diet is decaying plant material. They will feed on other macroinvertebrates, small fish and fish eggs.</td>
</tr>
</tbody>
</table>