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ENGINEERING EVALUATION/COST ANALYSIS (EE/CA) REPORT

KANAWHA RIVER
NITRO, WEST VIRGINIA

APPENDICES – VOLUME 2 OF 2

FEBRUARY 27, 2015
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APPENDIX A

CSTAG CORRESPONDENCE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Signed May 14, 2004

MEMORANDUM

SUBJECT: CSTAG Recommendations on the Kanawha River, WV Contaminated Sediment Site

FROM: Stephen J. Ells **/s/ Stephen J. Ells**
John C. Meyer, Co-chairs **/s/ John C. Meyer**
Contaminated Sediments Technical Advisory Group (CSTAG)

TO: Dennis Matlock, On-scene Coordinator
Randy Sturgeon, Remedial Project Manager
Region 3

Background

OSWER Directive 9285.6-08, *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites* (February 12, 2002), established the Contaminated Sediments Technical Advisory Group (CSTAG) as a technical advisory group to "monitor the progress of and provide advice regarding a small number of large, complex, or controversial contaminated sediment Superfund sites." The main purpose of the CSTAG is to help Regional site project managers of selected large, complex, or controversial sediment sites appropriately manage their sites throughout the Superfund process in accordance with the eleven risk management principles set forth in the OSWER Directive. CSTAG membership consists of one representative per Region, two from the Office of Research and Development, and two from the Office of Superfund Remediation and Technology Innovation.

Brief Description of the Site

In March 2004, EPA, Monsanto and Pharmacia entered into an Administrative Order on Consent to conduct an Engineering Evaluation/Cost Analysis (EE/CA) to study dioxin-contaminated sediment in the Kanawha River. The EE/CA Order requires Monsanto to characterize the nature and extent of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD, a form of dioxin) contamination in the Kanawha River Site as a result of contaminant releases from the now-defunct Flexsys America L.P. plant in Nitro, West Virginia. The purpose of the EE/CA is to evaluate response alternatives that would protect public health, welfare, and the environment and to provide sufficient information for EPA to determine the necessity, feasibility, and efficacy of particular non-time critical removal actions.

The study area covers approximately 14 miles of the Kanawha River from the confluence of the Coal and Kanawha Rivers to the Winfield lock and dam. Although TCDD contamination extends beyond the Winfield dam, the CSTAG focused its review on the study area as this is also believed to be the area of greatest TCDD contamination in the river. EPA Region 3 believes that the Flexsys plant, which is located in this area, is the predominant source of TCDD to the river. The plant, previously owned by Monsanto, was used to produce the herbicide 2,4,5-trichlorophenoxyacetic acid (2,4,5-T). 2,4,5-T was made from 2,4,5-trichlorophenol (also made by Monsanto). TCDD is formed as a by-product in the production of trichlorophenol and ends up in the 2,4,5-T.

The Kanawha River, the Pocatalico River and Armour Creek (tributaries to the Kanawha River) were placed on the State of West Virginia's 303(d) list of water quality impaired bodies because of TCDD contamination, and a Total Maximum Daily Load (TMDL) was completed in September 2000. The applicable standards included in the TMDL specify that the maximum allowable concentration of TCDD should not exceed 0.014 pg/L in the Kanawha River, and 0.013 pg/L in the Pocatalico River and Armour Creek.

Based on fish tissue samples collected in October 1985, the State of West Virginia issued an advisory not to consume fish collected from the Kanawha River between the Coal and Ohio Rivers. The current advisory extends from the from the I-64 bridge at Dunbar (at or near the downstream end of the former Monsanto plant) to the Ohio River and includes the lower two miles of the Pocatalico River and of the Armour, Heizer and Manilla Creeks. The advisory is a "do not eat" advisory for carp, catfish, suckers, and hybrid striped bass. In addition, there is a one meal/month limit on all other species.

EPA Region 3 believes that the most expedient way to begin addressing the sediment contamination is to conduct a non-time critical removal action. Sampling to date shows areas at and downstream of the former Monsanto plant that have elevated levels of TCDD and areas that appear to be relatively clean. EPA Region 3 believes that by addressing the hotspots, it can significantly reduce the average sediment dioxin concentration and thereby reduce the fish tissue levels of dioxin.

The CSTAG visited the site and met with the site team on April 21 and 22, 2004. The West Virginia Department of Environmental Protection attended much of the meeting. Four of the invited stakeholders made presentations to the CSTAG. The four presenters included the Monsanto Company, the West Virginia Bureau of Public Health (WVBPH), the Heizer/Manilla Watershed Organization, and the West Virginia River Coalition.

CSTAG Recommendations

Based upon the site visit, the review of the site information provided to us, and the presentations made by the stakeholders, the CSTAG offers the following recommendations in order that the OSC can more fully address the 11 principles. The CSTAG expects that the OSC will consider these recommendations as the investigations continue, as the conceptual site model is refined, and as response alternatives are developed and evaluated. The CSTAG recognizes that the project has just begun and appreciates the opportunity to provide recommendations this early in the process.

Principle #1, Control Sources Early

- In order to better understand, track, and communicate about the numerous potential sources of dioxin contamination to the study area, develop a comprehensive map of the potential sources of contamination, including documentation of various historical aliases for each source area.
- Document existing dioxin inputs from surface water and sediment from tributaries (*e.g.*, Pocatalico River, Heizer Creek, and the Manilla Creek).
- Make an additional effort to evaluate, at least qualitatively, the relative contribution of contaminant releases from each major upland/on-shore source to sediment and surface water in the study area. Develop a prioritization scheme in order to identify and classify the largest contaminant contributions and the most significant transport pathways (*e.g.,* groundwater, bank erosion, overland flow, *etc.*). This information could be used to prioritize any upland source studies and control actions and to phase any in-river actions that may be warranted.
- In order to evaluate the extent to which in-place sediment contamination is a "source", design the EE/CA study to be able to determine the relative contributions to the water column and fish contamination from on-going sources compared to in-place sediment. Although the TMDL study concluded that, within the study area, the in-place sediment was not a source of water column contamination because the total suspended solid (TSS) load remained constant, resuspension of sediments can still be occurring.
- Coordinate with the NPDES program to ensure that point sources to the Kanawha River (*e.g.*, Fike pretreatment outfall, Dana/Kincaid outfall, Poca WWTP, stormwater discharges) contain dioxin limits in the NPDES permits where appropriate.
- Coordinate with the RCRA program on the Flexsys cleanup with respect to river inputs. Discuss whether any early actions to address inputs to the river are appropriate (*e.g.*, sheetpiling along the river bank, hydraulic containment of groundwater).

Principle #2, Involve the Community Early and Often

- Develop a comprehensive community involvement program that encompasses all of the on-going EPA investigation and cleanup efforts in the valley. Discuss with the State whether a joint EPA/State community involvement program would be appropriate.
- Work with the community to determine whether there is interest in creating a valley-wide community advisory group.
- Consider using a variety of ways to communicate site information to the public (*e.g.*, local public television station, internet, periodic stakeholder meetings).

Principle #3, Coordinate with States, Local Governments, Tribes, and Natural Resource Trustees

- Work with ATSDR/WVBPH to clarify their plans for and the objectives of any health consultations for the site.
- Work with the WVBPH to evaluate the most effective placement of fish consumption advisory signs to reach potential fish consumers. Evaluate whether posting additional signs upstream of the study area is warranted, especially at boat ramps where fishers may enter the river and then travel to the area covered by the advisory.
- Discuss with West Virginia's fish consumption advisory committee the consumption rates used to develop the State's fishing advisory. Consider undertaking a creel survey (fish consumption survey) to determine the effectiveness of the fish consumption

advisory and to garner information about consumption rates, species, and cooking preparation methods.

- Coordinate with the agencies that issue dredging permits to ensure that environmental impacts caused by the resuspension of dioxin-contaminated sediments are fully evaluated before any proposed dredging. Request notification from such agencies for any activities proposed within the study area.
- Check with local universities to determine whether additional data exist to refine the conceptual site model (CSM) (*e.g.*, dioxin data in various media, other COCs, documentation of adverse impacts to biota, information on resident species that might be useful for long-term monitoring).
- Coordinate with the Corps of Engineers to discuss whether sediment management activities for the Winfield dam contribute to dioxin transport beyond the study area. If so, discuss potential modifications in order to minimize any transport.

<u>Principle #4, Develop and Refine a Conceptual Site Model that Considers Sediment Stability</u>

- Evaluate the stability of the surficial sediments in the River using, as proposed, the *in situ* inverted flume developed by Ravens and Gschwend (1999). However, since this device only measures the shear stress required to initiate surficial bed sediment movement, this device cannot be used to characterize the erosion potential of sediment (*i.e.*, critical shear stress and resuspension rate) with depth. CSTAG recommends that the USACE's Sedflume be used, in addition to the *in situ* inverted flume, for this purpose.
- Develop a screening level ecological risk assessment in order to evaluate the protectiveness, in regard to ecological receptors, of any potential response action and the associated cleanup goals.
- Evaluate grain size distribution in the surface sediments (*i.e.*, top three inches) within the river to help guide location of the sediment stability studies and chemistry samples.
- Identify the screening criteria used to determine that other human health exposure pathways do not need to be quantified (*e.g.*, dermal contact with surface water).
- Develop a pictorial CSM that shows such things as inputs and exports of dioxin from the study area, fate and transport mechanisms, and exposure pathways. Use this CSM to help refine the goals of this study and to identify data gaps to help guide the data collection activities.
- To predict the lateral variations in flow velocities and the associated bed shear stresses, consider using a two-dimensional, depth-averaged or a three-dimensional (3D) hydrodynamic model rather than the one-dimensional HEC2 model. Even though the Kanawha River is most likely not vertically stratified, a 3D model would be able to simulate the secondary circulation that develops around bends, whereas a 1D or 2D model could not.

<u>Principle #5, Use an Iterative Approach in a Risk-Based Framework</u>

- When developing cleanup alternatives for the study area, evaluate phasing of cleanup actions in order to minimize recontamination of downstream areas.
- Evaluate whether the study area will be recontaminated from source areas upstream of the study area.

Principle #6, Carefully Evaluate the Assumptions and Uncertainties Associated with Site Characterization Data and Site Models

- Adopt a consistent approach in presenting dioxin data (*e.g.*, ppt TCDD, TEQ).
- Consider what approach (*e.g.*, BSAF, mathematical food chain models) will be used to link surface water/sediment chemistry with fish tissue concentrations. Different approaches require different kinds of data which could affect the proposed activities in the work plan.
- In evaluating the water column sample collection activities, consider data needs for both exposure assessment and contaminant transport (*e.g.*, nearshore and cross-sectional).
- Do not assume that dioxin concentrations are low in coarse grained areas. The coal fines in the shipping channel can absorb dioxin, (note that dioxin absorbed to coal may not be bioavailable, but could still contribute to water quality standard exceedances). The work plan should include several samples in channel areas to evaluate this possibility.
- Explain the rationale behind the proposed number of fish and sediment samples to establish baseline conditions or trends. Consider conducting a statistical analysis to determine the appropriate number of samples needed to establish temporal and spatial trends. Consider whether sufficient samples are planned to relate sediment concentrations to fish tissue concentrations for establishing action levels.
- Consider sampling fish species with small home ranges when establishing food chain models or developing BSAFs in order to reduce uncertainty as to the amount of dioxin uptake. Co-located sediment, fish tissue, and surface water quality samples within the estimated home range would also be helpful in establishing a link between sediment and fish tissue dioxin concentrations.
- Ensure that bathymetry and shoreline mapping are based on consistent fixed survey points.
- Since the proposed sampling program calls for widely spaced samples, consider better defining the localized variability in sediment dioxin concentrations by using several high density sampling areas.

Principle #7, Select Site-specific, Project-specific, and Sediment-specific Risk Management Approaches that will Achieve Risk-based Goals

- Establish a clear, risk-related objective(s) for the response action, *e.g.* to reduce risks from fish consumption in the study area and/or to reduce risks to downstream areas (including the Ohio River) by reducing the TCDD loading to those areas from the study area.

Principle #8, Ensure that Sediment Cleanup Levels are Clearly Tied to Risk Management Goals

- Prior to selecting a response action, clearly understand the relationship between the range of sediment clean-up goals and the human health and/or ecological assessment endpoints that are driving the need for a response. Any decision document (*e.g.*, action memorandum) should clearly explain the relationship between the final sediment cleanup levels and residual contaminant concentrations and the risk-based goals (*e.g.*, reduced fish tissue concentrations).

Principle #9, Maximize the Effectiveness of Institutional Controls and Recognize their Limitations

- Consider working with WVBPH to provide greater public outreach to improve awareness of and compliance with fish consumption advisories (*e.g.*, public education programs, brochures, postings in bait/tackle shops, fishing license proprietors)

Principle #10, Design Remedies to Minimize Short-term Risks while Achieving Long-term Protection The CSTAG will evaluate consistency with this principle later in the process.

Principle #11, Monitor During and After Sediment Remediation to Assess and Document Remedy Effectiveness The CSTAG will evaluate consistency with this principle later in the process.

Regional Response

Please send us a short written response to these recommendations within 60 days. If you have any questions or would like a clarification to any of these recommendations please call one of us (Steve Ells at 703.603.8822 or John Meyer at 214.665.6742).

cc: Abraham Ferdas, Region 3
Fran Burns, Region 3
Michael Cook, OSRTI
Elizabeth Southerland, OSRTI
David Lopez, OSRTI
JoAnn Griffith, OSRTI

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Wheeling Field Office
Wheeling, West Virginia 26003

October 8, 2004

MEMORANDUM

SUBJECT: Region III Response to CSTAG Recommendations on the Kanawha River, WV Contaminated Sediment Site

FROM: Dennis Matlock, On-Scene Coordinator
EPA Region 3

TO: Stephen J. Ells (EPA Headquarters) and John C. Meyer (EPA Region 6)
Co-Chairs, Contaminated Sediments Technical Advisory Group (CSTAG)

Background

We appreciate the opportunity to work with the Contaminated Sediments Technical Advisory Group (CSTAG) on the Kanawha River Site and for the comments and recommendations CSTAG provided to assist the project team in incorporating EPA's eleven management principles for contaminated sediment sites. We look forward to further discussion with the CSTAG as our project progresses. Our responses to CSTAG's recommendations are provided below.

Brief Description of the Site

In March 2004, EPA, Monsanto and Pharmacia entered into an Administrative Order on Consent to conduct an Environmental Evaluation/Cost Analysis (EE/CA) to study dioxin-contaminated sediment in the Kanawha River. The EE/CA Order requires Monsanto to characterize the nature and extent of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD, a form of dioxin) contamination in the Kanawha River Site as a result of contaminant releases from the now-defunct Flexsys America L.P. plant in Nitro, West Virginia. The purpose of the EE/CA is to evaluate response alternatives that would protect public health, welfare, and the environment and to provide sufficient information for EPA to determine the necessity, feasibility, and efficacy of particular non-time critical removal actions.

The study area covers approximately 14 miles of the Kanawha River from the confluence of the Coal and Kanawha Rivers to the Winfield lock and dam. Although TCDD contamination extends beyond the Winfield dam, the CSTAG focused its review on the study area as this is also believed to be the area of greatest TCDD contamination in the river. EPA Region III believes that the Flexsys/Solutia plant, which is located in this area, is the predominant source of TCDD to the river. The plant, previously owned by Monsanto, was used to produce the herbicide 2,4,5-trichlorophenoxyacetic acid (2,4,5-T). 2,4,5-T was made from 2,4,5-trichlorophenol (also produced by Monsanto). TCDD is formed as a by-product in the production of trichlorophenol and ends up in the 2,4,5-T.

Response to CSTAG Recommendations

The CSTAG provided the following recommendations to help the OSC more fully address the eleven principles. The recommendations were based upon a site visit, the review of the site information provided to CSTAG by the project team and the presentations made by several stakeholders. Below are the Region's responses to the recommendations. In addition, the OSC will continue to consider, as appropriate, these recommendations as the investigation continues, as the conceptual site model is refined and as response alternatives are developed and evaluated.

Principle #1, Control Sources Early

Recommendation: In order to better understand, track, and communicate about the numerous potential sources of dioxin contamination to the study area, develop a comprehensive map of the potential sources of contamination, including documentation of various historical aliases for each source area.
Response: We agree that tracking and communication of information related to potential sources between the various State and Federal source control programs will be a key element in the development of an overall cleanup strategy for the Kanawha River. As part of the draft EE/CA work Plan, Monsanto has prepared an initial draft map summarizing potential sources of dioxin contamination within the regional watershed, as identified from prior investigations. This map will continue to be updated as new information is obtained by EPA, the WVDEP and Monsanto, and will be included in the EE/CA Report and included in the GIS-based mapping for the Site.

Recommendation: Document existing dioxin inputs from surface water and sediment from tributaries (*e.g.*, Pocatalico River, Heizer Creek, and the Manilla Creek).
Response: Previous sampling completed by EPA, WVDEP, and the Ohio River Sanitation Commission (ORSANCO), and flow modeling completed by the U.S. Army Corps of Engineers (USACE) partially characterized dioxin inputs from regional tributaries, including the Pocatalico River and Armour Creek. The initial Conceptual Site Model (CSM) developed in the draft EE/CA Work Plan presented a loading analysis updated with recent data, including an analysis of available sediment sampling data. EPA has approved EE/CA surface water sampling activities in the Kanawha River at locations upstream and downstream of the project study area and at two locations within the study area (at the former Monsanto facility and near Guarno Creek which is downstream of Armour and Pocatalico Creek). This information, plus future sediment stability tests and river modeling will help provide an overall mass balance of the dioxin transport in the study area. The need to conduct specific sampling in, for example, the Pocatalico and/or Armour Creek areas will be evaluated in light of the results of the currently approved sampling event.

Recommendation: Make an additional effort to evaluate, at least qualitatively, the relative contribution of contaminant releases from each major upland/on-shore source to sediment and surface water in the study area. Develop a prioritization scheme in order to identify and classify the largest contaminant contributions and the most significant transport pathways (*e.g.,* groundwater, bank erosion, overland flow, *etc.*). This information could be used to prioritize any upland source studies and control actions and to phase any in-river early actions that may be warranted.
Response: All information that EPA, WVDEP and Monsanto has obtained or will obtain regarding potential sources will be utilized to evaluate dioxin contributions to the river. The CSM will be updated after each major data collection activity to incorporate the new data. At

that time, data from other sources can also be incorporated. As part of each update, the predominate sources of dioxin will be highlighted such that EPA can evaluate opportunities for early source control. The initial CSM developed in the draft EE/CA Work Plan theorized that two greatest sources of dioxin in the water column were ground water discharge from the former Monsanto facility and sediment resuspension due to coal dredging (which has ceased).

Recommendation: In order to evaluate the extent to which in-place sediment contamination is a "source", design the EE/CA study to be able to determine the relative contributions to the water column and fish contamination from on-going sources compared to in-place sediment. Although the TMDL study concluded that, within the study area, the in-place sediment was not a source of water column contamination because the total suspended solid (TSS) load remained constant, resuspension of sediments can still be occurring.
Response: Data from co-located surface water, sediment, and fish tissue data will be used to evaluate the relative contributions to fish contamination. In addition, the EE/CA Work Plan includes plans for a detailed evaluation of potential sediment-related releases of dioxin to the water column, including characterization of resuspension processes using a range of sediment transport analysis methods (e.g., hydrodynamic analysis, sediment stability testing, radioisotope analysis, and sediment trap deployment). This study, plus the rest of the dioxin mass balance evaluation will help EPA determine the surface water loading from on-going sources versus in-place sediment.

Recommendation: Coordinate with the NPDES program to ensure that point sources to the Kanawha River (*e.g.*, Fike pretreatment outfall, Dana/Kincaid outfall, Poca WWTP, stormwater discharges) contain dioxin limits in the NPDES permits where appropriate.
Response: We agree that coordinating with the State and Federal NPDES' programs is important to minimize any on-going dioxin inputs to the river. The project team will contact these programs to discuss such items as dioxin permit limits (if they exist), the necessity of dioxin permit limits, detection of any testing, loading calculations, etc. Any historical data obtained will be used to help refine the CSM.

Recommendation: Coordinate with the RCRA program on the Flexsys cleanup with respect to river inputs. Discuss whether any early actions to address inputs to the river are appropriate (*e.g.*, sheetpiling along the river bank, hydraulic containment of groundwater).
Response: The project team has had a number of discussions over the past several years with the RCRA program and agrees that coordination of the EE/CA and any subsequent cleanup activities with the activities at the Flexsys America L.P. site under the RCRA Corrective Action program is important.

<u>Principle #2, Involve the Community Early and Often</u>

Recommendation: Develop a comprehensive community involvement program that encompasses all of the on-going EPA investigation and cleanup efforts in the valley. Discuss with the State whether a joint EPA/State community involvement program would be appropriate.
Response: The project team has begun developing a Community Relations Plan for the project. The team will discuss the plan with the State and discuss whether or not a joint program would be appropriate. The team will also discuss with the RCRA program whether or not the communication activities of the EE/CA and the Corrective Action project at the former Monsanto facility should be combined.

Recommendation: Work with the community to determine whether there is interest in creating a valley-wide community advisory group.
Response: The Region will discuss this issue with the community.

Recommendation: Consider using a variety of ways to communicate site information to the public (*e.g.*, local public television station, internet, periodic stakeholder meetings).
Response: The Region is in the process of developing a Community Involvement Program and will consider various methods of communication.

<u>Principle #3, Coordinate with States, Local Governments, Tribes, and Natural Resource Trustees</u>

Recommendation: Work with ATSDR/WVBPH to clarify their plans for and the objectives of any health consultations for the site.
Response: EPA will continue to work with ATSDR and WV Bureau of Public Health. ATSDR/WVBPH plan to conduct several reviews during 2005. One involves the review of sediment and surface water data (scheduled for late spring/early summer) and the other involves reviewing recreation use of the river (scheduled for middle to late summer).

Recommendation: Work with the WVBPH to evaluate the most effective placement of fish consumption advisory signs to reach potential fish consumers. Evaluate whether posting additional signs upstream of the study area is warranted, especially at boat ramps where fishers may enter the river and then travel to the area covered by the advisory.
Response: The Region has already installed numerous signs along the Kanawha River. EPA will continue to coordinate with WVBPH regarding additional sign placements.

Recommendation: Discuss with West Virginia's fish consumption advisory committee the consumption rates used to develop the State's fishing advisory. Consider undertaking a creel survey (fish consumption survey) to determine the effectiveness of the fish consumption advisory and to garner information about consumption rates, species, and cooking preparation methods.
Response: Since the main goal of the EE/CA is to evaluate cleanup options to reduce fish tissue concentrations, the Region does not believe that a creel study is appropriate at this time. The Region may reconsider this issue if it becomes apparent that such a study would benefit the project.

Recommendation: Coordinate with the agencies that issue dredging permits to ensure that environmental impacts caused by the resuspension of dioxin-contaminated sediments are fully evaluated before any proposed dredging. Request notification from such agencies for any activities proposed within the study area.
Response: We agree that close coordination between the various State and Federal regulatory agencies is needed to ensure that any future dredging projects in the area appropriately minimize environmental impacts of such actions. The project team will begin this coordination by obtaining a point of contact in both the State and the USACE in regard to dredging activities in this area.

Recommendation: Check with local universities to determine whether additional data exist to refine the conceptual site model (CSM) (*e.g.*, dioxin data in various media, other COCs, documentation of adverse impacts to biota, information on resident species that might be useful for long-term monitoring).
Response: Significant efforts have been made to obtain as much data as possible for the Site. Monsanto will contact local universities, such as the University of Charleston, to determine the status of any historical and/or on-going research or studies.

Recommendation: Coordinate with the Corps of Engineers to discuss whether sediment management activities for the Winfield dam contribute to dioxin transport beyond the study area. If so, discuss potential modifications in order to minimize any transport.

Response: In developing the draft EE/CA Work Plan, Monsanto performed an initial review of USACE's past sediment management actions, including localized dredging in the Winfield Dam area. If, as the CSM is further refined, it becomes apparent that changes in the USACE's sediment management strategy would help reduce dioxin transport beyond the Winfield Dam, the project team will discuss appropriate options with the USACE. The need for future modifications to the USACE's sediment management actions should be further assessed as part of the EE/CA.

<u>Principle #4, Develop and Refine a Conceptual Site Model that Considers Sediment Stability</u>

Recommendation: Evaluate the stability of the surficial sediments in the river using, as proposed, the *in situ* inverted flume developed by Ravens and Gschwend (1999). However, since this device only measures the shear stress required to initiate surficial bed sediment movement, this device cannot be used to characterize the erosion potential of sediment (*i.e.*, critical shear stress and resuspension rate) with depth. CSTAG recommends that the USACE's Sedflume be used, in addition to the *in situ* inverted flume, for this purpose.
Response: The Region agrees that the Ravens flume will only measure shear stress required to initiate surficial bed sediment movement. The need for SEDFLUME tests will be evaluated once the Ravens flume data is interpreted in concert with bottom shear stresses computed from modeling efforts (i.e., if the model shows stresses that will initiate surficial bed sediment movement, SEDFLUME testing will be conducted).

Recommendation: Develop a screening level ecological risk assessment in order to evaluate the protectiveness, in regard to ecological receptors, of any potential response action and the associated cleanup goals.
Response: A screening level ecological risk assessment will be conducted using both historical data and data collected as part of the EE/CA.

Recommendation: Evaluate grain size distribution in the surface sediments (*i.e.*, top three inches) within the river to help guide location of the sediment stability studies and chemistry samples.
Response: The EE/CA Work Plan includes an initial (Phase I) bathymetric and geophysical survey task that will map sediment bed properties, including surface features and general surface grain size distributions. As part of this activity, sediment samples (0-4 inches) will be collected for grain size analysis to support interpretation of the data. This data will allow grain size distributions of surficial sediments to be determined and mapped. The results of this Phase I evaluation will assist in the scope of Phase II sediment stability studies and chemical characterization tasks.

Recommendation: Identify the screening criteria used to determine if other human health exposure pathways need to be quantified (*e.g.*, dermal contact with surface water).
Response: Based on our knowledge of the site and the bioaccumulative characteristics of dioxin, the Region believes that fish consumption is by far the greatest risk driver at this site. As a result, the EE/CA is focused on this pathway. If additional data points to other significant pathways that would not be concurrently addressed along with the fish consumption pathway, the Region will evaluate whether or not changes in the scope of the study at the site are necessary.

Recommendation: Develop a pictorial CSM that shows such things as inputs and exports of dioxin from the study area, fate and transport mechanisms, and exposure pathways. Use this CSM to help refine the goals of this study and to identify data gaps to help guide the data collection activities.

Response: As part of the next revision to the CSM that will incorporate the data collected this fall, a pictorial section will be added to help summarize inputs and outputs of dioxin from the study area, as well as key fate and transport mechanisms and exposure pathways. Inputs will include both point and non-point sources identified during implementation of the study.

Recommendation: To predict the lateral variations in flow velocities and the associated bed shear stresses, consider using a two-dimensional, depth-averaged or a three-dimensional (3D) hydrodynamic model rather than the one-dimensional HEC2 model. Even though the Kanawha River is most likely not vertically stratified, a 3D model would be able to simulate the secondary circulation that develops around bends, whereas a 1D or 2D model could not.
Response: The Region and Monsanto have had several preliminary discussions regarding the type of modeling effort required for the EE/CA. The Region understands that the one-dimensional model likely is not sophisticated enough to answer the questions necessary for the project and will take this into account once the detailed plans for the model are being developed and reviewed.

Principle #5, Use an Iterative Approach in a Risk-Based Framework

Recommendation: When developing cleanup alternatives for the study area, evaluate phasing of cleanup actions in order to minimize re-contamination of downstream areas.
Response: The Region will evaluate phasing of cleanup actions in order to minimize re-contamination of downstream areas.

Recommendation: Evaluate whether the study area will be re-contaminated from source areas upstream of the study area.
Response: As part the evaluation of cleanup criteria and cleanup options, the potential for re-contamination from sources upstream of the study area will be evaluated.

Principle #6, Carefully Evaluate the Assumptions and Uncertainties Associated with Site Characterization Data and Site Models

Recommendation: Adopt a consistent approach in presenting dioxin data (*e.g.*, ppt TCDD, TEQ).
Response: Efforts will be made to report dioxin data in consistent units to allow for easier comparison of data. Also, the identity of the data will be clearly presented (e.g., just 2,3,7,8 -tetrachlorodibenzo-p-dioxin [2,3,7,8,-TCDD] or a Toxicity Equivalence [TEQ] value).

Recommendation: Consider what approach (*e.g.*, BSAF, mathematical food chain models) will be used to link surface water/sediment chemistry with fish tissue concentrations. Different approaches require different kinds of data which could affect the proposed activities in the work plan.
Response: The BSAF approach is being used to link sediment chemistry with fish tissue concentrations.

Recommendation: In evaluating the water column sample collection activities, consider data needs for both exposure assessment and contaminant transport (*e.g.*, near shore and cross-sectional).
Response: Surface water sampling will be completed utilizing a flow weighted compositing approach to provide data at each sample location representative of the water quality throughout the river cross-section. Further interpretation of water column concentrations at specific locations will be evaluated with the aid of modeling tools.

Recommendation: Do not assume that dioxin concentrations are low in coarse grained areas. The coal fines in the shipping channel can absorb dioxin, (note that dioxin absorbed to coal may not be bioavailable, but could still contribute to water quality standard exceedances). The work plan should include several samples in channel areas to evaluate this possibility.
Response: The Region agrees the that coal fines can absorb dioxin. Several sediment surface samples will be collected in relatively coarse-grained areas that may also have coal fines to further characterize dioxin concentrations in the river.

Recommendation: Explain the rationale behind the proposed number of fish and sediment samples to establish baseline conditions or trends. Consider conducting a statistical analysis to determine the appropriate number of samples needed to establish temporal and spatial trends. Consider whether sufficient samples are planned to relate sediment concentrations to fish tissue concentrations for establishing action levels.
Response: The fish sampling program has been substantially revised compared to the first draft of the EE/CA work plan that was discussed with the CSTAG. A statistical approach to determining the number of fish to be collected (both number of composites and the number of fish per composite) has been used. Additionally, the home range of each species has been factored into the placement of the sampling locations. As part of this fall's sampling event, sediment samples are being collected to help evaluate the local variability of the dioxin levels.

Recommendation: Consider sampling fish species with small home ranges when establishing food chain models or developing BSAFs in order to reduce uncertainty as to the amount of dioxin uptake. Co-located sediment, fish tissue, and surface water quality samples within the estimated home range would also be helpful in establishing a link between sediment and fish tissue dioxin concentrations.
Response: In addition to the collection of catfish and bass, fish with small home ranges (such as juvenile white and redhorse suckers and pumpkinseed) are being collected. In addition to reducing uncertainty, these species will respond faster to changes in levels of dioxin in the sediment and surface water allowing trends to be identified at an earlier date. Co-located sediment, fish tissue, and surface water quality samples are being collected.

Recommendation: Ensure that bathymetry and shoreline mapping are based on consistent fixed survey points.
Response: The Region will ensure that bathymetry and shoreline mapping are based on consistent fixed survey points.

Recommendation: Since the proposed sampling program calls for widely spaced samples, consider better defining the localized variability in sediment dioxin concentrations by using several high density sampling areas.
Response: As part of this fall's sampling event, composite sediment samples are being collected at locations where fish are being collected. The Region is sampling some of the individual sediment samples to help evaluate localized variability in sediment dioxin concentrations.

Principle #7, Select Site-specific, Project-specific, and Sediment-specific Risk Management Approaches that will Achieve Risk-based Goals

Recommendation: Establish a clear, risk-related objective(s) for the response action, *e.g.* to reduce risks from fish consumption in the study area and/or to reduce risks to downstream areas (including the Ohio River) by reducing the TCDD loading to those areas from the study area.
Response: The main goal of the EE/CA is to evaluate cleanup options that will reduce the fish tissue levels of dioxin, however other goals, such as reducing TCDD loading from the study area to downstream areas of the Kanawha River and the Ohio River may be evaluated as well.

Principle #8, Ensure that Sediment Cleanup Levels are Clearly Tied to Risk Management Goals

Recommendation: Prior to selecting a response action, clearly understand the relationship between the range of sediment clean-up goals and the human health and/or ecological assessment endpoints that are driving the need for a response. Any decision document (*e.g.*, action memorandum) should clearly explain the relationship between the final sediment cleanup levels and residual contaminant concentrations and the risk-based goals (*e.g.*, reduced fish tissue concentrations).
Response: Data collection activities in the EE/CA are being designed to provide understanding of the relationship between sediment and fish tissue dioxin levels. Any decision document will clearly explain the relationship between the final sediment cleanup levels and residual contaminant concentrations and the risk-based goals (*e.g.*, reduced fish tissue concentrations).

Principle #9, Maximize the Effectiveness of Institutional Controls and Recognize their Limitations

Recommendation: Consider working with WVBPH to provide greater public outreach to improve awareness of and compliance with fish consumption advisories (*e.g.*, public education programs, brochures, postings in bait/tackle shops, fishing license proprietors)
Response: The Region will work with WVBPH and the WVDEP in determining ways to improve public outreach

Principle #10, Design Remedies to Minimize Short-term Risks while Achieving Long-term Protection

Recommendation: The CSTAG will evaluate consistency with this principle later in the process.
Response: N/A

Principle #11, Monitor During and After Sediment Remediation to Assess and Document Remedy Effectiveness

Recommendation: The CSTAG will evaluate consistency with this principle later in the process.
Response: N/A

If you have any questions or would like a clarification to any of these recommendations please call one of us (Dennis Matlock at 304.234.0284 or Randy Sturgeon at 215.814.3227).

cc: Fran Burns, Region 3
Randy Sturgeon
Carrie Dietzel
Bruce Pluta
Marc Greenberg
Kathy Patnode

Abe Ferdas
Tom Bass

APPENDIX B

SEDIMENT BATHYMETRY AND GEOPHYSICAL INVESTIGATION REPORT
– GOLDER ASSOCIATES, INC. & KANAWHA RIVER VELOCITY PROFILING
AND DISCHARGE MEASUREMENT REPORT – BLUE COAST SCIENTIFIC, INC.

Golder Associates Inc.

18300 NE Union Hill Road, Suite 200
Redmond, WA USA 98052-3333
Telephone (425) 883-0777
Fax (425) 882-5498
www.golder.com

Golder Associates

December 29, 2004

Our ref: 043-1307

Anchor Environmental, L.L.C.
6650 SW Redwood Lane, Suite 110
Portland, Oregon 97224

Attention: Mr. Todd Thornburg

RE: RESULTS OF THE KANAWHA RIVER GEOPHYSICAL SURVEY

Dear Mr. Thornburg:

This report presents the result of the hydrographic and geophysical survey conducted by Golder Associates Inc. on the Kanawha River, West Virginia from October 21st to October 25th, 2004.

The enclosed document briefly summarizes the instrumentation and field operations, discusses the methods and procedures for data analysis and presents the interpreted results. In addition the results of the bathymetric, sidescan sonar and subbottom profiler interpretations are presented on a series of maps included in a separate bound volume.

Please contact the undersigned if you have any questions regarding this report. We appreciated the opportunity to work with Anchor Environmental on this challenging project.

Sincerely

GOLDER ASSOCIATES INC.

Richard E. Sylwester
Associate/Senior Geophysicist

DS for DA

David Aldrich
Senior Scientist

RES/DA/tp

122904res1.doc

AR100624

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REPORT ON

RESULTS OF THE KANAWHA RIVER GEOPHYSICAL SURVEY

Submitted to:

Anchor Environmental, L.L.C.
6650 SW Redwood Lane, Suite 110
Portland, OR 97224

Submitted by:

Golder Associates Inc.
18300 NE Union Hill Road, Suite 200
Redmond, WA 98052

Distribution:

4 Copies Conestaga-Rovers & Associates
2 Copies - Anchor Environmental, L.L.C.
1 Copy - Golder Associates Inc.

December 29, 2004

043-1307

EXECUTIVE SUMMARY

A comprehensive hydrographic and geophysical survey, using a precision echosounder, subbottom profiler and sidescan sonar, was conducted on the Kanawha River between Winfield Dam and the Coal River (RM 31 to RM 46.6). The objective of the investigation was to obtain data to characterize the riverbed including the river bathymetry, the lateral distribution of bedrock, and the aerial extent and thickness of unconsolidated sediment. The following summarizes the results of this investigation.

- The width of the river channel ranges from approximately 800 to 1200 feet and the water depth of the main channel is approximately 30 feet.
- The steep river banks consist of exposed bedrock on the right bank (east) and bedrock and sediment on the left bank (west). Bedrock is also often exposed on the river floor or mantled with a thin sediment cover (less than 1 foot)
- The unconsolidated sediment is interpreted to consist of fine to medium-grained material. The sediment deposits, which are variable along the river, have a maximum thickness of 6 feet in several areas along the lower slope of the left bank, and 3 to 4 feet thick in discontinuous deposits along the riverbed.
- There are localized zones on the riverbed that could not be penetrated by the acoustic signal. The seismic response of this material is characteristic of sediment containing organic material and/or biogenic gas from the degradation of organic material. The actual nature of these acoustical opaque materials would need to be confirmed by sediment coring or sampling.
- Several pipelines that cross the river and one possible sunken vessel, or very large piece of debris, were detected on the river bed.

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LIST OF FIGURES

LIST OF ATTACHMENTS
(Provided under separate cover)

1.0 PROJECT OBJECTIVE

A bathymetric and geophysical survey was conducted for the purpose of mapping the water depth and riverbed of the Kanawha River, between Winfield Dam (RM 31.1) and the Coal River (RM 46). The specific objective of the subsurface investigation was to characterize the riverbed and map the distribution and thickness of recent sediment deposits. This information will be used by others to interpret river geomorphology with regards to the location of bedrock exposures, and identifying areas affected by scour and erosion and low-energy areas where fine-grained deposits may be accumulating. In addition, these data will be used to assist in selecting sites for sediment sampling in a follow-on phase of investigation.

2.0 FIELD OPERATIONS

2.1 Survey Area

The survey area is located on the Kanawha River between the confluence of the Coal and Kanawha Rivers and Winfield Dam a distance of approximately 14 miles (Figure 1). The approximate width of the river in this area ranges from 800 to 1200 feet with an average maximum water depth of 30 feet. To obtain detailed information on the riverbed and subsurface stratigraphy, a series of transects were run between the river banks spaced at an interval of approximately 200 feet (Sheets 1-22). On many crossings it was not possible to reach the shorelines because of debris, trees and brush growing offshore and shallow water. Four transects were also run parallel to the each shoreline to provide a continuous profile and sidescan sonar image of the shoreline and river banks along the entire length of the survey area.

2.2 Navigation

The position of the survey vessel was determined using a differential global positioning system (DGPS). The navigation data were acquired with a CSI PRO Max, interfaced with Coastal HYPACK navigation software. The shipboard DGPS receiver obtained differentially corrected WGS 84 latitude and longitude values, using the Omnistar satellite, five times per second with sub-meter accuracy.

The position of the survey vessel was displayed in real-time on a color monitor that also provided additional navigation parameters to the helmsman. This enabled piloting the survey vessel along transects that crossed the river perpendicular to the centerline at a 200 foot interval between adjacent transects as well as running four transects parallel to the shoreline.

2.3 Bathymetry

Precision bathymetric data were acquired with an Odom Echotrack 200 kHz precision echosounder. This instrument produced a hard-copy print out and also sent digital depths to the navigation computer where it was archived for post-cruise processing.

Measurements to determine the velocity of sound in the water (bar check) and draft of the transducer were performed each day. This information was used for initial system calibration and also logged in the navigation computer and used during data editing and processing

The Winfield Dam operators were contacted for obtaining pool elevation each day during the survey. Bathymetric data files obtained from the ACOE dual transducer survey, conducted by a private contractor in July and August, 2004, were used to provide additional water depths particularly in the very nearshore areas. The contractor mounted a transducer on the bow of their vessel and obtained depth data up to the shoreline (This was not possible during this investigation because of the towing depth of the subbottom profiler and sidescan sonar transducers). The maximum discrepancy in depth between the ACOE data and the data obtained on this survey was an occasional 2 to 5 inch difference which occurred on the steep slopes. However, the majority of the depths from the two surveys was within several inches of each other or showed no appreciable difference.

2.4 Sidescan Sonar

Acoustic images of the riverbed were acquired with a GeoAcoustic dual frequency sidescan sonar (Figure 2). The data were displayed in real-time on a thermal graphic recorder and archived on a Sony

PC208 digital recorder. Both the graphic recorder and the digital recorder received event marks at a 20 second interval from the navigation system. The sidescan data were acquired and displayed on a time scale of 160 milliseconds which represents a horizontal swath width of 400 feet; 200 feet to either side of the sidescan sonar transducer (Figures 3 and 4).

2.5 Subbottom Profiler (SBP)

A high-resolution subbottom profiler was used to characterize the nature and determine the distribution and thickness of unconsolidated, fine to medium-grained sediment. The subbottom data were acquired with a Datasonic Model 1200 SBP operating at a frequency of 3.5 kHz, displayed in real-time on an EPC Model 1086 thermal graphic recorder, and recorded on a Sony Model PC 208 digital recorder along with the side scan sonar data. The graphic recorder and the digital acquisition system were interfaced with the navigation system that provided fix marks at a 20-second interval.

3.0 ANALYSIS AND INTERPRETATION

3.1 Navigation and Bathymetry

The navigation and geophysical data were downloaded to processing computers for editing, analysis and conversion to graphic, GIS and CAD images and maps.

The navigation and bathymetry data were edited for anomalous readings, and then converted to their respective formats for mapping. The navigation data were converted to state plane coordinates, WV south, imported to Arc Map and GIS (v.9.0) and plotted as trackline maps, with event marks, at a scale of 1 inch = 300 feet (1:3600)

The bathymetric data were adjusted for minor variation in the velocity of sound in water determined from the bar checks. The data from this survey showed excellent correlation with the bathymetric data set obtained from the ACOE. The two data sets were merged, contoured at a two (2) foot contour interval and plotted on a scale of 1 inch = 300 feet (1:3600).

3.2 Sidescan Sonar Data Analysis

The sidescan sonar data were used to:

- characterize the riverbed sediment (fine-grained, medium-grained etc) based on the reflection signal strength (fine-grained sediment produce a light pattern on the data and medium or coarse-grained sediment produce a dark pattern),
- identify and map bedforms (sand waves or sand ripples) that help to characterize the river dynamics,
- map the location of bedrock (appears as an extremely dark pattern on the data and often produces shadows behind pinnacles), and
- identify cultural artifacts such as pipelines, sunken vessels etc. resting on the riverbed.

Examples of these interpreted features and the sidescan sonar pattern are shown on Figures 3 and 4. The sidescan sonar information was plotted on an overlay of the trackline map and eventually integrated with the subbottom profiler results to produce the final map set showing the interpretation of surficial and subsurface geologic features on the riverbed (Sheets 1A-22A).

3.3 Subbottom Profiler Data Analysis

Analysis of the SBP data consisted of reviewing the entire data set on a color monitor and developing a general sediment classification of riverbed material based on reflection patterns or characteristics. This method of classifications is known as seismic facies analysis.

For example, on the SBP data, bedrock reflections are characterized by high amplitude reflections (dark images on the data), have an irregular, angular surface and often produce multiple reflections or echoes of the riverbed (Figures 5 and 6). The identification and mapping of bedrock was further aided by the sidescan sonar data. Uniform, fine-grained sediments on the other hand are acoustically transparent, or have a low amplitude return (Figure 5). That is, they produce a reflection from the surface (water-riverbed contact) and the lower boundary of the deposit (sediment-bedrock contact) with no internal reflectors or horizons within the deposit itself. Medium to coarse-grained sediments, or a mixture of fine and coarse-grained sediments have reflection patterns that fall within these two extremes. That is, limited subsurface penetration, internal reflections within the deposit, and are often laterally discontinuous.

One unusual reflection pattern was observed at several locations on the riverbed. This reflection pattern appeared as an extremely smooth surface, exhibited no subsurface penetration, and produced strong multiple reflections (Figure 6). The geologic nature of this reflection pattern cannot be specifically determined without additional sediment samples. However, this type of reflection is characteristic of fine-grained sediment that contains organic material particularly if they produce biogenic gas. Several of the sediment grab samples obtained leaves and other plant debris that potentially would produce biogenic gas during decomposition. The presence of gas and organic debris produces sediment having a low compressional velocity, low shear strength, and low density, resulting in most of the acoustic energy being reflected at the water sediment interface.

Following general classification of the riverbed material the thickness of the fine and medium or mixed grained sediment deposits were measured on the SBP records using a compressional velocity of 5000 feet/second to convert the time scale to a depth scale in feet. The thickness of the deposits was then plotted on the trackline maps, contoured and coded with a pattern to distinguish the different sediment type.

4.0 RESULTS

The results of the hydrographic and geophysical investigation are presented on several figures located in the appendix and in an attached booklet of maps. One set of maps shows the river bathymetry overlain on the survey tracklines (Sheets 1-22). A second set of maps presents the results from the integration of the sidescan sonar and subbottom profiler data (Sheets 1A-22A). The following is a brief discussion of the information presented on these maps.

4.1 Bathymetry

The water depth ranged from the shoreline to a maximum of 60 feet. The typical depth along the main channel of the river was 20 to 60 feet. Because of the presence of debris, brush and trees, as well as shallow water it was not possible to obtain bathymetric data to the rivers edge. However, shallow water bathymetric data, acquired on the ACOE multitransducer survey, were used to fill in these areas. The slope of the right bank was very steep, usually on the order of 1:3 whereas the slope of the left bank was somewhat more gradual at 1:4 to 1:5.

4.2 Sidescan Sonar and Subbottom Profiler Results

The interpreted results from these two acoustic systems were integrated to produce the surficial features map and sediment thickness maps. The results of the geophysical investigation will be discussed in terms of the acoustic characteristic and interpreted geology, as well as non-geologic features observed on the data.

4.2.1 Bedrock

No subsurface penetration was achieved on the steep river banks that are interpreted to consist of exposed bedrock. Bedrock forming the right bank often extends from the base of the slope to the thalweg or deepest part of the channel and may have a thin, discontinuous sediment cover (less than 1 foot thick). On the left bank however the bedrock on the lower slope is buried under sediment and seldom extends onto the river floor.

4.2.2 Unconsolidated Sediments

Unconsolidated sediments were found primarily on the lower slope of the left river bank and on the riverbed in the main channel. The sediments range in size from fine to medium-grained, or a mixture of the two and in some areas possibly contain organic debris. In addition, some of the sediment on the riverbed appear as small bedforms, sand waves or ripples, with a height of less than 1 foot and a wavelength of 10 to 20 feet (Figure 4).

The largest deposits of sediment are comprised of fined-grained material that are up to 6 feet thick. The largest deposits tend to be located between RM 31.5 and RM 35.9 (Sheets 1A to 7A). It is possible that some of these deposits are the result of shoreline erosion and subsequent slope failure. Other localized deposits, ranging in thickness from 1 to 5 feet, are towards the center of the floor of the channel along much of the river for example RM 41.2 (Sheet 16A). The sediments on the river bed of the main channel range from fine to medium-grained or a mix of the two.

The sediments that may contain organic debris are primarily located along the right side of the river between RM 34.4 and RM 38 (Sheets 9A to 11A). Smaller pockets of this sediment were also found at several other locations.

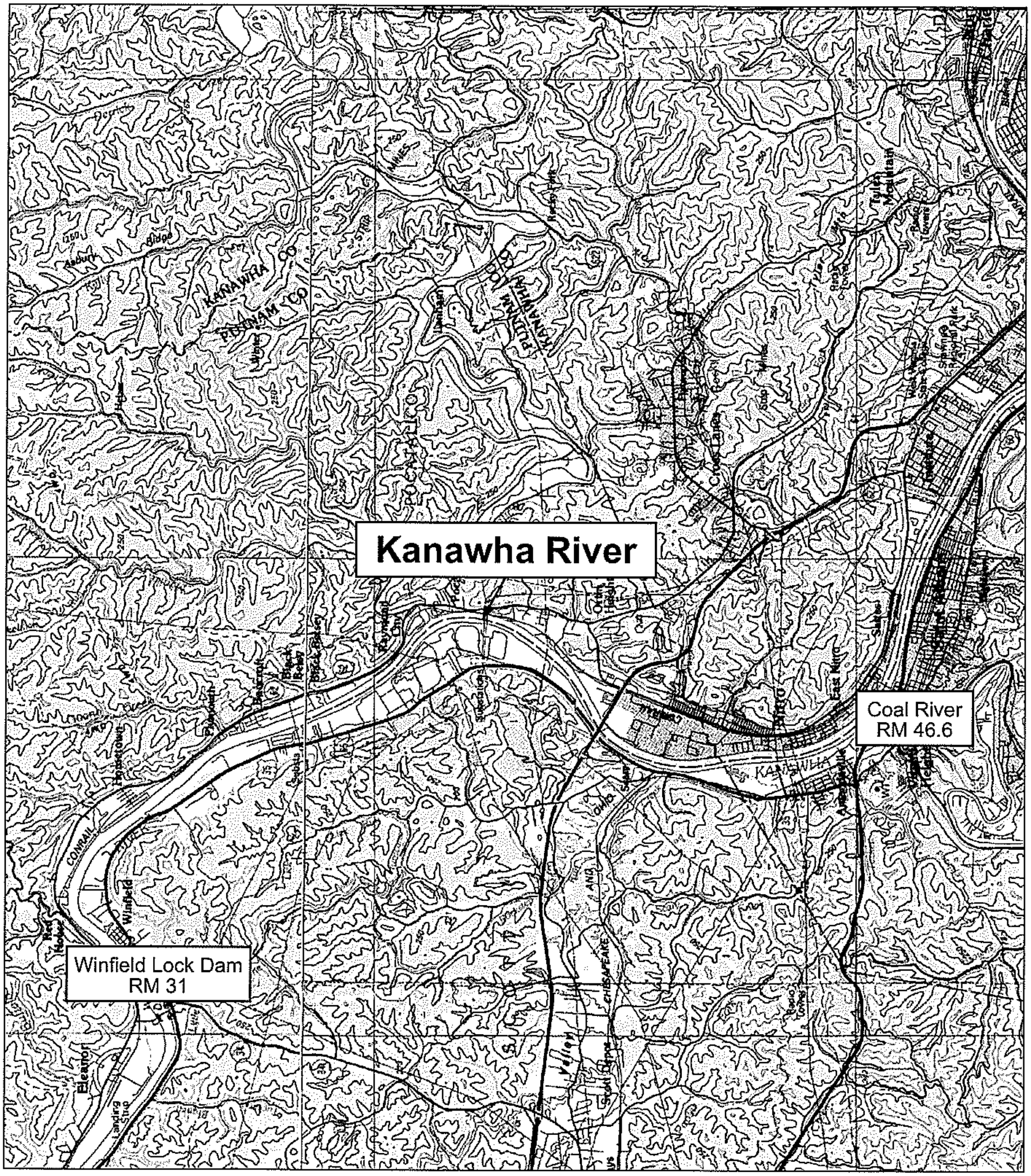
4.2.3 Cultural Artifact and/or Debris

Only a few, small and unidentified objects were detected on the sidescan sonar data. These might be small pieces of pipe or cable usually less than 10 feet in length with very little relief above the river floor; on the order of 1 foot or less. The largest targets detected were two pipelines that cross the river (Figure 3), several bedrock pinnacles, and a possible sunken vessel located near RM 36.1 (Sheet 8A).

5.0 LIMITATION OF GEOPHYSICAL METHODS

Golder services are conducted in a manner consistent with the level of care and skill ordinarily exercised by other members of the geophysical community currently practicing under similar conditions subject to the time limits and financial and physical constraints applicable to the services. Subbottom profiling and side scan sonar are remote sensing geophysical methods that may not detect all surface and subsurface discrete targets or stratigraphic features of interest. Furthermore, it is possible that because of the presence of organic material or gas-charged sediment, or coarse-grained material, that the SBP may be ineffective for mapping the thickness of recent sediment deposits.

FIGURES



Source: *USGS 30x60 Minute Topographic Quadrangle Map, Charleston and Ripley, West Virginia (1984)*

FIGURE 1

SITE LOCATION MAP

ANCHOR/KANAWHA RIVER GEOPHYSICS/VA

DRAWING NO. 0431307003fg08.fh11 DATE 12/27/04 DRAWN BY EFS

Golder Associates

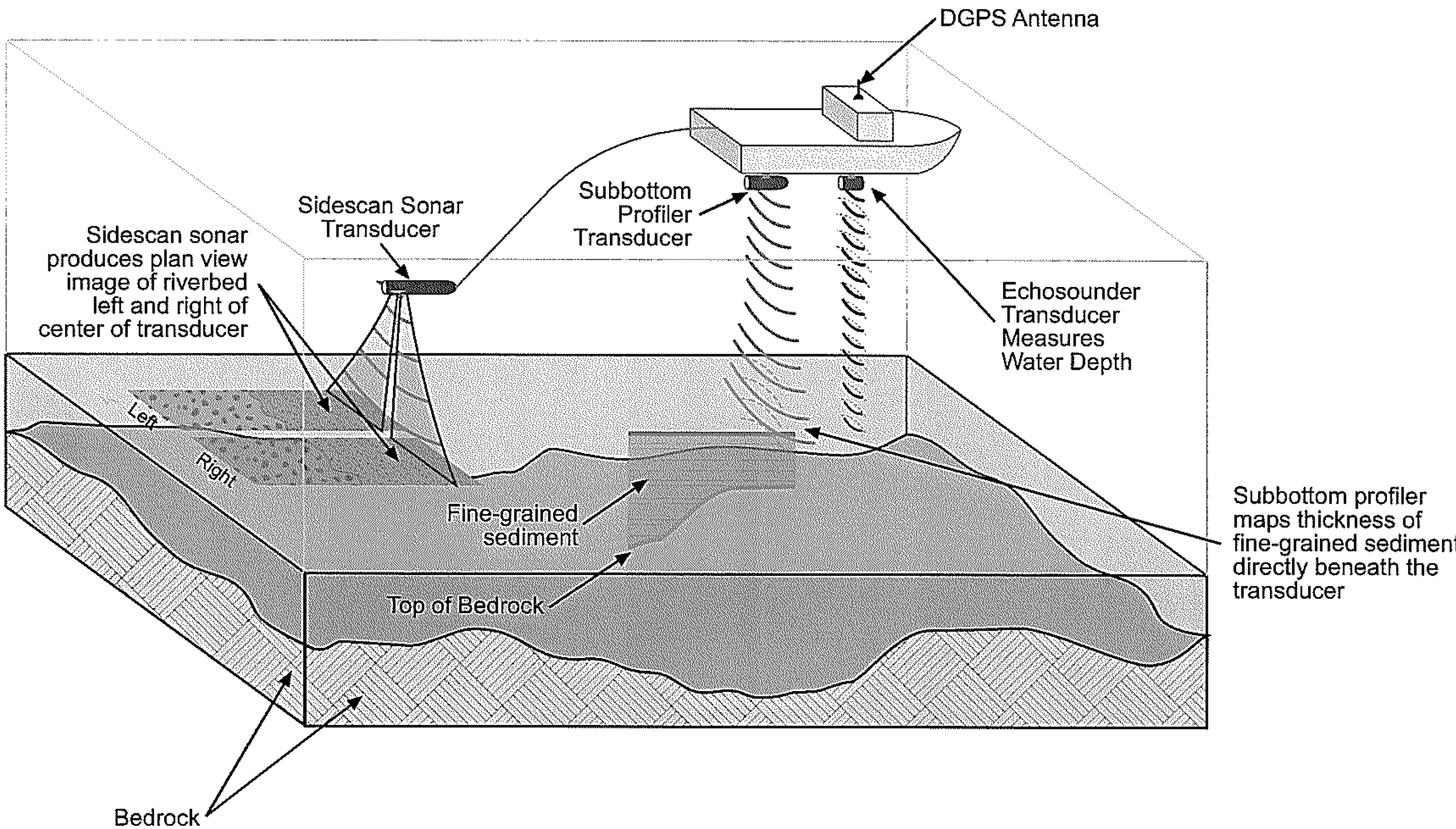


FIGURE 2
SIDESCAN SONAR, ECHOSOUNDER AND SUBBOTTOM PROFILING METHODS
ANCHOR/KANAWHA RIVER GEOPHYSICS/VA

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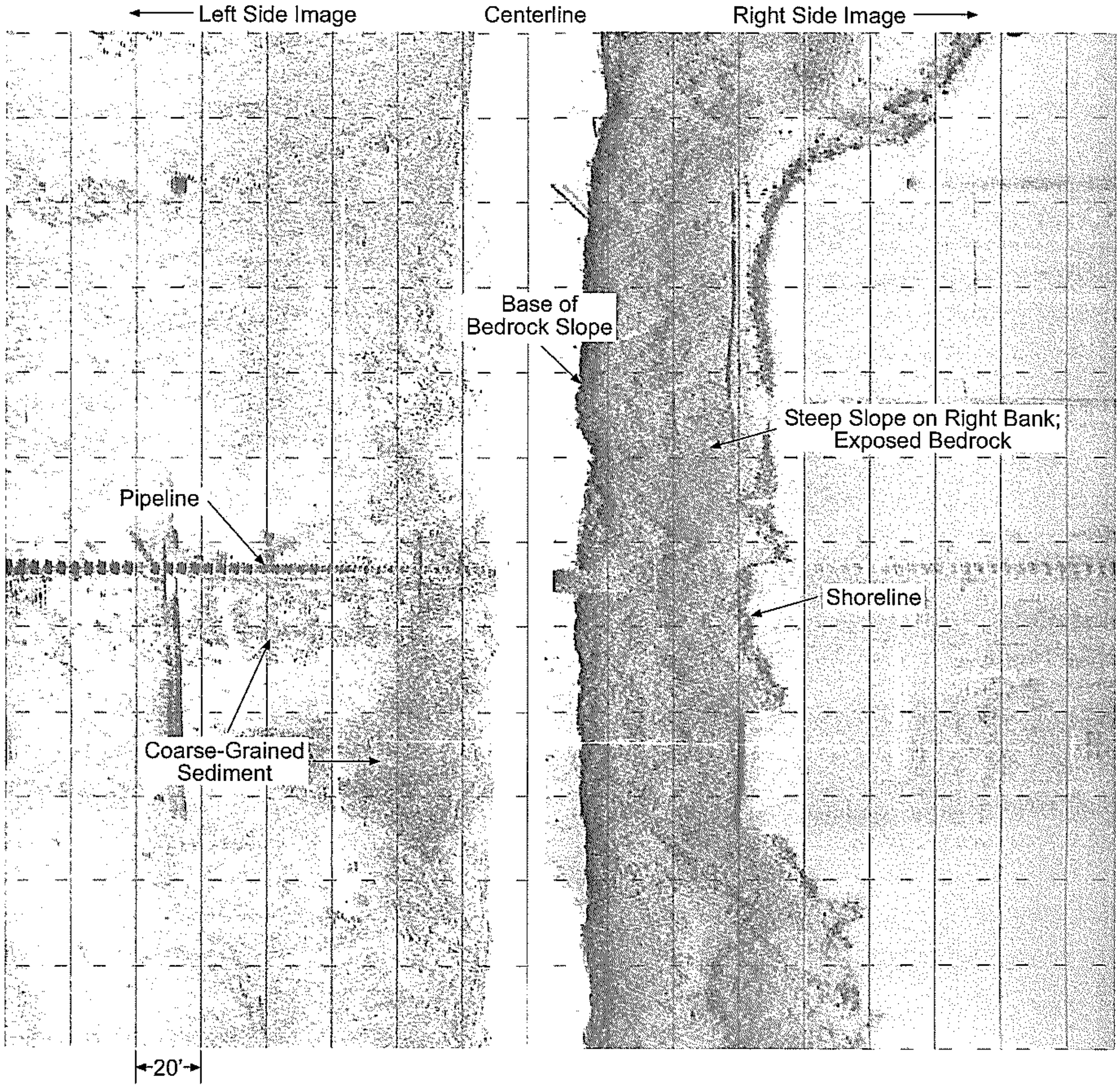

See Figure 2 for orientation of image.

FIGURE 3

SIDESCAN IMAGE PARALLEL TO SHORELINE

ANCHOR/KANAWHA RIVER GEOPHYSICS/VA

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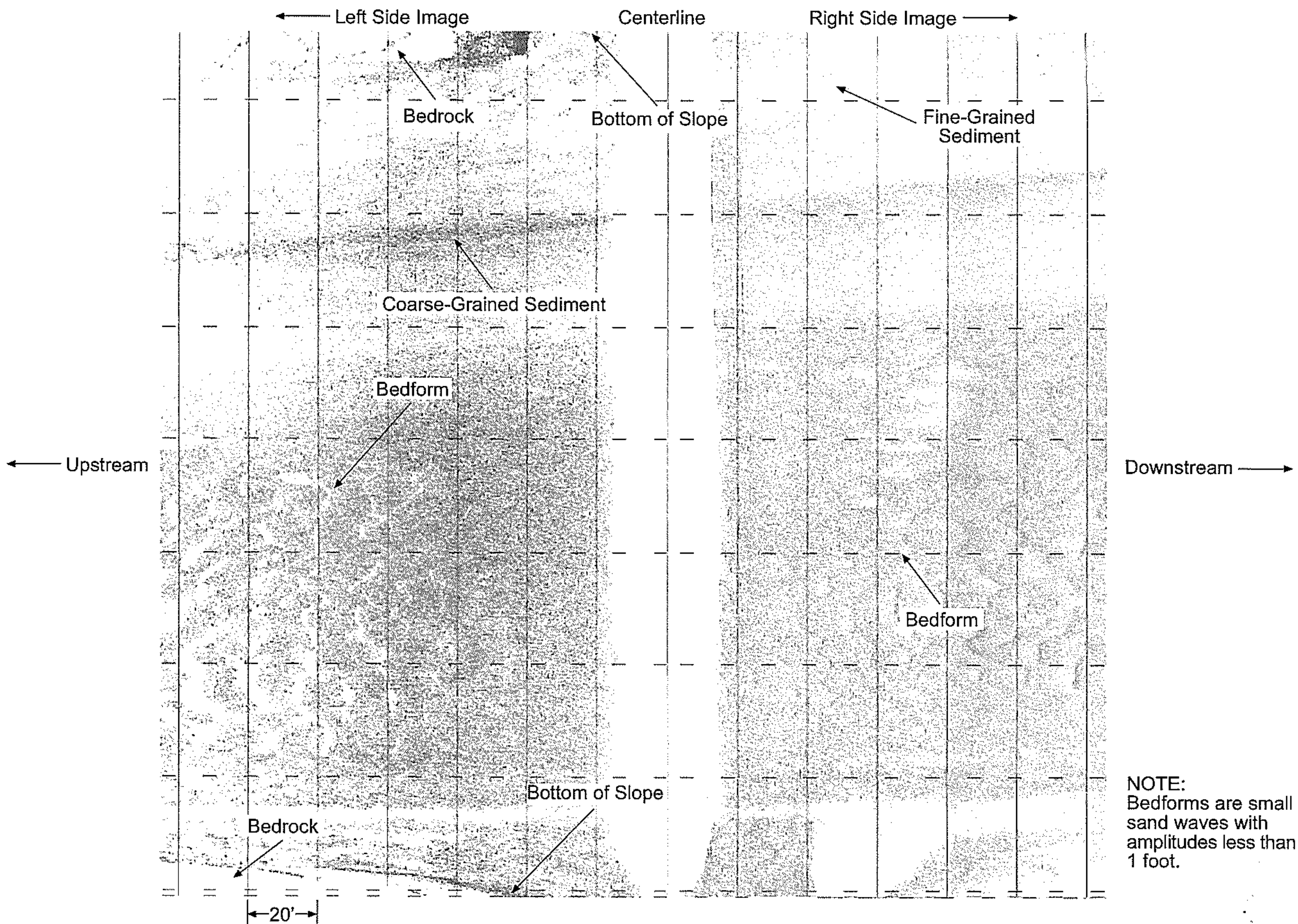

NOTE:
Bedforms are small sand waves with amplitudes less than 1 foot.

See Figure 2 for orientation of image.

FIGURE 4
PLAN VIEW SONAR IMAGE ACROSS RIVER
ANCHOR/KANAWHA RIVER GEOPHYSICS/VA

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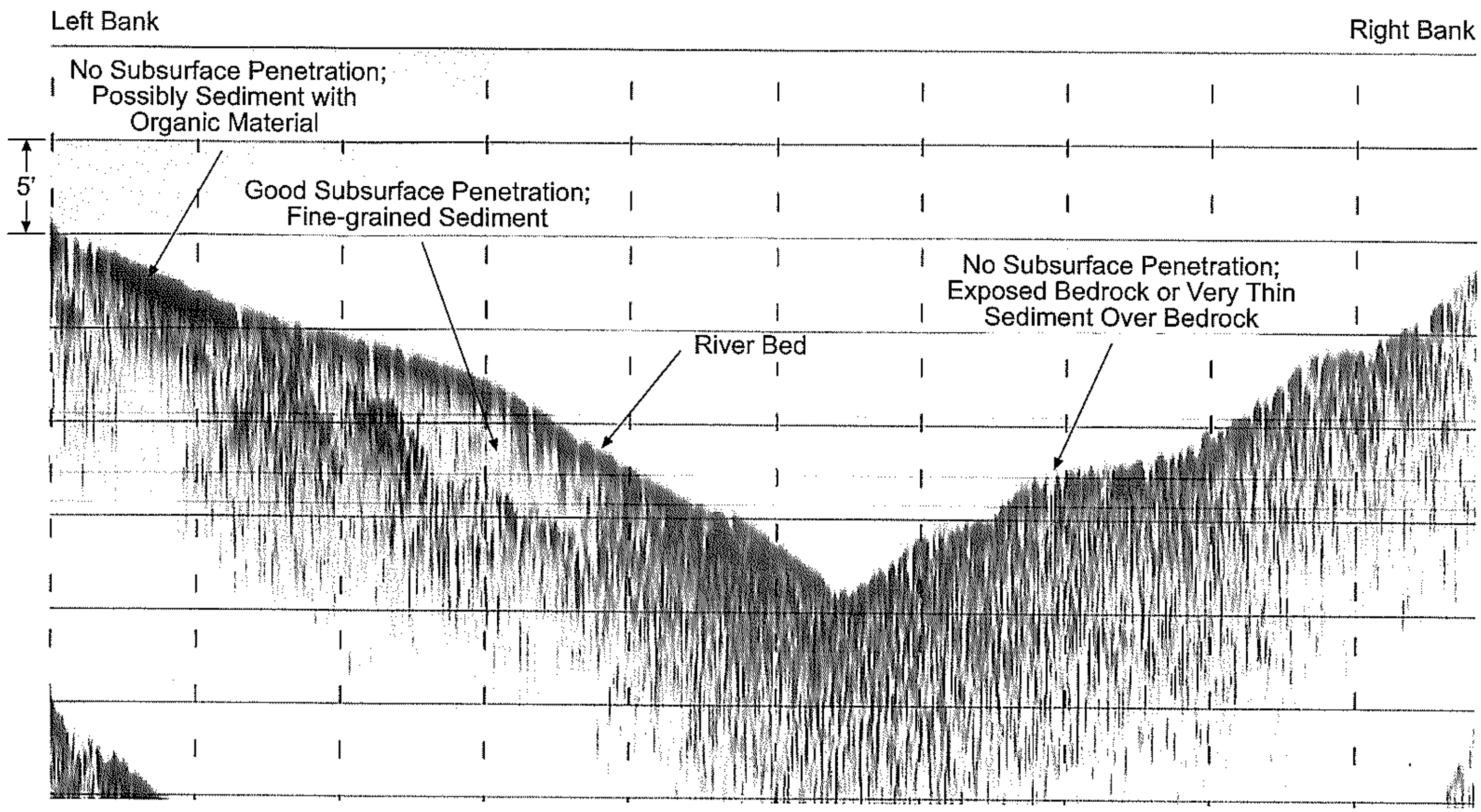

FIGURE 5

REPRESENTATIVE SUBBOTTOM PROFILE ACROSS RIVER

ANCHOR/KANAWHA RIVER GEOPHYSICS/VA

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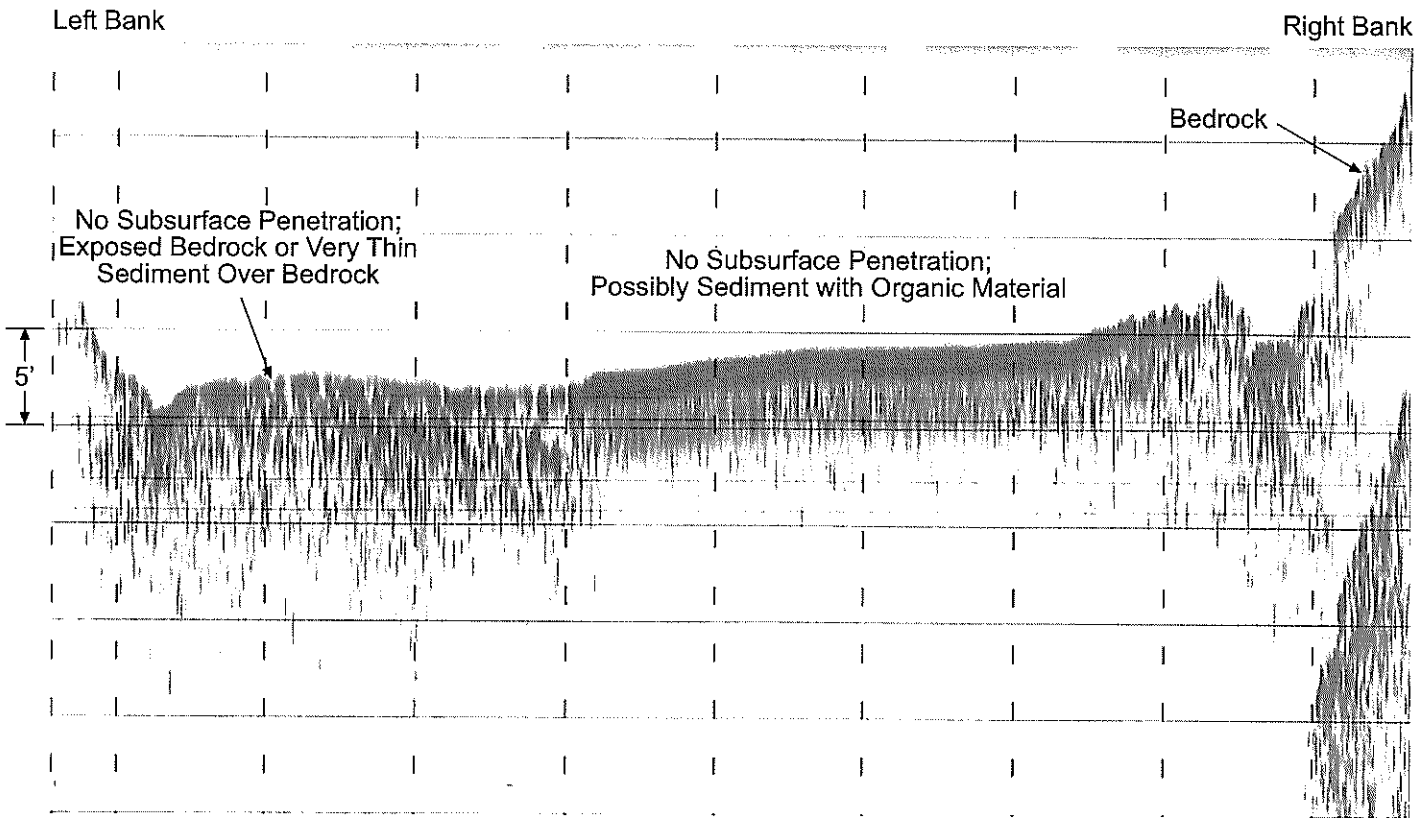


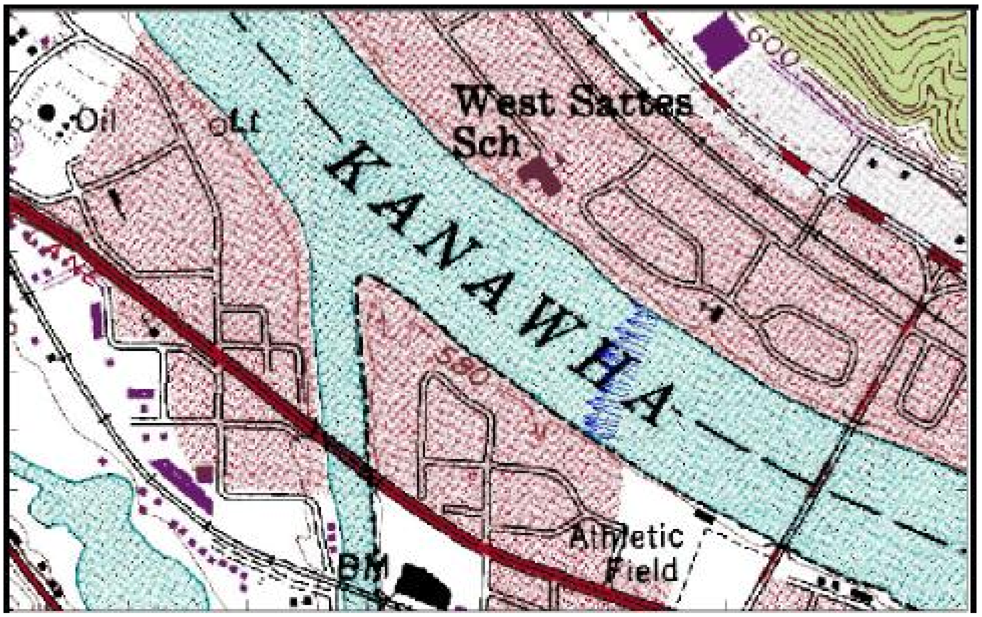
FIGURE 6
REPRESENTATIVE SUBBOTTOM PROFILE ACROSS RIVER
ANCHOR/KANAWHA RIVER GEOPHYSICS/VA

DRAWING NO. 0431307003fg02.fh11 DATE 12/28/01 DRAWN BY EFS

Golder Associates

Kanawha River Velocity Profiling and Discharge Measurement

West Virginia, USA



Prepared for:
Conestoga-Rovers & Associates
Waterloo, Ontario

Jessica M. Hartsock Blue Coast Scientific, Inc. 221 Whiterock Drive Mount Holly, NC 28120 USA

October 2004

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Introduction

On October 6 and 7, 2004, river current measurements were collected on the Great Kanawha River, West Virginia to resolve volume flow rates and assist in establishing water sampling locations. Blue Coast Scientific, Inc. (Blue Coast) performed this data collection in conjunction with Conestoga-Rovers, & Associates (CRA).

Current measurements were collected using a vessel-mounted Acoustic Doppler Current Profiler (ADCP) along five pre-defined transect lines through the survey area (Figure 1). This effort resulted in high-resolution observations of spatial and temporal variations in tidal currents throughout the survey area. During the field operations, weather conditions were good, with air temperatures of 15 to 20^{o} C, mostly clear skies, and light winds. Vessel traffic was minimal throughout the survey period.

This report describes ADCP data collection techniques, data processing techniques, and volume flow rate calculations. Data is presented graphically as navigations charts overlaid with depth-averaged currents, color contoured cross-sections of speed and direction, and time series of depth-averaged velocity vectors. Volume flow rates are presented in tabular form.

Description of Data Acquisition Instrumentation

Measurements were obtained with a BroadBand 1200 kHz Acoustic Doppler Current Profiler (ADCP) manufactured by RD Instruments (RDI) of San Diego, CA. The ADCP was mounted to a rigid frame, which was attached to a plank of wood and hung over the side of the survey vessel. The ADCP was oriented to look downward into the water column, with the sensors located 22 cm below the water surface on October 6 and 40 cm below the water surface on October 7. The depth of the ADCP was adjusted to accommodate the draft of the survey vessel; a flat bottomed Jon boat was used on October 6 and a Pontoon boat was used on October 7. The mounting technique assured no flow disturbance due to vessel wake.

The ADCP emits individual acoustic pulses from four transducers mounted in the head of the instrument angled at 20° from the vertical. The instrument then listens to the backscattered echoes from discrete depth layers in the water column. The difference in time between the emitted pulses and the returned echoes, reflected from ambient sound scatterers (plankton, debris, sediment, etc.), is the time delay. BroadBand ADCPs measure the change in travel times from successive pulses. As particles move further away from the transducers sound takes longer to travel back and forth. The change in travel time, or propagation delay, corresponds to a change in distance between the transducer and the sound scatterer, due to a Doppler shift. The propagation delay, the time lag between emitted pulses, and the speed of sound in water are used to compute the velocity of the particle relative to the transducer. By combining the velocity components for at least three of the four directional beams, the current velocities are transformed using the unit's internal compass readings to an orthogonal earth coordinate system in terms of east, north, and vertical components of current velocity.

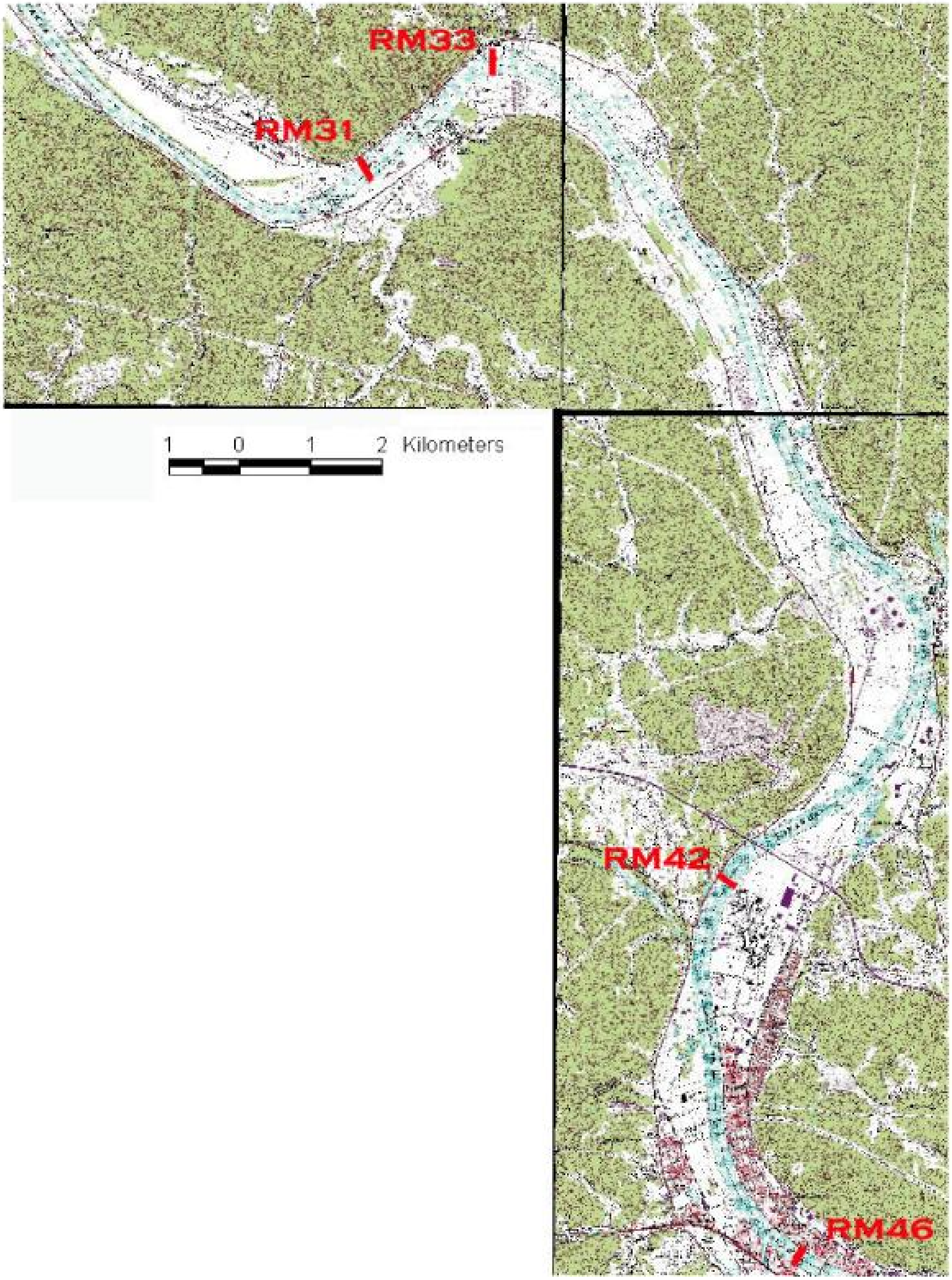

Figure 1. Overview map of Kanawha River survey region from river mile 31 to river mile 46 (river mile 68 was not included to reduce scale of map). Although the river is primarily oriented north to south, the sharp bend near river mile 33 creates an east to west orientation.

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Vertical structure of the currents is obtained using a technique called 'range-gating'. Received echoes are divided into successive segments (gates) based on discrete time intervals of pulse emissions. The velocity measurements for each gate are averaged over a specified depth range to produce a single velocity at the specified depth interval ('bin'). A velocity profile is composed of measurements in successive vertical bins.

The collection of accurate current data with an ADCP requires the removal of the speed of the transducer (mounted to the vessel) from the estimates of current velocity. 'Bottom tracking' is the strongest echo return from the emission of an additional, longer pulse to simultaneously measure the velocity of the transducer relative to the bottom. Bottom tracking allows the ADCP to record absolute versus relative velocities beneath the transducer. In addition, the accuracy of the current measurements can be compromised by random errors (or noise) inherent to this technique. Improvements in the accuracy of the measurement for each bin are achieved by averaging several velocity measurements together in time. These averaged results are termed 'ensembles'; the more pings used in the average, the lower the standard deviation of the random error.

For this study, the standard deviation (or accuracy) of current estimates (resulting from an ensemble average of 5 individual pulses) was approximately 8.65 cm/sec. Each ensemble took approximately 2 seconds to collect. Averaging parameters resulted in a horizontal resolution of approximately 2 meters along the transect line. For example, at River Mile 68 the survey transect was approximately 220 meters, resulting in approximately 110 independent velocity profiles per transect. The vertical resolution was set to 25 cm, or one velocity observation every 25 cm of water depth. The first measurement bin was centered 78 cm from the surface on October 6 and 96 cm on October 7. The depth of the first bin allowed for the transducer draft as well as an appropriate blanking distance between the transducer and the first measurement bin.

Differential GPS positioning was collected concurrently with the ADCP measurements. The position data were read from the device in the WGS-84 coordinate system. Position updates were available every 1 second. Each ADCP ensemble and GPS position were recorded by WinRiver (®RD Instruments), an integrated ADCP and navigation software package running on a PC laptop computer.

Description of Survey Technique

Current measurements were collected by the ADCP at five (5) pre-defined locations between river mile 31 and river mile 68 on the Kanawha River (Figure 1). Upon arrival at each location, a transect line from left bank to right bank (looking upstream) in the vicinity of the designated river mile was surveyed (identified as "Q1"). Based on the survey Q1, three locations were selected to anchor and collect continuous time series of velocity. The three locations were chosen to identify the potential differences in water velocity based on channel shape and water depth. The stationary velocity measurements are identified as "left", "center", and "right" to indicate the position the boat was anchored relative to the channel looking upstream. A second survey of the transect line was conducted upon completion of the stationary velocity measurements,"Q2". At some locations, additional transect lines were measured, identified as "Q3" and "Q4".

At least two velocity survey transects and three stationary velocity profiles were measured at each river mile location. The transect line at each river mile location was designed to measure as accurately as possible the water velocities from left bank to right bank, and to capture the volumetric flow rate at the specified river mile. ADCP measurements were collected in the vicinity of river mile (RM) 31, RM 33, RM 42, RM 46, and RM 68.

Data Processing Techniques

Data processing consisted of the following:

- Convert raw ADCP (binary) files to engineering units
- QA/QC procedures to verify the accuracy of both ADCP and position data
- Manipulate the ADCP data to calculate spatial averages and cross section discharge values

Current velocity measurements and GPS positioning were recorded in WinRiver, a real-time data collection program provided by RD Instruments (RDI). The data files were converted from raw binary format to engineering ASCII values using WinRiver in playback mode. This conversion process is described in greater detail in the RDI ADCP manual, and consists of developing a user-defined output file format through which all conversions are defined.

The output data file from this procedure consists of multiple ensemble data ‘packets’. The ensemble ‘packet’ consists of a single line containing the time of the profile, the ensemble number, the GPS position, and internal sensor data (heading, pitch, roll, and temperature measured by the ADCP) followed by consecutive rows and columns of the profile data. Each row of profile data corresponds to one bin, or depth layer, with succeeding columns representing velocity magnitude and direction, east and north components of velocity, error velocity, echo amplitudes (for 4 beams), and percentage of good acoustic pings. Each ensemble, collected approximately every 2 seconds, has 57 rows corresponding to each discrete depth layer (0.78 to 15 meters) with each row containing 12 columns of data. A single data file, consisting of multiple ensembles, was recorded for each transect. For this project, 28 ADCP data files were recorded.

The data were reduced through a QA/QC procedure to calculate vertical averages. Data recorded for the bottom-most bins in the water column can be contaminated by side lobe reflections from the transducer. At times, the measurements can be invalid. Validity of the bottom bin measurements is determined by comparing the standard deviation (std) of bottom values to the standard deviation of mid-column measurements. If the std at the bottom was more than twice the std of mid-column measurements, the bottom bin was discarded. If the bottom value was within the limits defined by adjacent measurements, the value was included.

A mean value of each east and north component of velocity is calculated for each vertical profile. The velocity component mean values are then used to determine mean speed and mean direction at each position recorded along the survey transect. Plan view charts, such as in Figure 2, and velocity time series, such as Figure 4 illustrate depth-averaged velocity measurements. Velocity direction was noisy due to the low velocity magnitudes in Kanawha River. A weighted triangle filter was used to smooth the velocity vectors displayed in color contoured cross-sections.

The Latitude and Longitude position recorded on a Leica handheld GPS during the survey appear to be slightly inaccurate in the horizontal when plotted on aerial photographs of the river. New positions were derived based on transect end point positions approximated from aerial photographs, and ADCP bottom track velocities.

The total discharge, Q, represents the total volumetric flow perpendicular to the river cross-section. The total volume flow rate is the summation of the volume flow rate at each discrete time interval (ensemble). A velocity vector cross-product algorithm is used to determine accurately the discharge normal to the channel cross-section (i.e. along-stream). The discharge through a profile during a single ensemble, Q_i is the cross product, F_z , of the water velocity, V_w , and the boat velocity, V_b integrated over the ensemble depth, *d*, multiplied by the time interval, t_i .

$$Q_i = \left[\int_0^d \mathbf{F}_z \, dz \right] t_i$$

where,

$$\mathbf{F}_z = (\overline{V_w} \times \overline{V_b}) \bullet \overline{k}$$

and,

k = a unit vector in the vertical direction

t_i = elapsed travel time between ensemble *i* and ensemble *i*-1, in seconds

The velocity vector cross-product algorithm is a form of the common discharge equation $Q = AV$. For a moving boat, the area *A* is defined as the vertical surface beneath the path along which the vessel travels. The cross product will equal zero when the vessel is moving directly upstream or downstream, and will equal V_w when the vessel is moving normal to V_w .

The total measured volumetric flow, Q_m is the summation of measured volumetric flow at each ensemble between time *i* and time *i*-1, where *i* = 1 to *N*, and *N* is the total number of ensembles.

$$Q_m = \sum_{i=1}^{N} Q_i$$

There are three areas of each river cross-section that are not measured during an ADCP transect and thus not represented by Q_m . The three unmeasured areas are Q_s , the volume flow through the blanking distance between the water surface and the first good bin, Q_d , the volume flow through the last good measurement bin and the bottom, and Q_e , the unmeasured volume flow near the channel banks.

Therefore, the total volumetric flow is,

$$Q = Q_m + Q_s + Q_d + Q_e$$

The ADCP cannot directly measure the surface velocity, it is assumed the surface layer discharge is equivalent to the discharge in the first depth layer. Data recorded for the bottom-most bins in the water column can be contaminated by side lobe reflections from the transducer and the measurements can be invalid. The same linear assumption was applied to bottom bins when the bin measurement was declared invalid; that is, the bottom bin value was assumed equivalent to the overlying bin velocity value. The volumetric flow edge estimates Q_e are calculated using the basic discharge equation $Q = AV$. The velocity V is estimated as the measured mean velocity at the first or last ensemble, and A is estimated by a triangular area.

Results

The ADCP survey on Great Kanawha River, West Virginia provided observation of the temporal and spatial variability of flow between river mile 31 and river mile 68. The data are presented in two formats: (1) multi-image cross-sections of velocity transects collected to measure volume flow rate and (2) time series of depth-averaged current vectors at stationary locations. All map coordinates are in UTM zone 17 NAD83 meters, and all velocities are in cm/s.

For each river mile location there are at least two cross-sections and one time series. In the multi-image cross-section, the top panel presents a plan view of depth-averaged currents on a navigation chart. The second panel presents color contour of current speed, scaled by the bar to the right, and the lower panel depicts current direction, scaled by the color spectrum to the right. The figures begin at river mile 31 and end at river mile 68.

In general, the Kanawha River flows from the south to the north. Due to the natural curvature and bends of the river, flow direction at each river mile is a local effect or river orientation. For example, at river mile 31 flow is directed southwest, and upstream is northeast. In general current speeds were swiftest at river mile 68, and slowest at river mile 33.

Volume flow rates were calculated for each Q transect measured. The total volume flow rate calculations showed some variability at any single river mile location. The variability is primarily due to differenced in water velocity from one transect to another due to the natural ebb and flow of a river. Slight differences in boat navigation attempting to traverse the exact transect as previously, may also introduce some variability. Total volume flow rates are presented in Table 1.

Volumetric flow rates will vary along the length of the river due to natural and mechanized gains and losses of water to the system. The lowest volumetric flow was observed at river mile 42, and the highest volume flow rates were observed at river mile 31. The large amount of industry, river management, and creeks or streams along the Kanawha River, contributes to the variability in volumetric flow from section to section.

Table1. Volumetric Flow (Q) and length of transect line listed by river mile

Transect name	Q (m^3/s)	Length (m)
RM31 - Q1	283	328
RM31 - Q2	266	330
RM33 - Q1	260	221
RM33 - Q2	209	228
RM42 - Q1	196	235
Rm42 - Q2	159	232
RM46 - Q1	226	224
RM46 - Q2	236	226
RM46 - Q3	244	224
RM68 - Q1	251	220
RM68 - Q2	249	219
RM68 - Q3	213	221
Rm68 - Q4	205	219

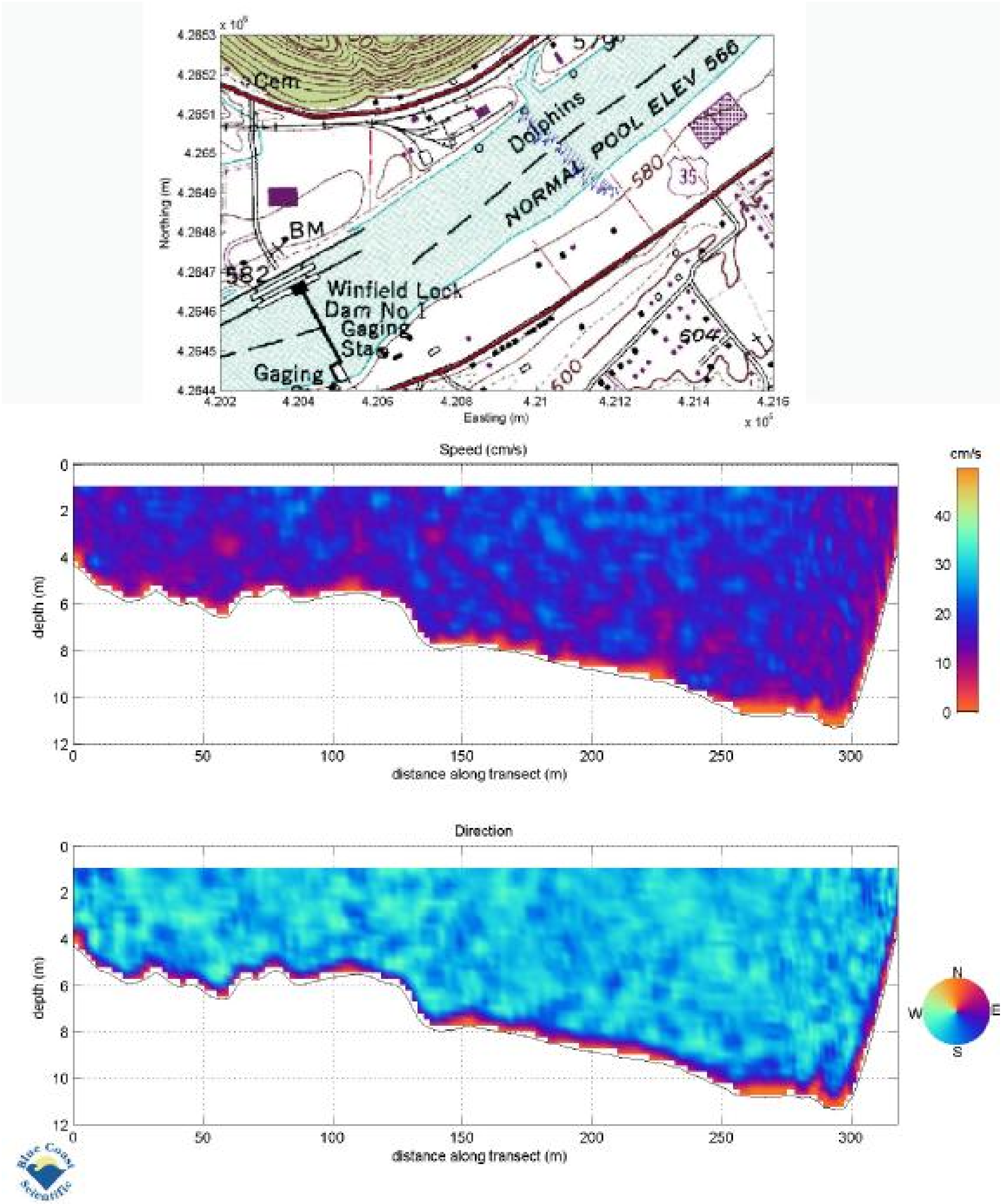

Figure 2. Transect Q1 measured at river mile 31, just upstream from Winfield Lock. The transect was navigated from left to right looking upstream (NW to SE). The span of current vectors on the navigation chart show the pool elevation was above normal, reaching the 580 foot elevation contour. River flow was approximately 20 cm/s towards the southwest. The river cross-section plots indicate the channel hugs the right bank at this location.

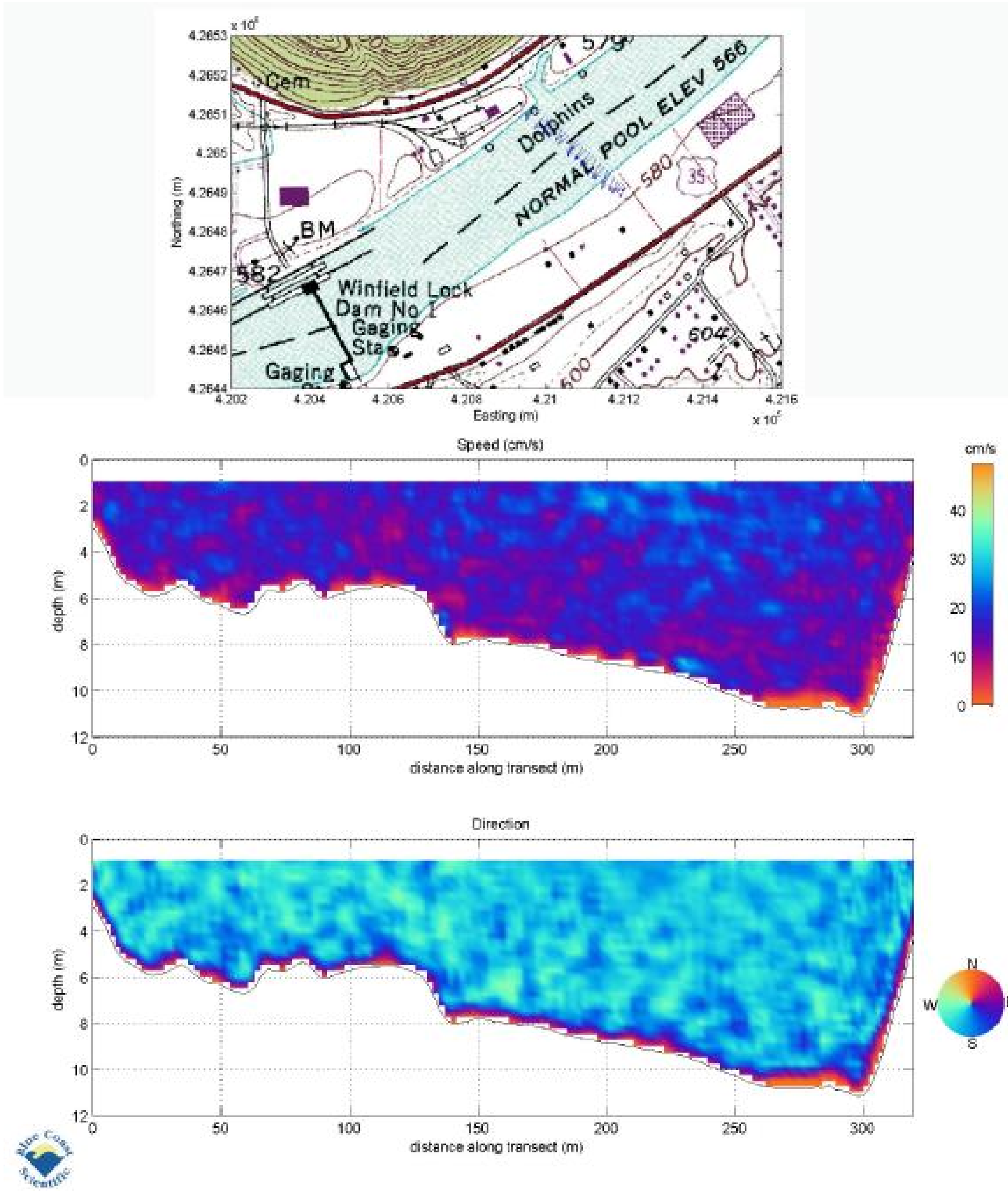

Figure 3. Transect Q2 measured at river mile 31, just upstream from Winfield Lock. The transect was navigated from left to right looking upstream (NW to SE). The span of current vectors on the navigation chart show the pool elevation was above normal, reaching the 580 foot elevation contour. River flow was approximately 20 cm/s towards the southwest.

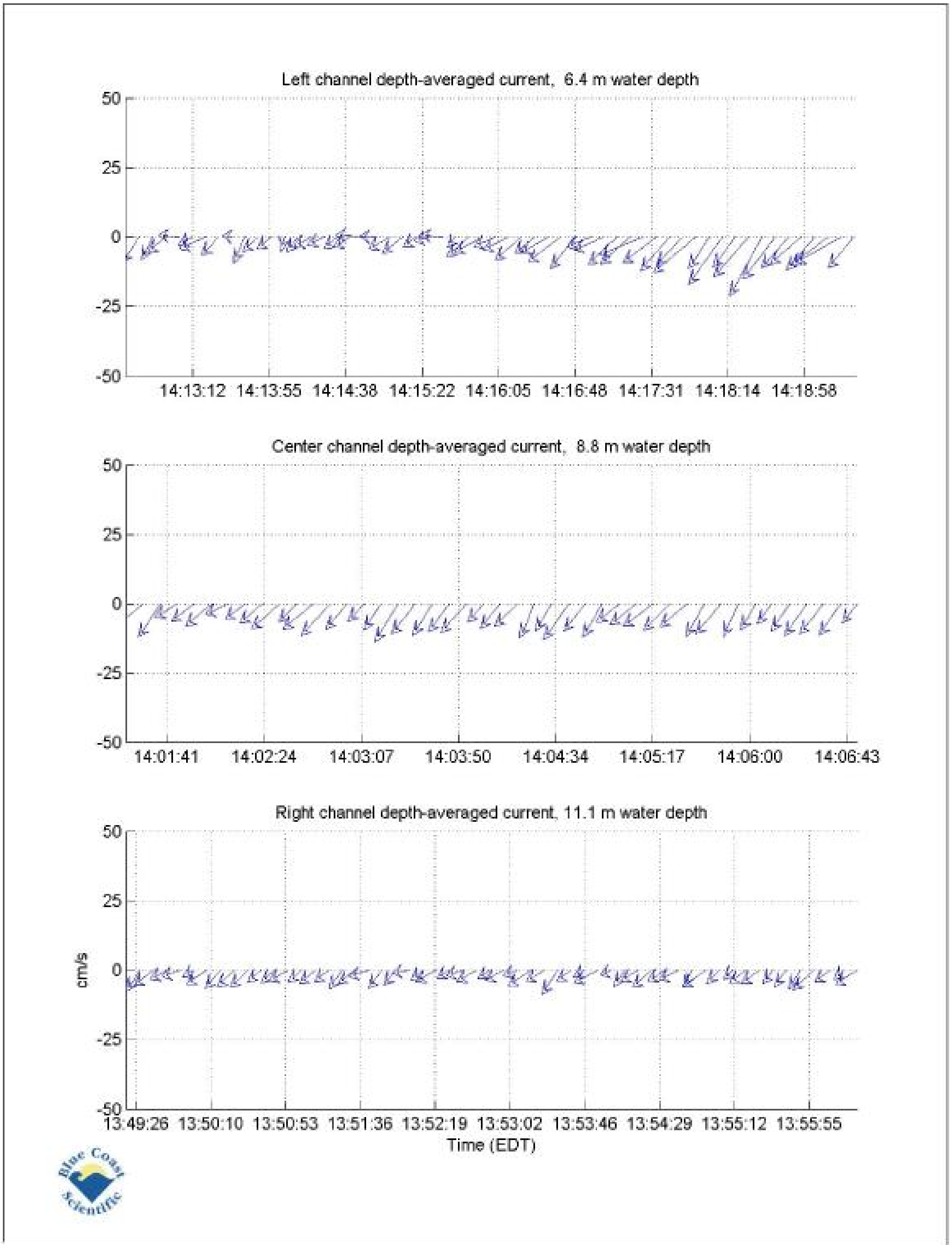

Figure 4. Depth-averaged velocity measurements near the left side (NW), center, and right side (SE) of the channel at river mile 31. Current speeds increased during the 5 minute time period on the left side of the channel at a water depth of 6.4 meters, but were relatively consistent at the other two locations. On average current speeds were highest at the center channel station.

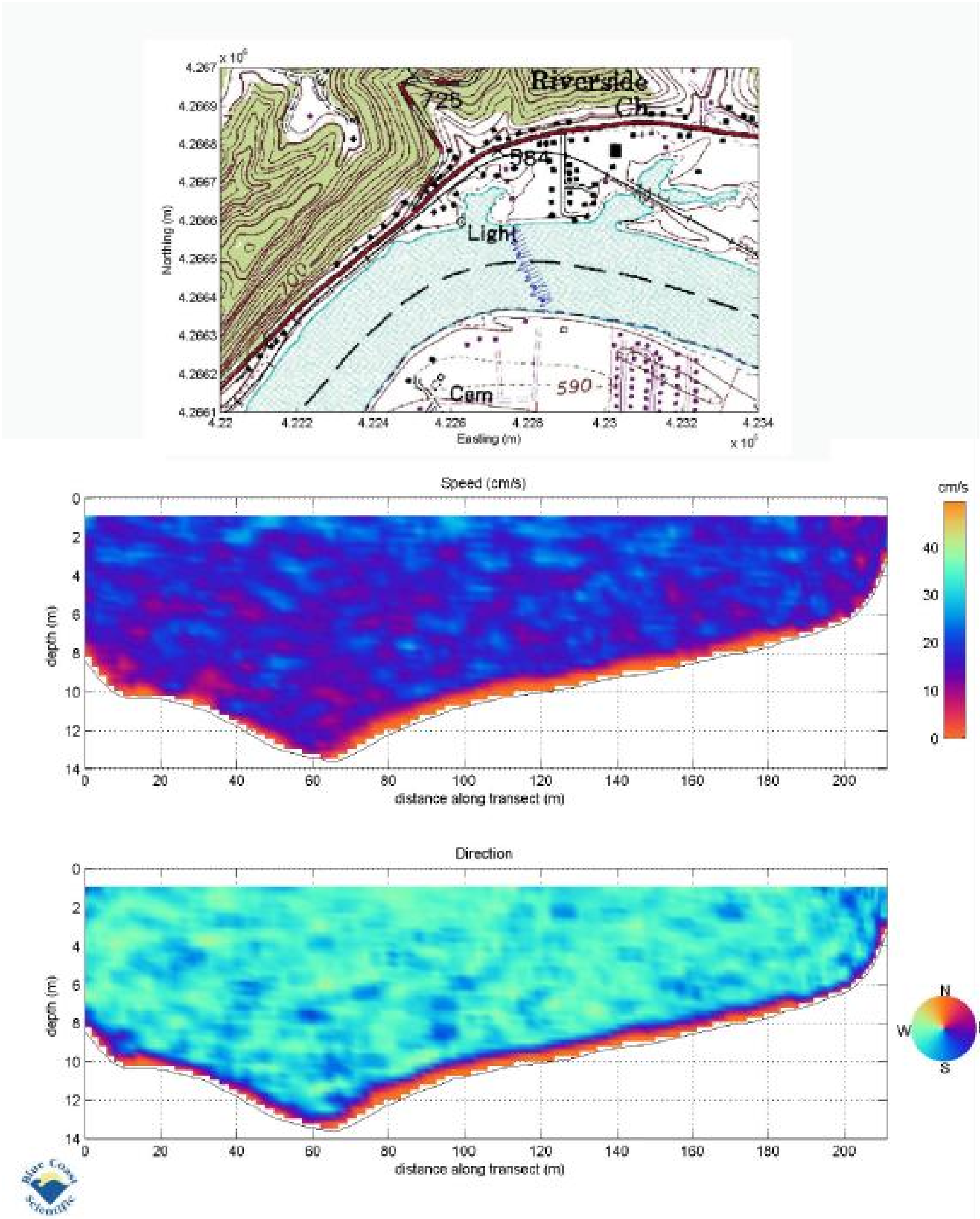

Figure 5. Transect Q1 measured at river mile 33, in the vicinity of Little Guano Creek. The transect was navigated from left to right looking upstream (N to S). River flow was approximately 20 cm/s directed towards the south-southwest. The river cross-sections indicate the deepest point of the river channel is approximately 60 meters from the left river bank, and 160 meters from the right river bank.

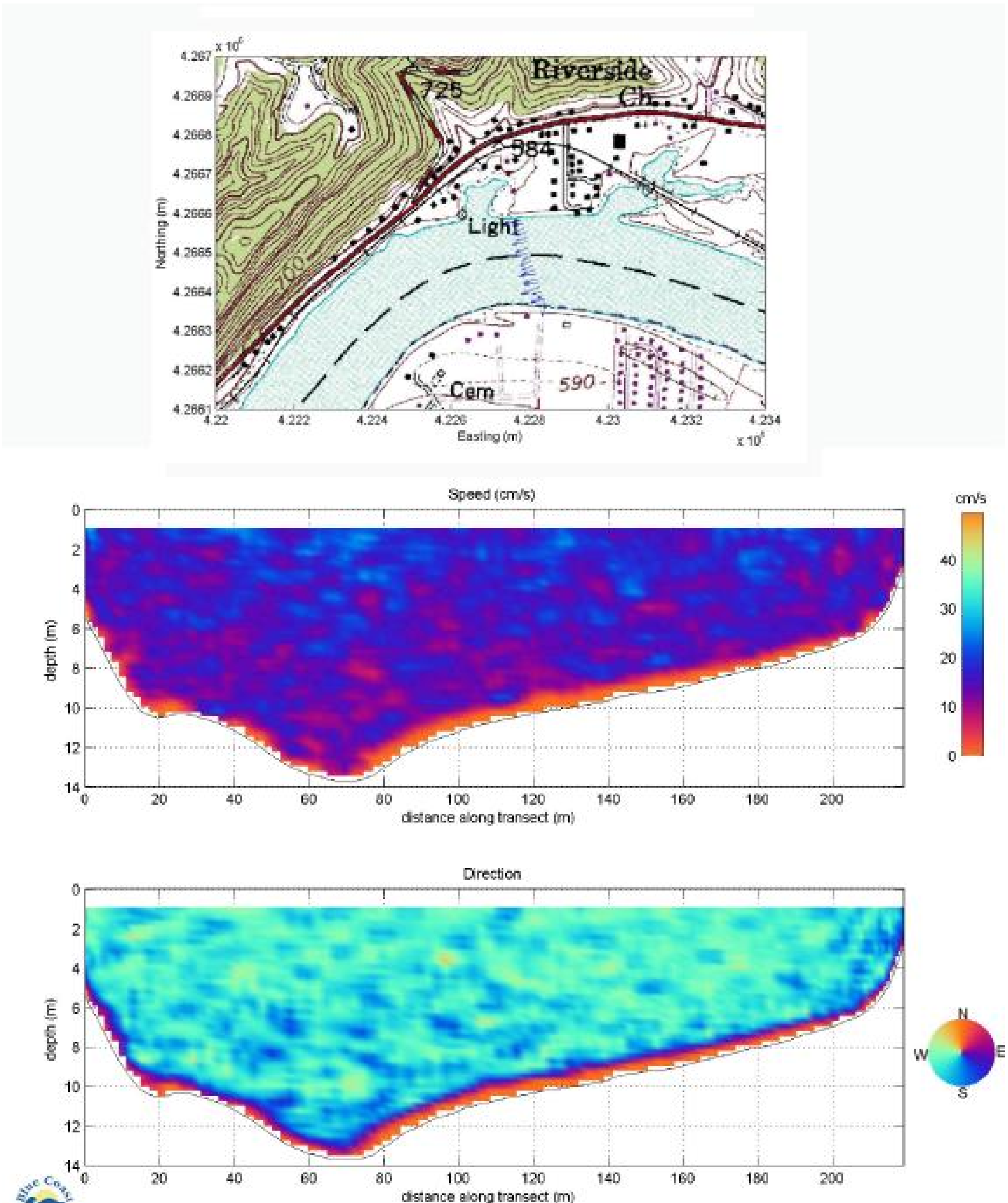

Figure 6. Transect Q2 measured at river mile 33, in the vicinity of Little Guano Creek. The transect was navigated from left to right looking upstream (N to S). On average, river velocity speeds were slightly lower across Q2 than Q1.

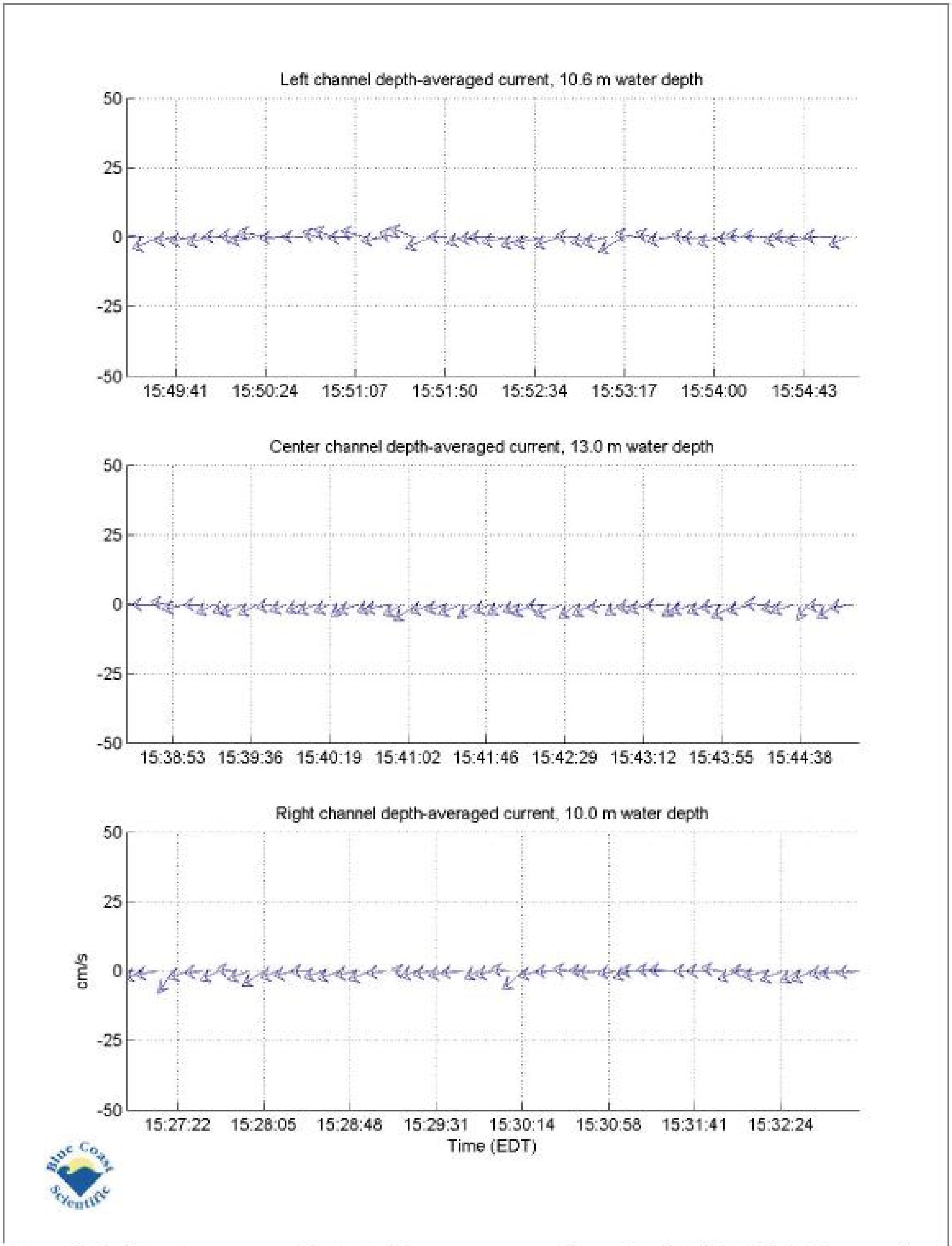

Figure 7. Depth-averaged velocity measurements near the left side (N), center, and right side (S) of the channel at river mile 33. Current speeds were relatively consistent throughout the 5 minute measurement period at all three locations.

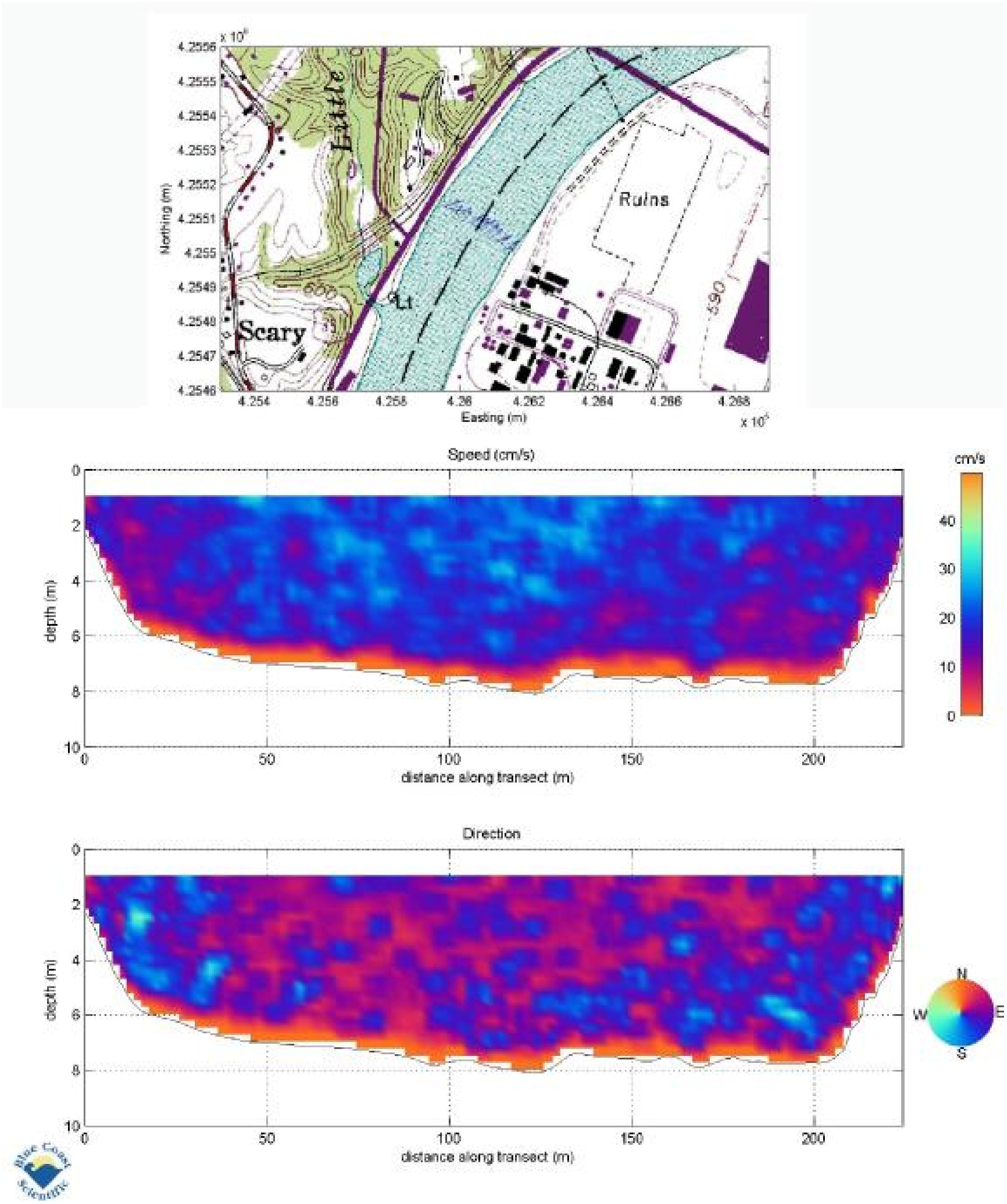

Figure 8. Transect Q1 measured at river mile 42. The transect was navigated from left to right looking upstream (SE to NW). River flow was approximately 20 cm/s directed towards the northeast. The river cross-sections indicate the river channel is relatively flat in this area. Flow speeds are slightly higher in the center of the channel.

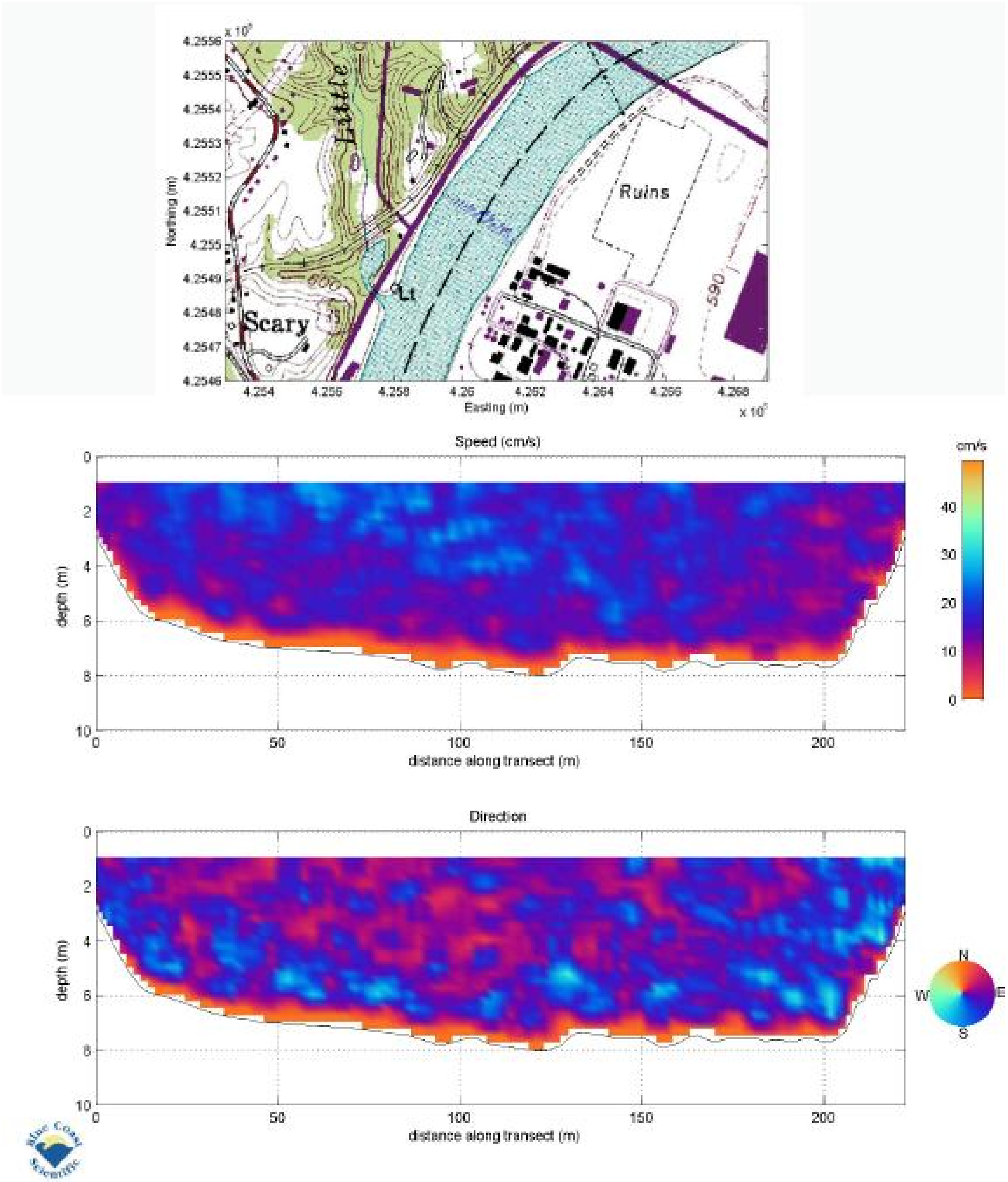

Figure 9. Transect Q2 measured at river mile 42. The transect was navigated from left to right looking upstream (SE to NW). River flow was approximately 20 cm/s directed towards the northeast. Flow speeds are lower along the banks of the river.

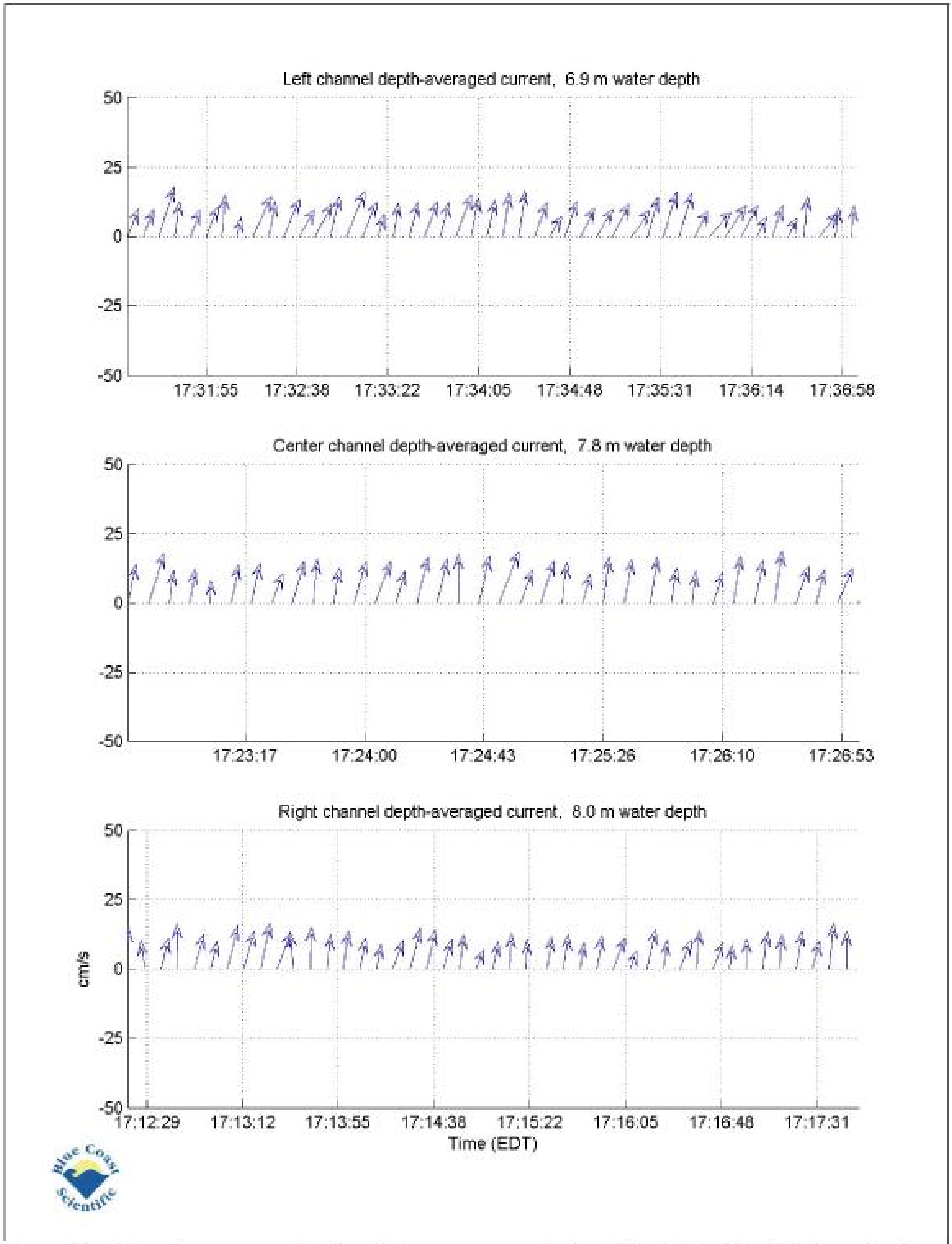

Figure 10. Depth-averaged velocity measurements near the left side (SE), center, and right side (NW) of the channel at river mile 42. Current speeds at all three locations demonstrate a natural pulsing, slightly increasing and slightly decreasing, throughout the 5 minute measurement period.

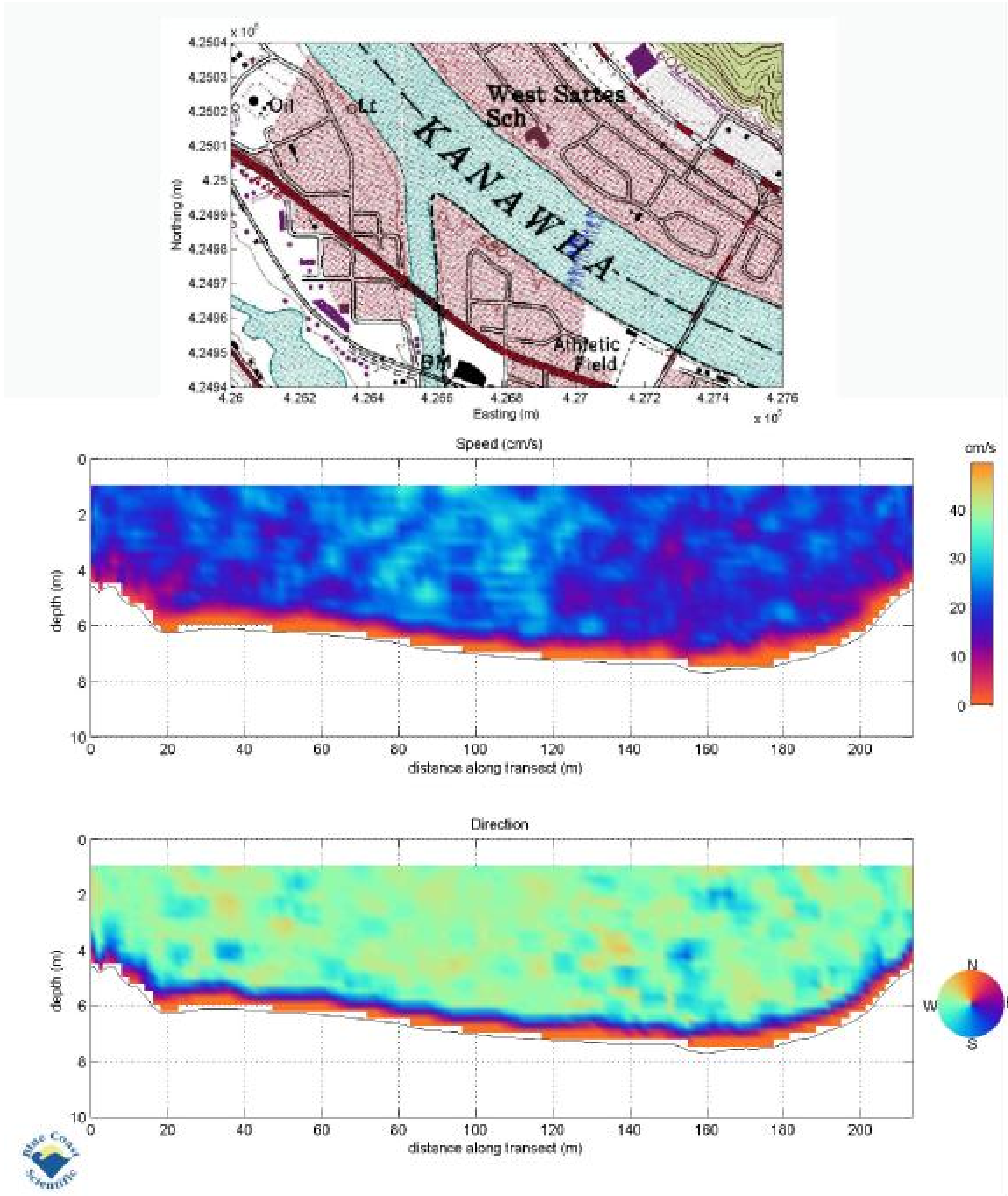

Figure11. Transect Q1 measured at river mile 46. The transect was navigated from left to right looking upstream (N to S). On average, river flow was approximately 20 cm/s directed towards the west. Flow speeds exceeded 30 cm/s in the center of the channel.

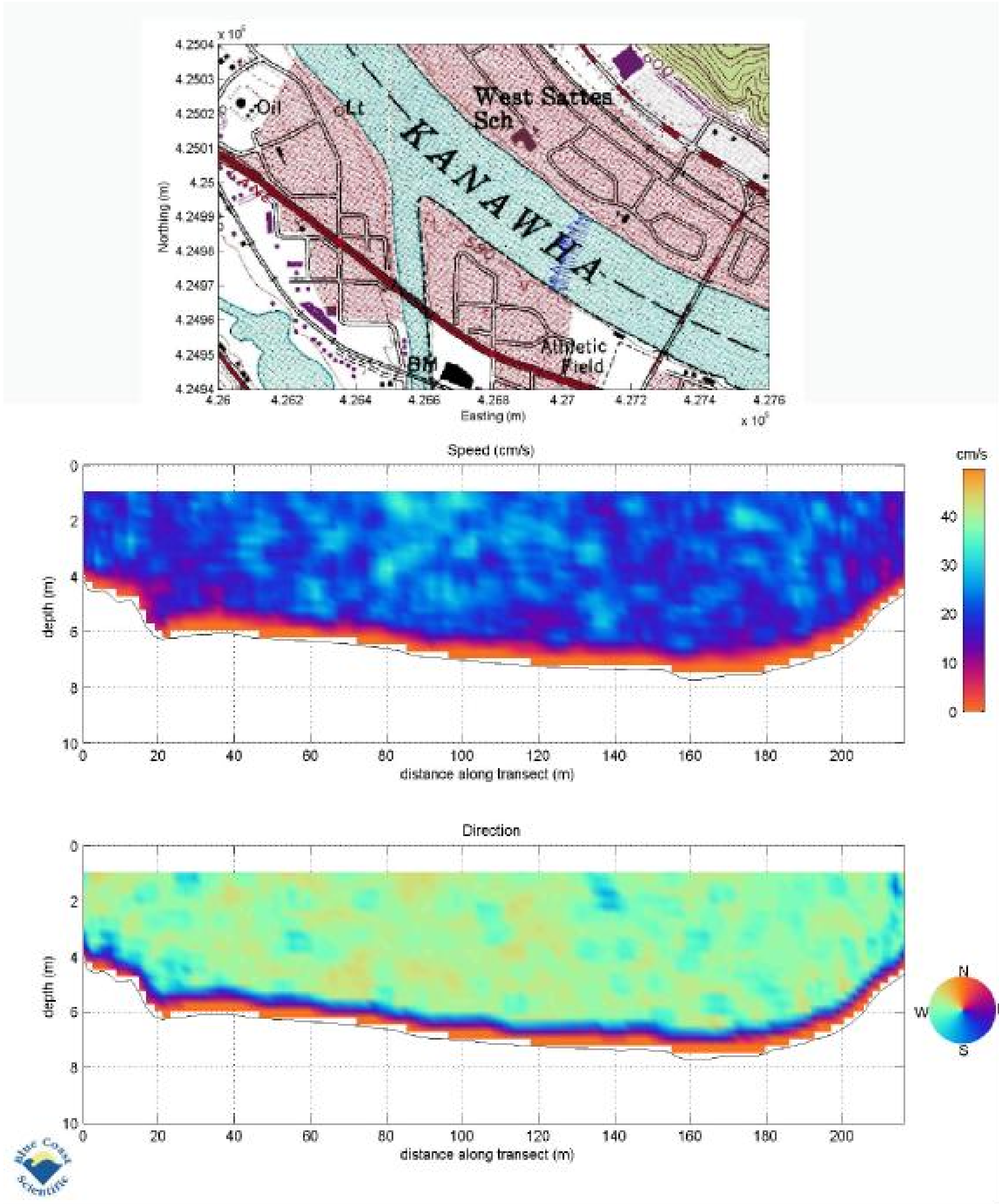

Figure 12. Transect Q2 measured at river mile 46. The transect was navigated from left to right looking upstream (N to S). The river channel is relatively flat, but slightly deeper on the south side of the channel.

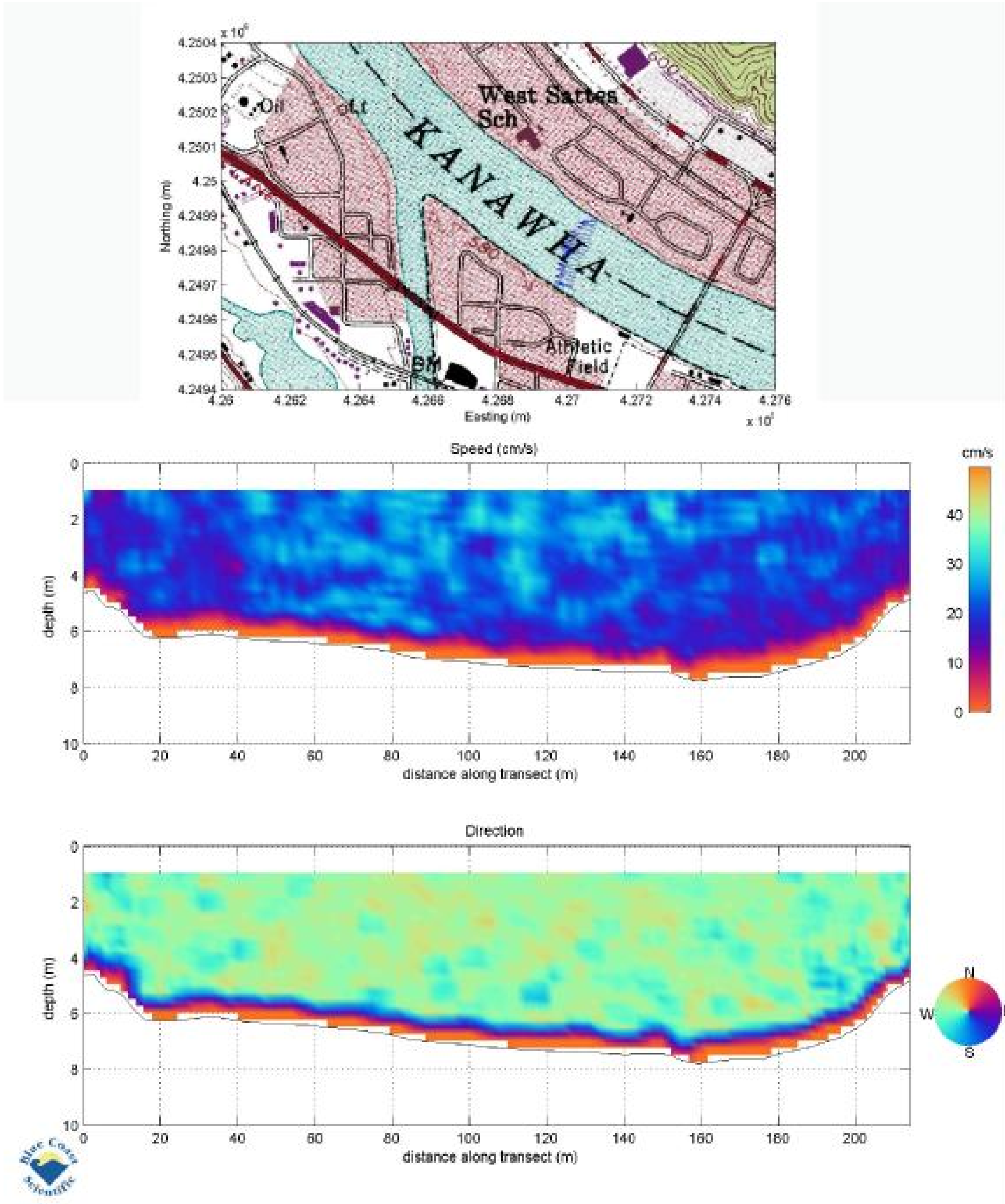

Figure 13. Transect Q3 measured at river mile 46. The transect was navigated from left to right looking upstream (N to S). On average, river flow speeds were slightly higher during transect Q3.

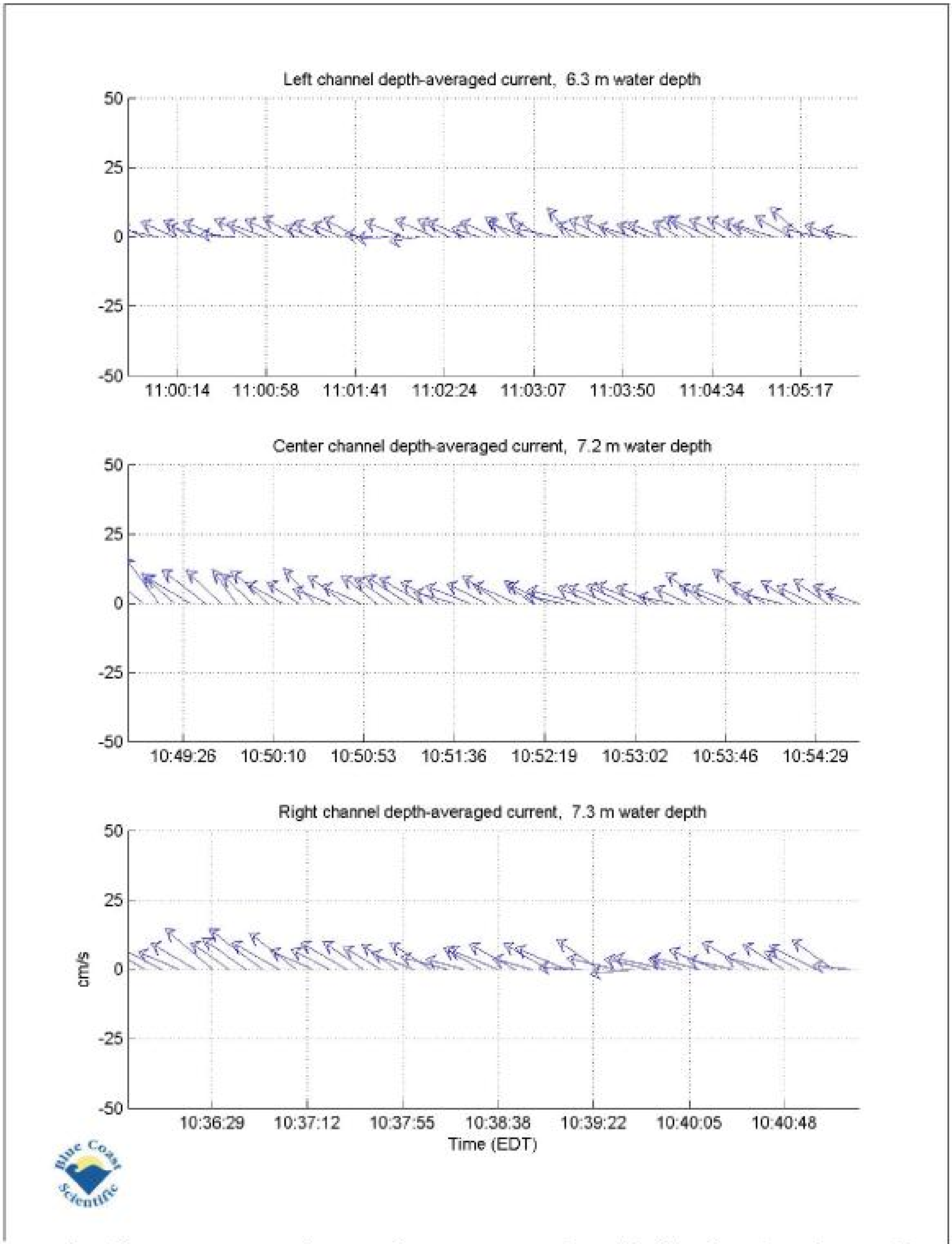

Figure 14. Depth-averaged velocity measurements near the left side (N), center, and right side (S) of the channel at river mile 46. Currents tended to ebb and flow, pulsing in speed, throughout the 5 minute measurement period at all three locations.

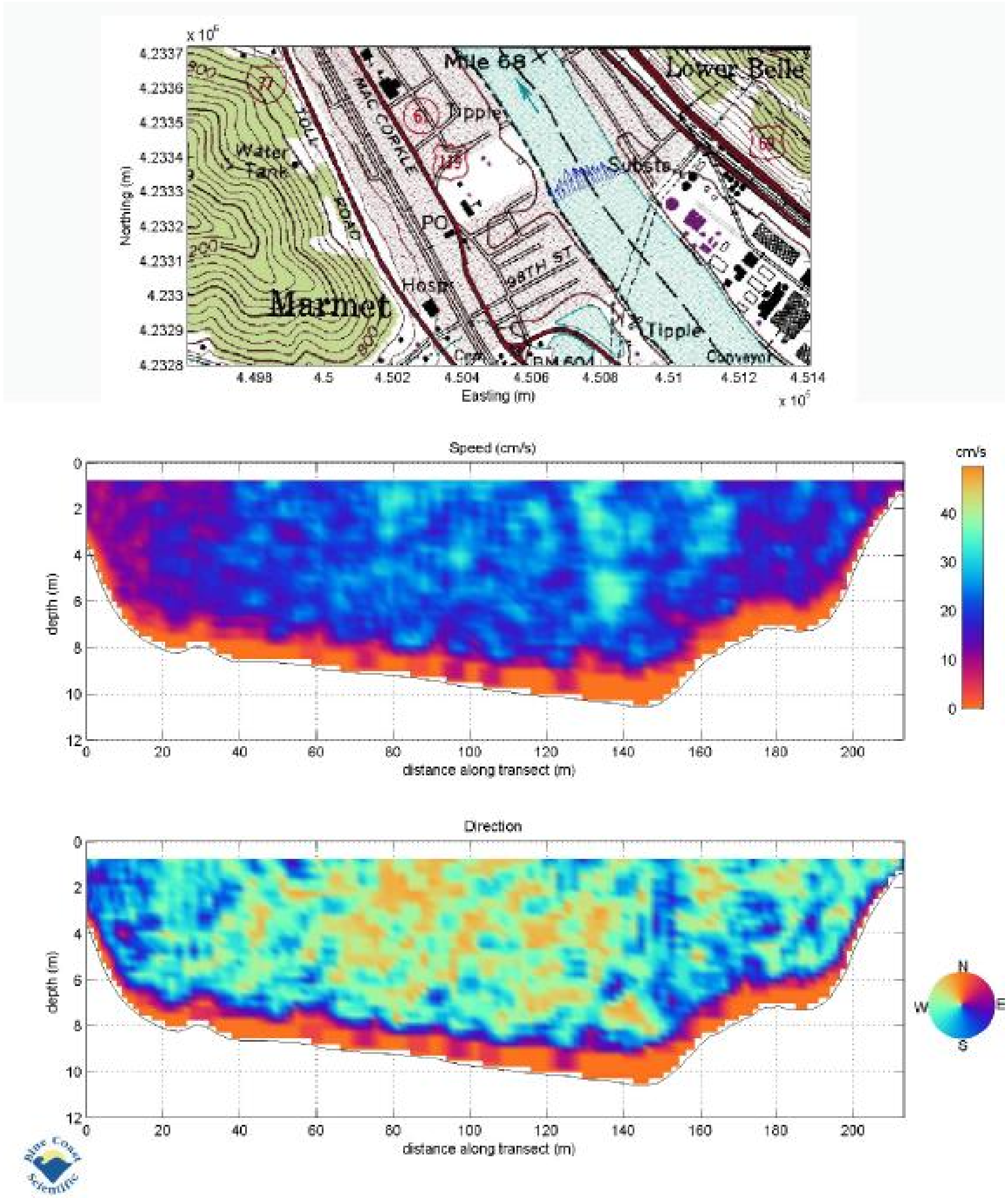

Figure 15. Transect Q1 measured at river mile 68, just downstream from the Marmet dam. The transect was navigated from left to right looking upstream (NE to SW). On average, river flow was approximately 25 cm/s directed towards the northwest. Flow speeds reached 40 cm/s in the profile approximately 140 m from the northeast side of the channel, where the water depth was approximately 10 m.

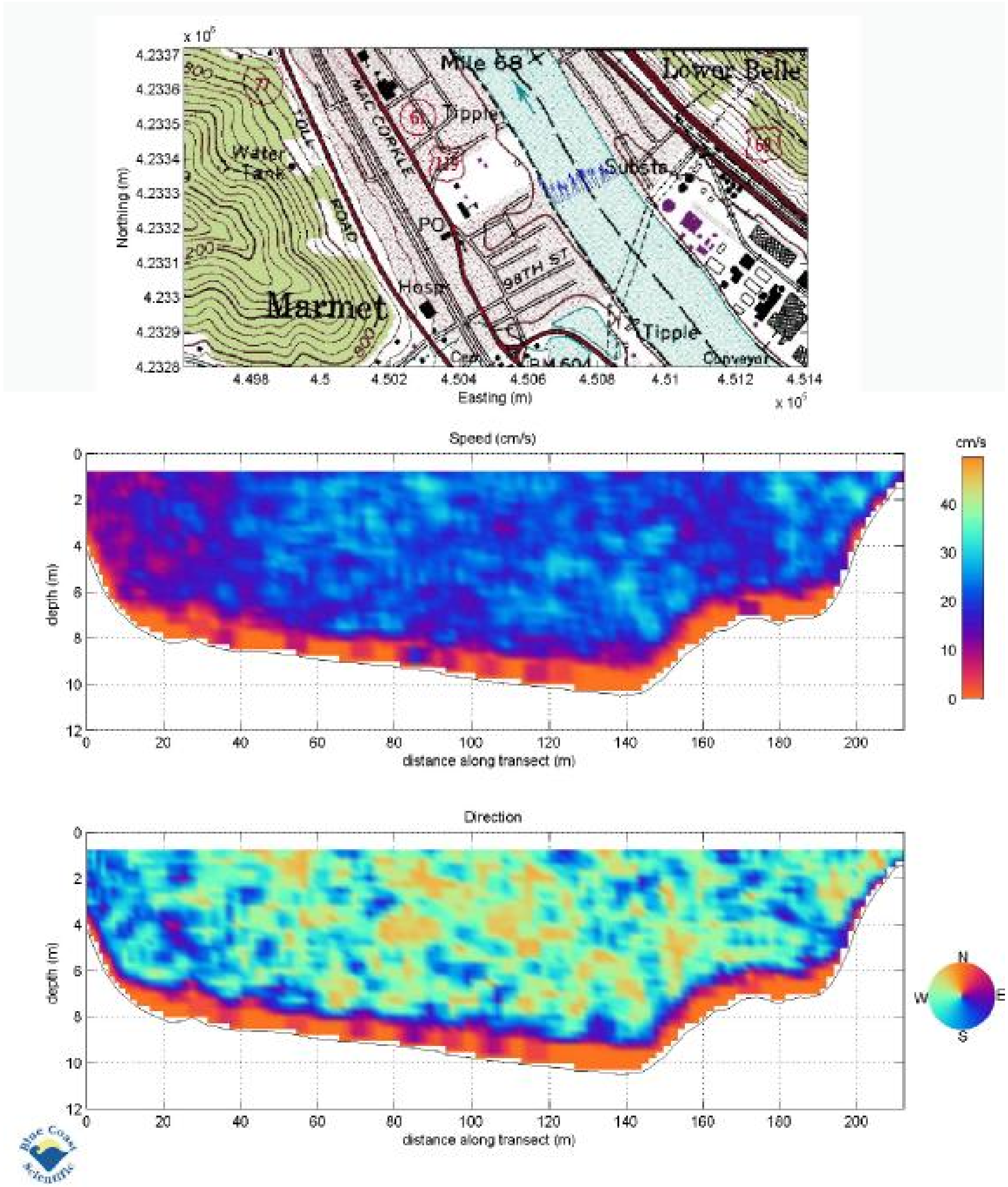

Figure 16. Transect Q2 measured at river mile 68, just downstream from the Marmet dam. The transect was navigated from left to right looking upstream (NE to SW). On average, river flow speeds were lower across transect Q1 than Q2.

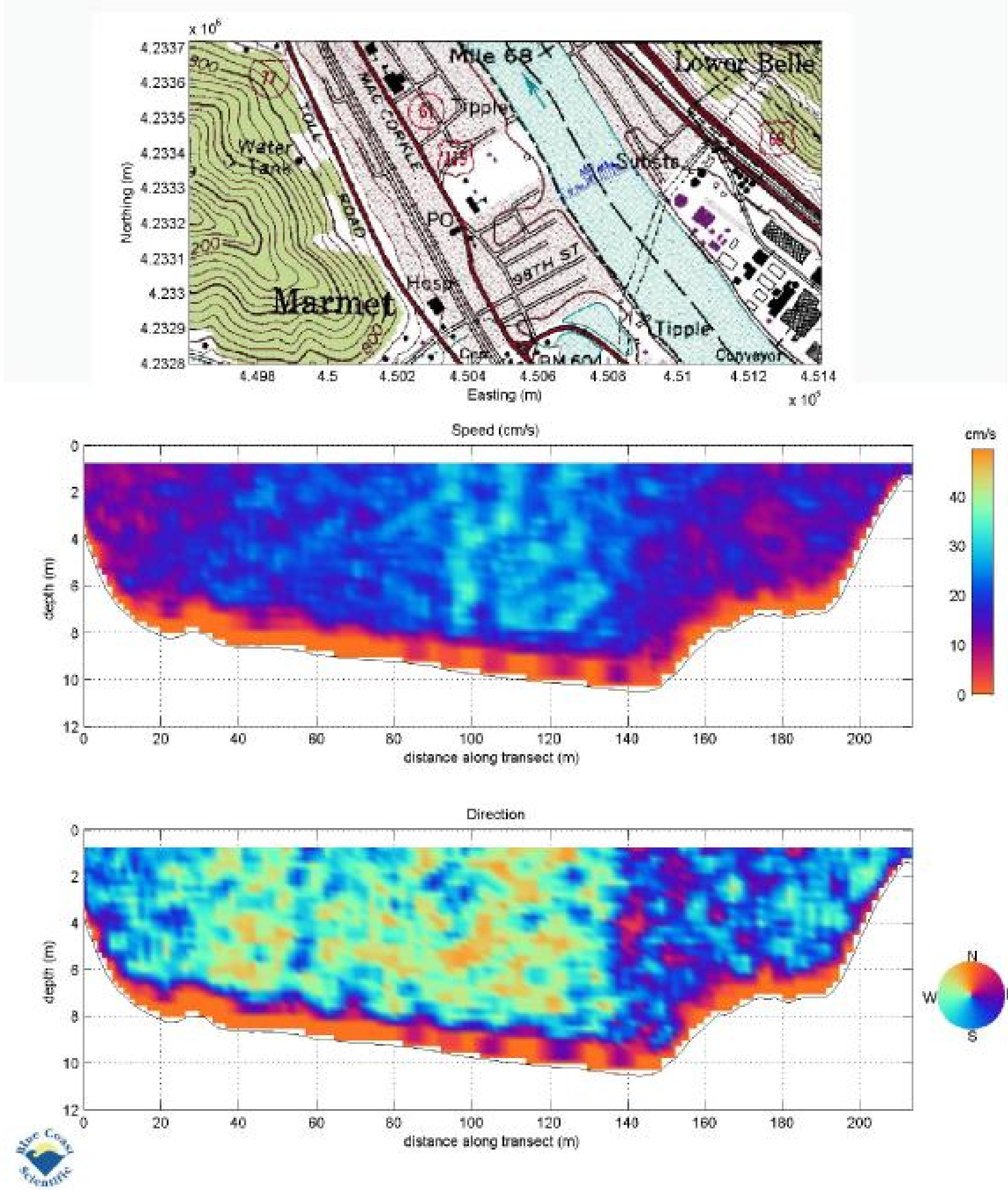

Figure 17. Transect Q3 measured at river mile 68, just downstream from the Marmet dam. The transect was navigated from left to right looking upstream (NE to SW). River flow was directed towards the center of the channel across this transect. In the top figure, depth-averaged current vectors on the southwest side are directed northerly, towards the center of the channel. In the lower figure, currents on the right side (southwest side) show the same northerly trend throughout the water column.

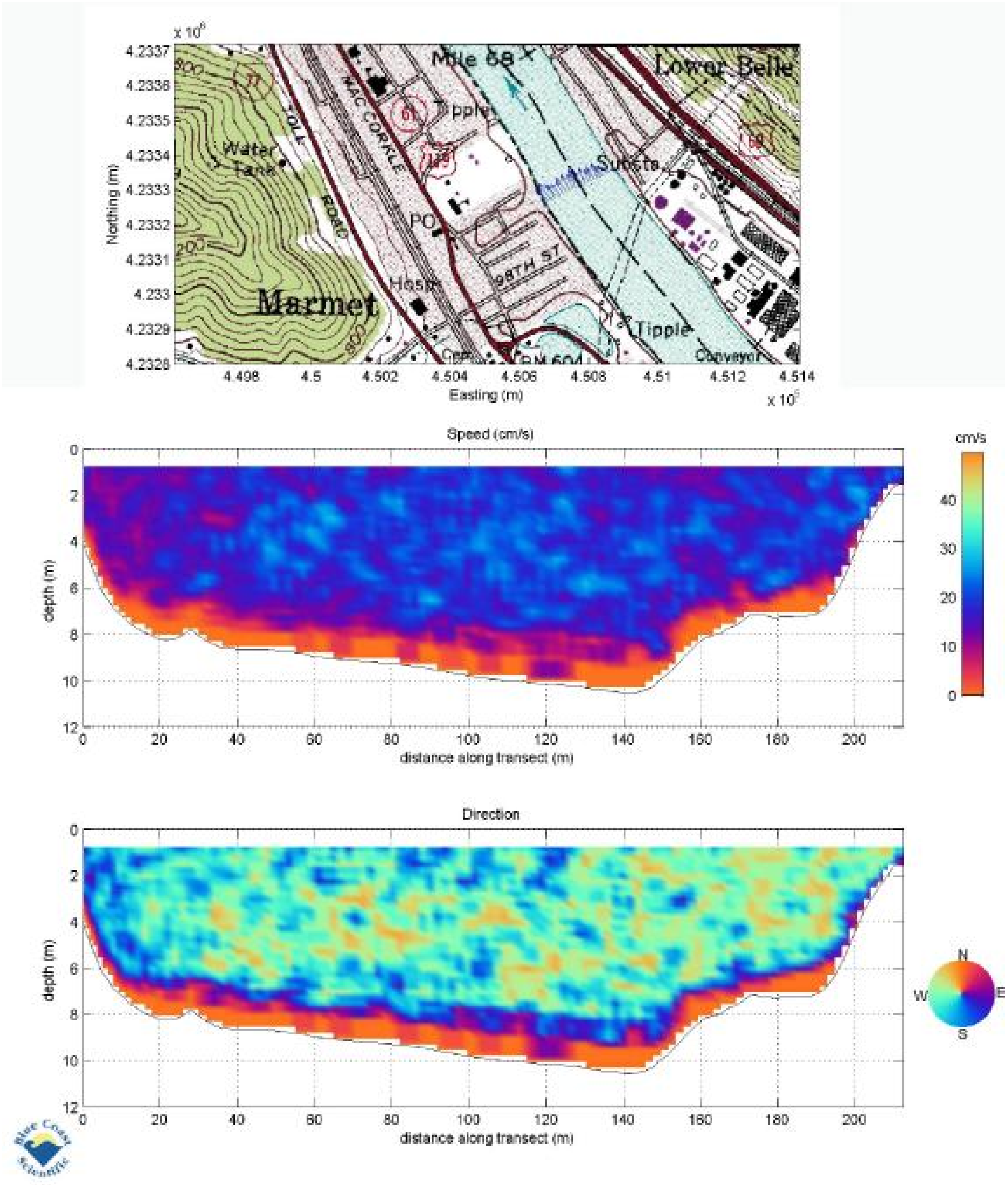

Figure 18. Transect Q4 measured at river mile 68, just downstream from the Marmet dam. The transect was navigated from left to right looking upstream (NE to SW). On average, river flow speeds were lowest across transect Q4 at river mile 68.

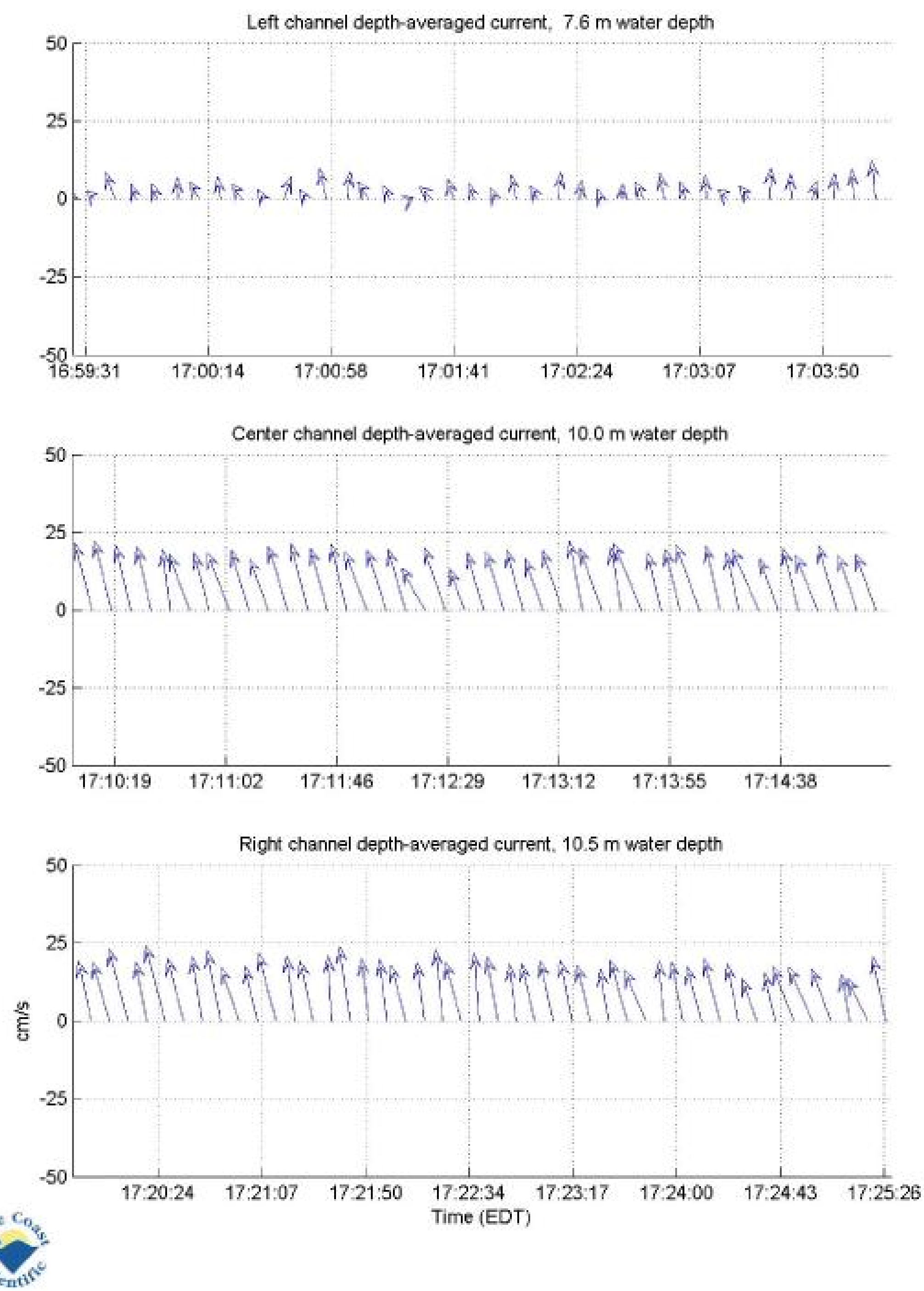

Figure 19. Depth-averaged velocity measurements near the left side (NE), center, and right side (SW) of the channel at river mile 68. Current speeds were weakest at the left channel location, on the steeply sloping side of the channel in a water depth of 7.6 m. Current speeds were relatively consistent at each individual station over the 5 minute time period.

APPENDIX C

SUMMARY OF PREVIOUS INVESTIGATIONS

APPENDIX C.1

SUMMARY OF PREVIOUS INVESTIGATIONS

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SUMMARY OF PREVIOUS INVESTIGATIONS

KANAWHA RIVER
NITRO, WEST VIRGINIA

FEBRUARY 2015
REF. NO. 031884 (51) – APPENDIX C.1
This report is printed on recycled paper.

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LIST OF ACRONYMS

%	percent
2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
2,4-D	2,4-Dichlorophenoxyacetic acid
2,4,5-T	2,4,5-Trichloropenoxyacetic acid
ACF Industries	American Car and Foundry Industries
ACLF	Armour Creek Landfill
Allied Chemical	Allied Chemical Corporation
Bayer	Bayer Corporation
CNFRL	Columbia National Fisheries Research Laboratory
COCs	Contaminants of Concern
CSM	Conceptual Site Model
Dow	Dow Chemical Company
EOC	Extent of Contamination
fg/L	femtograms per liter
FMC	FMC Corporation
FPRL	Fish Pesticide Research Laboratory
HCLF	Heizer Creek Landfill
HRS	Hazard Ranking System
Kanawha Dredging	Kanawha Dredging and Mineral Company
Midwest	Midwest Steel Corporation
MP	Mile Point
ND	Not detected
ng/kg	nanograms per kilogram
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
OCDD	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dixoin
ORSANCO	Ohio River Valley Water Sanitation Commission
OxyChem	Occidental Chemical Corporation
PCDDs	polychlorinated dibenzo-p-dioxins
pg/g	picograms per gram
Potesta	Potesta & Associates, Inc.
ppb	parts per billion
ppt	parts per trillion
PSML	Poca Strip Mine Landfill

LIST OF ACRONYMS
(cont'd)

QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
REMCOR	Remedial Corporation
Rhône-Poulenc	Rhône-Poulenc AG Company
River	Kanawha River
RM	River Mile
SATA	Site Assessment and Technical Assistance Team
Site	Kanawha River Site located in Nitro, West Virginia
TEQs	Total Toxicity Equivalents
TMDL	Total Maximum Daily Load
UCC	Union Carbide Company
UCL	upper confidence limit
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
U.S. ACE	United States Army Corps of Engineers
U.S. EPA	United States Environmental Protection Agency
U.S. FDA	United States Food and Drug Administration
U.S. FWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
Voyager Coal	Voyager Coal Company
Weston	Roy F. Weston, Inc.
WV	West Virginia
WB BPH	West Virginia Bureau for Public Health
WV CDC	West Virginia Center for Disease Control
WV DEP	West Virginia Department of Environmental Protection
WV DNR	West Virginia Department of Natural Resources
WVU	West Virginia University

1.0 SUMMARY OF PREVIOUS INVESTIGATIONS

This appendix provides a summary of previous environmental investigations that were completed at the Kanawha River (River) Site located in Nitro, West Virginia (WV) (Site). This information was utilized in conjunction with the potential source areas and Conceptual Site Model (CSM) information to focus the investigative efforts of the Extent of Contamination (EOC) Study. The Site extends 45.5 miles from the confluence of the Coal River to where the River enters the Ohio River. The Pocatalico River and Armour Creek segments of concern each extend two miles upstream of their respective confluences with the River (Limno-Tech, Inc., 2000).

A detailed summary of each investigation is provided in the following sections. The investigations are listed in chronological order, by location. Letters and memorandum have also been reviewed and have been listed according to the date of the correspondence.

1.1 KANAWHA RIVER

November 1976

Sampling and Analysis of Fish Tissues for Toxic Substances, EPA/FWS IAG-DY-01001, Final Report, U.S. Fish and Wildlife Service, 1980

This final report summarizes the results of an interagency agreement between the U.S. Fish and Wildlife Service (U.S. FWS) and United States Environmental Protection Agency (U.S. EPA). In November 1976, the U.S. FWS and the Columbia National Fisheries Research Laboratory (CNFRL) (known as the Fish Pesticide Research Lab (FPRL) at the time) agreed to sample several fish samples from their storage bank. Selected archived monitoring samples were analyzed for priority pollutants, including dioxins. This information was provided to U.S. EPA in order to assess the risks of exposure to these substances to people and the environment.

Approximately 180 samples representing selected collection sites of interest, collected over the period of 1970 through 1978, were analyzed for selected toxic substances. Thirty primary stations were selected from U.S. FWS freshwater fish monitoring network, and 24 secondary stations were chosen to be used as substitutes for primary stations, should the archive samples not be available. Samples collected prior to 1970 were not selected due to uncertainty of their validity due to storage problems.

Station No. 023 was located on the River at Winfield, WV. This station was not analyzed for dioxins, but was analyzed for phenols. Results indicated that no residues of phenolic compounds were present in 1970 or 1971, however were present in measurable levels in 1973, 1974, and 1976 samples. Dibenzofurans were found in the Ohio River at Station No. 024, Marietta, Ohio (1971 sample) and at Station No. 069, Cincinnati, Ohio (1970 sample) (Ludke, 1980).

August – November 1984, and September 1985

Work/Quality Assurance Project Plan, An Evaluation of Dioxin Contamination in Fish Tissue and Sediments in the Kanawha and Mud Rivers, WV, WV DNR, Draft – March 10, 1986

The Monitoring Branch of the Division of Water Resources of the WV Department of Natural Resources (WV DNR), prepared this Draft Work/Quality Assurance Project Plan. It was prepared to address the issue of dioxin contamination in fish in the Kanawha River from a spatial aspect, and to determine if sediments contain measurable amounts of dioxin. This report also summaries background investigations, which led to the 1984 fish consumption advisory.

The objective of the proposed sampling activity was to determine the extent of dioxin contamination in selected target fish species and sediments from a geographic standpoint. The proposed sampling locations were upstream and downstream of Nitro, WV, and in selected tributary areas, which include: Amour Creek and the Pocatalico River. Sediment samples were to be collected at fish sample sites located in depositional type areas.

The results of the investigation are to be used to determine the EOC beyond the Nitro area, the original study area that the fish advisory was based upon. Emphasis was on heavily fished areas in the River and other major tributaries, in order to determine if the existing fish consumption advisory is appropriate in terms of geographic boundaries and fish species.

In 1984, U.S. EPA conducted a National Dioxin Study, which was based on tiers, or categories of contamination. The tier scale ranged from one to seven, the lower the tier number, the greater the potential for higher levels of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD) contamination. The River at Nitro, and the River at Gauley Bridge, along with approximately 400 other U.S. sites were examined as part of this study. The River sites were classified as Tier 7 sites, which are defined as, "Networks of existing ambient stations where fish and soil were sampled to determine whether 2,3,7,8-TCDD is widespread in the environment, and if so, at what levels". The River at Nitro was chosen based on the presence of past chemical manufacturing processes involving dioxin. U.S. EPA and WV DNR collected samples from August to November 1984. Detectable levels of dioxin were found in fish from the River at Nitro at the following concentrations:

- Largemouth bass fillet: 13 parts per trillion (ppt) (0.013 parts per billion (ppb))
- Smallmouth bass fillet: 22 ppt (0.022 ppb)
- Whole Black buffalo: not detected at or above 1.2 ppt (ND (1.2) ppt) (ND (0.0012) ppb)
- Whole Smallmouth bass: 31 ppt (0.031 ppb)
- Whole Spotted bass: 51 ppt (0.051 ppb)

Based on these results, the WV Center for Disease Control (WV CDC), and the U.S. Department of Health and Human Services commented that only two of the samples were fillets. Fillet samples are more representative of human health risks than whole samples, since fillet specimens contain only the edible portion of the fish. Whole fish samples are more representative of the ecosystem, as analysis can detect 2,3,7,8-TCDD contaminated soil contained in the fish gastrointestinal track, which is not consumed by humans. It was noted that this would explain why whole samples had higher 2,3,7,8-TCDD levels. The U.S. Food and Drug Administration (U.S. FDA), has stated fish contaminated with 2,3,7,8-TCDD levels exceeding 50 ppt (0.05 ppb), should not be consumed and not to consume fish at levels 25 – 50 ppt (0.025 – 0.05 ppb) more than twice per month.

Additional fish samples were collected in September 1985 in response to these comments. All samples were fillets and samples consisted of a greater number of species, individuals per sample, and samples than the 1984 sampling event. Concentrations of 2,3,7,8-TCDD and tissue lipids were as follows:

- Largemouth bass: 2.1 – 5.3 picograms per gram (pg/g) (0.0021 – 0.0053 ppb), 0.3 – 0.4 percent (%) lipids
- Spotted bass: 13.0 pg/g (0.013 ppb), 0.5 % lipids
- Smallmouth bass: 6.8 pg/g (0.068 ppb), 0.3% lipids
- Sauger: 6.0 – 6.4 pg/g (0.006 – 0.0064 ppb), 0.5 – 0.7 % lipids
- Channel Catfish: 6.9 – 38.1 pg/g (0.0069 – 0.0381 ppb), 1.5 – 2.0% lipids
- Smallmouth buffalo: 19.8 – 56.0 pg/g (0.0198 – 0.056 ppb), 2.1 – 4.6% lipids
- Freshwater drum: 7.1 – 9.5 pg/g (0.071 – 0.095 ppb), 0.7 – 1.3% lipids

The WV Governor's Office issued a fish advisory based on these results on March 1, 1986. The public was advised not to consume fish caught in the River from the mouth of the Coal River in St. Albans, to the confluence of the River and the Ohio River at Point Pleasant, WV (WV DNR, 1986).

October 1984

Memorandum – 2,3,7,8-Tetrachlorodibenzodioxin (TCDD) Contamination of Fish in the Kanawha River, Nitro, WV, Center for Disease Control, 1985

The WV CDC sent this memorandum to Charles C. Walters, Public Health Advisor for U.S. EPA Region III on June 28, 1985 in response to data that U.S. EPA sent to WV CDC.

U.S. EPA submitted five fish samples for analysis for 2,3,7,8-TCDD. Specimens were collected from the River near Nitro. This sampling was conducted in response to recommendations from WV CDC, which was previously provided as part of a review of the Old Monsanto Chemical facility conducted in October 1984.

Samples were composites of ten fish, composited by fish species. Results are summarized as follows:

- Largemouth bass fillet: 13 ppt (0.013 ppb)
- Smallmouth bass fillet: 22 ppt (0.022 ppb)
- whole Black buffalo: not detected (ND) (1.2) ppt (ND(0.0012) ppb)
- whole Smallmouth bass: 31 ppt (0.031 ppb)
- whole Spotted bass: 51 ppt (0.051 ppb)

WV CDC concluded that the presence of 2,3,7,8-TCDD in fish from the River indicated that 2,3,7,8-TCDD is a contaminant of that ecosystem. The WV CDC further stated that "although dioxin concentrations in the fish fillet samples are not above 25 ppt (0.025 ppb), the presence of other fish contaminants, as indicated by a previous WV fish consumption advisory, in addition to dioxin poses a health threat to persons regularly consuming fish from the segment of the Kanawha River" (Jones, 1985).

November 1984, September 9, 1985

Draft - Assessment of Lifetime Cancer Risk from Consuming Fish Contaminated with 2,3,7,8-Tetrachlorodibenzo-p-dioxin from the Kanawha River, WV, U.S. EPA, 1986

This report was prepared by U.S. EPA in order to determine 2,3,7,8-TCDD concentrations in edible portions of fish from the River near Nitro, and to assess the risk of consuming specific fish species.

In November 1984, U.S. EPA analyzed samples of fish from the River near Nitro for 2,3,7,8-TCDD at the request of WV CDC. Samples contained detectable concentrations of 2,3,7,8-TCDD. WV CDC concluded that although dioxin concentrations in fish fillets were not above 25 ppt (0.025 ppb), the presence of other contaminants in addition to dioxin posed a health threat to those who regularly consumed the fish.

Additional fish sampling was conducted by WV DNR to address this issue. On September 9, 1985, fish samples were collected along the north bank of the River between Poca (MP 39.6) and Nitro (MP 41.9). Sampling was conducted approximately where the 1984 fish samples were collected, and entirely within the backwater from the Winfield Dam. Armour Creek enters the River in this area. The highest concentration of 2,3,7,8-TCDD found was 56 pg/g (0.056 ppb), and was observed in a composite of 5 fillets from Smallmouth buffalo. The lowest concentration of 2.1 pg/g (0.0021 ppb), was found in a composite of five largemouth bass fillets.

In terms of estimated lifetime excess cancer risks, Smallmouth buffalo were found to have the highest mean risk, 0.24 meals per year for a risk of 1 in a 100,000. Largemouth bass had the lowest mean risk 2.0 meals per year for a risk for 1 in a 100,000. U.S. EPA therefore advised consumers not eat more than one 8-ounce meal of Largemouth bass fillet per year, or one meal of Smallmouth buffalo fillets every 8.3 years.

U.S. EPA stated that since 2,3,7,8-TCDD appeared to be strongly partitioned to tissue lipids, consumption of oily fish likely carries a higher risk than eating lean fish (Smith, 1986_1).

1984, October 1985, July 28, 1987

A Study of Dioxin Contamination in Sediments in the Kanawha River Basin, EPS-QA87-004, Final Project Report, EPA Region III, 1988

In 1984, U.S. EPA conducted a National Dioxin Study, during which samples of fish tissue were collected from the River at Nitro. The study classified this area as a "Tier 2" site, indicating that it is "possibly contaminated with 2,3,7,8-TCDD by the manufacture of pesticides from 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T) and associated disposal practices". In October 1985, five samples of fish tissue were collected at Nitro, and results reported that whole fish samples of Small-mouthed bass and Spotted bass were contaminated with 31 pg/g (0.031 ppb), and 51 pg/g (0.051 ppb) of 2,3,7,8-TCDD, and fillets of Largemouth bass, and Smallmouth buffalo contained 13 pg/g (0.013 ppb) and 22 pg/g (0.022 ppb) of 2,3,7,8-TCDD.

As a result of the 1984 study, in 1986 WV Governor Arch Moore advised the public not to consume fish collected from the Kanawha River in the area between the Coal River and the Ohio River.

As a result of these finding, U.S. EPA conducted sediment sampling in April 1986, in order to meet the following objectives:

- Determine the area extent of 2,3,7,8-TCDD contamination
- Determine if contamination is continuing
- Locate "hot spots" of contamination
- Locate any present sources

Fifty-one sediment samples were analyzed for 2,3,7,8-TCDD and results determined that:

- Sediments in the lower River are uniformly contaminated with 2,3,7,8-TCDD levels approaching 100 nanograms per kilogram (ng/kg) (0.1 ppb)
- 2,3,7,8-TCDD inputs may be continuing, or scouring and bioturbation may be maintaining the high 2,3,7,8-TCDD concentrations in surface sediments
- There are two 2,3,7,8-TCDD hot spots, the Pocatalico River near Poca, and at the mouth of Armour Creek

U.S. EPA determined two hypotheses regarding continuing sources:

- 2,3,7,8-TCDD was or is being released from landfills near the two 2,3,7,8-TCDD hot spots, and this contamination has spread throughout the lower River
- 2,3,7,8-TCDD was or is being released into the River from unknown sources, and has accumulated in the backwaters of Armour Creek and the Pocatalico River

In order to investigate the hypotheses, U.S. EPA conducted an additional sampling activity on July 28, 1987. To test the first hypotheses, sampling stations were located near the landfills next to Armour Creek and the Pocatalico River. To test the second hypothesis, sampling stations were located in Bills Creek and Lingbarger Creek.

U.S. EPA concluded that data supports the second hypothesis, which states that contamination is from unknown sources and is being deposited in slow-flowing backwaters of tributaries along the River. It was also concluded that low-level dioxin contamination is widespread in the lower River backwater areas below Nitro.

Dioxin was not detected in sediment samples collected from the Coal River, which indicates that the source(s) are downstream of the Coal River, probably at or below Nitro. The highest concentrations of dioxin were found in sediments collected from the mouths of backwater River streams.

Contamination in Armour Creek was more widespread than expected, indicating additional sources in that watershed. The highest concentration in Armour Creek was found near its mouth. Dioxin sediment concentrations exceeded 1 ppb in Armour Creek.

The highest dioxin contamination in the Pocatalico River was found at Station No. 1 near its mouth. There was also contamination at the mouth of Linbarger and Bills Creek. Dioxin sediment concentrations exceeded 1 ppb in Linbarger Creek, and low-level contamination, less than 0.1 ppb, was found in sediment samples from the Pocatalico River and Bills Creek.

U.S. EPA recommendations included:

- Developing a backwater sediment sampling program in the area south of Charleston to further define contamination problems
- Conducting verification sampling in Linbarger Creek for possible remedial action
- Consideration of a remedial action in Armour Creek due to continued high levels of dioxin
- Conducting soil sampling along the railroad right-of-way in order to determine a possible source (U.S. EPA Region III, 1988)

1985 - 1987

Letter from WV DNR to U.S. EPA Region III, U.S. Army Corps of Engineers dioxin data from Kanawha and Ohio River fish samples

This letter prepared by WV DNR presents dioxin data from the River and Ohio River fish samples collected by the U.S. Army Corps of Engineers (U.S. ACE) in 1986. It also presents a summary of fish tissue data collected in the River during 1985 to 1987.

Results provided by U.S. ACE, Huntington District, Operations and Readiness Division which was attached to the WV DNR letter. Results reported that 2,3,7,8-TCDD was only detected in channel catfish samples, and was below the detection level of approximately 1 ppt (0.001 ppb) in all other species examined. WV DNR noted that this was disturbing news, since dioxin was found in samples from Marmet at 26.4 ppt (0.0264 ppb), and at Gallipolis 21.9 ppt (0.0219 ppb) which are areas where it was not expected to be found. The concentration of 2,3,7,8-TCDD detected at the Winfield Locks and Dam was reported as 26.0 ppt (0.026 ppb) (WV DNR, NA).

April 4, 1986

Internal Memorandum from Roy L. Smith, U.S. EPA Region III: Sampling of Kanawha River Fish and Sediments for Dioxin Analysis

This memorandum reiterates WV Governor Arch Moore's advisory against consuming fish collected from the River between St. Albans and the confluence of the Kanawha and Ohio Rivers. The advisory is based on high concentrations of 2,3,7,8-TCDD found in fish fillets collected from the Nitro, WV area.

U.S. EPA and WV DNR were cooperating to further study the extent of contamination. The goals of the study were to determine the aerial extent of fish contamination, determine the aerial extent of sediment contamination, and to search for "hot spots" of sediment contamination. The investigation was to involve collecting fish tissue samples from 10 locations, and sediment samples from 17 locations. The Quality Assurance Project Plan (QAPP) states that 46 sediment and 40 fish tissue samples were to be collected, and samples analyzed for 2,3,7,8-TCDD at a detection limit of 1 pg/g (0.001 ppb). In addition, one sediment sample and three fish samples were to also be analyzed for pent- and hexa- isomers of polychlorinated dibenzo-p-dioxins (PCDDs) and possibly furans. Five fish tissue samples, which were captured by U.S. FWS in the Winfield area in 1976, 1978, and 1980 were to be analyzed for 2,3,7,8-TCDD at the same time as the new samples.

It was also noted that Senator Byrd recently received a letter from a constituent, which raised the possibility that Old Monsanto disposed of waste toluene in their Armour Creek Landfill (ACLF). Since toluene is reasonably water soluble, and is a good solvent for dioxin, it is suggested that dioxins buried at the ACLF site could migrate into groundwater, and into the River. It was therefore concluded that groundwater at the site should be sampled for both toluene and dioxin (Smith, 1986$_4$).

April 1986

Concentrations of 2,3,7,8-Tetrachlorodibenzo-p-dioxin in Sediments in the Kanawha River, WV and Proposal for Further Sediment Sampling, U.S. EPA, 1986

U.S. EPA Region III prepared this report as part of a cooperative effort between U.S. EPA and WV DNR to study 2,3,7,8-TCDD contamination in the River near Nitro, WV. This cooperative effort was the result of findings of 1984 U.S. EPA National Dioxin Study, and 1983 U.S. FDA fish advisories for 2,3,7,8-TCDD. The report summarizes the reasoning behind the joint effort, sampling activities conducted to date, and the findings of sediment sampling in the River in April 1986.

In 1984, U.S. EPA conducted a National Dioxin Study, during which five fish tissue samples were collected from River near Nitro, WV, and this area was classified as a Tier 2 site. A Tier 2 site is a site that is possibly contaminated with 2,3,7,8-TCDD by the manufacturer of pesticides from 2,4,5-trichlorophenol, and the associated disposal practices. U.S. EPA reported that whole fish samples of Smallmouth bass and Spotted bass were contaminated with 31 pg/g (0.031 ppb) and 51 pg/g (0.051 ppb) 2,3,7,8-TCDD, respectively. Fillets of Largemouth bass and Smallmouth bass were reported as 12 pg/g (0.012 ppb) and 33 pg/g (0.033 ppb) 2,3,7,8-TCDD, respectively.

In 1983, U.S. FDA advised Great Lakes fishermen not to consume fish containing 50 pg/g (0.05 ppb) 2,3,7,8-TCDD or greater, and not to consume fish containing 25 to 50 pg/g (0.025 to 0.05 ppb) 2,3,7,8-TCDD more then twice per month. Bass species typically contain lower residues of lipophilic organics as compared to other species such as channel catfish, and bottom feeders like Buffalofish. Since levels of 2,3,7,8-TCDD contamination near U.S. FDA levels of concern were reported in bass from the River, U.S. EPA concluded that other species may be contaminated with 2,3,7,8-TCDD at unacceptable levels.

The joint study has consisted of two sets of sampling to date. The first sampling event occurred in October 1985. Fillets from seven fish species were collected to detect differences in contamination among species. The second event was conducted in April 1986. Fillets from two fish genera were collected at seven locations to test the difference in concentration among locations. Results indicated that there is a significant difference in 2,3,7,8-TCDD concentration among species and location. The most contaminated fish were Smallmouth buffalo, White bass, channel catfish, and Freshwater drum. The least contaminated fish were Smallmouth bass, Sauger, Spotted bass, Largemouth bass, and Bluegill. The most contaminated areas were Armour Creek and the Pocatalico River, where the mean 2,3,7,8-TCDD residues in channel catfish fillets exceeded 25 pg/g (0.025 ppb), and the 90% upper confidence limits (UCLs) exceeded 50 pg/g (0.05 ppb). The fish tissue results confirmed the presence of unacceptable levels of contamination that could possibly endanger the health of fishermen. Based on the 1985 sample results, WV Governor Arch Moore issued an advisory not to consume fish collected from the River between the Coal and Ohio Rivers.

In April 1986, concurrent with the second set of fish tissue sampling, sediment sampling was conducted in the River, Armour Creek, and the Pocatalico River. The purpose of the sediment sampling was to determine the aerial extent of 2,3,7,8-TCDD contamination, determine if contamination was continuing, locate any "hot spots" of contamination, and locate any point sources. Results of the 2,3,7,8-TCDD analysis concluded that:

- There is widespread low-level 2,3,7,8-TCDD contamination at levels approaching 100 ng/kg (0.01 ppb) in sediments in the River, with hot spots in Armour Creek and the Pocatalico River
- 2,3,7,8-TCDD inputs to Armour Creek may be decreasing; however, 2,3,7,8-TCDD contamination of the Pocatalico River is increasing
- There are two hypotheses concerning continuing sources: contamination may have entered the tributaries directly from nearby landfills, or may have been deposited in backwater areas from the River

U.S. EPA recommended that additional sediment data be gathered to pinpoint 2,3,7,8-TCDD sources, and to test the two hypotheses. Proposed sediment sampling in Armour Creek and the Pocatalico River was designed to detect gradients from proximal sources. Proposed sediment sampling to downstream backwaters was proposed for Bills Creek (RM 38.2) and Linbarger Creek (RM 39.9). These samples were intended to characterize current 2,3,7,8-TCDD contamination and therefore included surface sediment samples only (Smith, 1986_2).

April and May, 1986

Dioxin Contamination in 1986 Fish Tissue Samples from the Kanawha River, Armour Creek, and the Pocatalico River, WV, 1986

This report was prepared by Roy L. Smith, et al. (Smith) for WV DNR.

In April and May 1986, fish were collected from Stations 1, 2, and 4 through 8 located on the River. Stations 3, 9, and 10 were not sampled because they were considered conditional stations that would be sampled pending the results from previous sampling. The target species for sampling were Largemouth, Smallmouth and Spotted basses, and channel catfish. Four composite samples were taken at each station, two channel catfish, and two bass, with each composite sample consisting of 3 to 5 fish.

Analytical results reported that channel catfish were significantly more contaminated with 2,3,7,8-TCDD than bass. Fish from Nitro and Plymouth were found to be the most contaminated at 45 ppt (0.045 ppb) and 35 ppt (0.035 ppb), respectively. Fish from St. Albans and Winfield had the lowest 2,3,7,8-TCDD concentrations at 2 to 5 ppt (0.002 to 0.005 ppb) and 5 to 16 ppt (0.005 ppb to 0.016 ppb), respectively. It was also noted that contamination of catfish varied more by location than did bass.

Included in Smith's report was Table 3, which provided mean 2,3,7,8-TCDD concentrations for each genus, location, and 90% UCLs for these means. There was a 50% probability that the true mean 2,3,7,8-TCDD concentrations were higher than estimated means, however only a 5% probability that the true means were higher than the 90% UCLs. It was therefore suggested that UCL values and not the mean be used to estimate upper bound human health risks from consuming fish.

Smith concluded that due to the significant interaction between species and location, some fish were considerably more contaminated with 2,3,7,8-TCDD than the means suggest. The highest 2,3,7,8-TCDD concentration was found in channel catfish collected from Armour Creek, which had a mean tissue concentration of 40.5 pg/g (0.0405 ppb), and a 90% UCL of 68.0 pg/g (0.068 ppb). Due to the possibility that there may be fishermen that consume fish exclusively from Armour Creek, Smith recommended that the UCL be used to estimate upper bound risks to individuals exposed at the maximum level (Smith, 1986_3).

July 17, 1986

Site Visit with Pamela Hayes as Requested by Mr. Boggess of St. Albans, WV DNR, 1986

On July 17, 1986, WV DNR inspectors Pamela Hayes and Rebecca J. Robertson visited the Rock Branch/Poca area to view three potential landfill areas. The trip was made at the request of Mr. Boggess of St. Albans, who requested that these areas be investigated due to Old Monsanto dumping materials at these areas several years prior to the investigation.

Inspectors reported that they were already aware of two of the three sites; however, the third was a new discovery, and most likely to contain dioxin wastes. The site in question was reported as being "located on Manila Creek, approximately one mile out on the right".

WV DNR Inspectors concluded that the site should be reported to U.S. EPA for further investigation (Robertson, 1986).

1990 to 1998

Updated Kanawha River Fish Consumption Advisory, WV Bureau for Public Health, 2000

WV DNR, WV Department of Environmental Protection (WV DEP), with assistance from U.S. EPA and WV University (WVU) sampled several species of fish in the River. These species include the following:

- Largemouth bass
- Smallmouth bass
- Spotted bass
- White bass
- Hybrid striped bass
- Suckers
- Crappie
- Sauger
- Freshwater drum
- Channel catfish

High dioxin concentrations were consistently found in channel catfish and hybrid striped bass.

Examination of historic sampling results revealed that traces of dioxin have been found in the edible portions of fish. The highest dioxin concentration, 70.93 ppt (0.07093 ppb) was found in hybrid striped bass collected from the River near Scary, WV and the lowest concentration, 0.89 ppt (0.00089 ppb) was found in crappie collected at Institute, WV. Results for channel fish ranged from 3.71 ppt (0.00371 ppb) to 68.21 ppt (0.06821 ppb) 2,3,7,8-TCDD.

As a result, the WV Bureau for Public Health (WV BPH), WV DNR, and WV DEP updated a fish consumption advisory that had been in place since 1986. The previous advisory included catfish and other bottom-feeding species caught in the River between the Coal River and Point Pleasant. The updated advisory includes additional fish, and extends from the Interstate 64 bridge at Dunbar downstream to Point Pleasant. This also covers Manila Creek, Heizer Creek, Armour Creek, Bills Creek, and the lower two miles of the Pocatalico River.

The updated advisory was also based on data obtained from a sampling event U.S. EPA performed in 1998, all data collected since 1990, and new protocols for setting risk levels for consumption of fish developed by the agencies through a contract with WVU. These new protocols contain more stringent guidelines than previously issued U.S. FDA guidelines.

The advisory entitled, WV Sport Fish Consumption Advisory Guide, recommends not consuming fish with a dioxin concentration greater than 20.7 ppt (0.0207 ppb) for both adults and children. This advisory was more protective than U.S. FDA standards previously used to establish advisories, which recommend 50 ppt (0.050 ppb) for the general public, and 25 ppt for children and women of a child-bearing age (Weston, 2000_1).

September 1998

Trip Report, Kanawha Valley-Dioxin Site, Nitro, Putnam County, WV, Weston, 1999

Complaints were made to WV DEP by residents living along the Pocatalico River, Heizer Creek, and Manila Creek who were concerned about the possibility of dioxin leaching from nearby landfills into these water bodies. In September 1998, U.S. EPA, in coordination with WV DEP, conducted a windshield assessment of four landfills of concern in the Nitro and Poca areas of Putnam County. These landfills included: the

Manila Creek Landfill, the Heizer Creek Landfill (HCLF), the Poca Strip Mine Landfill (PSMLF), and the ACLF.

On November 9, 1998, U.S. EPA directed the Roy F. Weston, Inc. (Weston) Site Assessment and Technical Assistance Team (SATA) to conduct a sampling assessment of dioxin contamination along the River Valley between Mile Point (MP) 39 and MP 49. This included sediment sampling along the Pocatalico River, Heizer Creek, Manila Creek, and Armour Creek in order to assess the levels of 2,3,7,8-TCDD being released from the four landfills of concern. Weston was also directed to investigate the impacts on the local fish population.

Sampling concentrated on determining dioxin levels downgradient of the four landfills, and therefore sampling occurred in three categories: downgradient of the landfills, in surface sediment, and fish sampling.

Elevated dioxin levels found downgradient of HCLF and the Manila Creek Landfill were determined to be possibly due to the migration of dioxin from the landfills. Creek sediment results of 4.9 ng/kg (0.0049 ppb) at Heizer Creek, and 6.8 ng/kg (0.0068 ppb) at Manila Creek were equivalent to the residential soil risk-based concentration of 4.3 ng/kg (0.0043 ppb) for dioxin. Therefore, it was noted that elevated sediment results from any stream could be due to a historical concentration of dioxin in sediment, and not necessarily due to continuous release from the landfills. Weston recommended that an additional study be conducted to delineate a historical concentration of dioxin in stream sediment from elevated levels due to migration from landfills.

Based on composite soil samples results and sediment samples collected at the entry point of Armour Creek, it was determined that elevated levels of dioxin were due to migration from the ditchline north of the railroad. Historical research conducted by Weston determined that the former Midwest Steel Corporation (Midwest) site and the adjacent landfill drain into the ditchline.

In regard to fish results, it was concluded that dioxin levels exceeded risk-based concentrations of 0.021 ng/kg (0.000021 ppb) at all locations, and increased significantly downstream of River MP 49. Results indicated that the highest fish dioxin levels are at MP 42 and MP 36, and at Armour Creek. In addition, fish dioxin levels at the Pocatalico River and Bills Creek were also significantly greater than those upstream at MP 49 (Weston, 1999).

1999

<u>Dioxin Contamination of the Ohio and Kanawha Rivers, WV Citizen Research Group, Baker, 1999</u>

The WV Citizen Research Group produced this study of dioxin in the Ohio and Kanawha Rivers in 1999, with funding from the Virginia Environmental Endowment.

The WV Citizen Research Group reports that dioxin in the River and other water bodies downstream of Nitro, including hundreds of miles of the Ohio River, is chemically traceable back to Old Monsanto's production of 2,4,5,-T between 1948 and 1969. They further state that dioxin still remains in the soils, sediments, groundwater, and river water of the Nitro area three decades after the production of 2,4,5-T ended. The dioxin has concentrated up the food chain, making fish from the River 1,000 times more likely to cause cancer in the consumer than from U.S. EPA's safe level. In 1998, the River carried a dioxin load that exceeded U.S. EPA's estimated total dioxin discharge from the entire U.S. pulp industry. For these reasons, the WV Citizen Research Group felt that the site should be placed on the National Priority List (NPL).

The study also states that the U.S. EPA draft Total Maximum Daily Load (TMDL) of the River dioxin did not report the geographic proximity of dioxin hotspots in the River's sediments to Old Monsanto's riverbank pesticide dumps and location of the former 2,4,5-T building. The draft also failed to mention Old Monsanto's (now Flexsys), wastewater outfall as a potential source area. It is suggested that the Old Monsanto's dioxin contamination in the Nitro area should be recognized in the NPL of Superfund sites, as other major Agent Orange sites have been already added to the list. The group stated that both the draft TMDL and site status reflect favoritism that U.S. EPA and the WV governor have shown Old Monsanto. The WV Citizen's Group stated that citizens are cautioned to remain skeptical of the motives of both Old Monsanto and government bureaucrats.

The WV Citizen Research Group report concluded with the following recommendations regarding dioxin standards and TMDLs:

- U.S. EPA should adopt a stringent enforceable dioxin standard for fish and new detection methods for water. This would make TMDLs more commonplace, which would place a greater burden on U.S. EPA and dioxin levels much lower than those in the River would be recognized as unhealthy.
- U.S. EPA needs to adopt a strategy to reduce the nation's major dioxin sources in order to deal with a multitude of dioxin TMDLs.

- The draft TMDL should be re-written to include all available relevant data from U.S. EPA and other federal, state, and regional agencies.
- The U.S. EPA Region III director should create a new TMDL team for the River in order to include team members from Resource Conservation and Recovery Act (RCRA), Superfund, and National Pollutant Discharge Elimination System (NPDES) programs; watershed groups including the United States Geological Survey (USGS), U.S. FWS, U.S. ACE, and the Ohio River Valley Water Sanitation Commission (ORSANCO), and citizens groups such as the WV Citizen Research Group and the Heizer-Manila Watershed Association.

The WV Citizen Research Group also concluded that the TMDL process has been delayed by U.S. EPA and feels that it would be better to start the report over again rather than to accept the current draft. Information should continue to be collected and incorporated to fill data gaps. As other important TMDLs will be based largely on the information in the River TMDL, the deadline for the report should be allowed to coincide with the deadline for the Ohio River. The WV Citizen Research Group stated that the River TMDL should be recognized as a means of dealing with one of the nation's worst cases of water pollution (Baker, 1999).

February 2000

<u>2000 – Trip Report, Kanawha River Valley Site (Nitro Storm Sewer/Outfall Investigation), Weston</u>

In the mid 1980's, WV DNR and U.S. EPA conducted a study which revealed significant levels of dioxin in sediment and fish tissue samples. In September 1998, U.S. EPA and WV DEP conducted a windshield assessment of the Kanawha Valley near Nitro and Poca. In November 1998, Weston SATA conducted a sampling assessment in the River under the direction of U.S. EPA. Sampling included the River and its tributaries in the vicinity of the four old landfills, and included the collection of soil, sediment, and fish tissue.

In February 2000, U.S. EPA directed SATA to investigate several outfalls, which discharge into the River, and the sanitary and stormwater systems located in and around the Nitro side of the River. The objective of this investigation was to gain information to be used to draft a dioxin sampling plan. Data from the sampling plan is required to determine point sources of dioxin to the River, and to be used in an upcoming draft TMDL report.

During the week of February 28, 2000, SATA visited various facilities and representatives in the Nitro area in order to gain a better understanding of the stormwater and sanitary drainage systems. Several maps of both the current system and of the original system, installed during World War I (WWI), were obtained from Nitro's Wastewater Superintendent Constance Stephens. These maps were examined for possible point sources where dioxin contamination could be entering the River or Armour Creek. SATA identified specific locations where the old WWI system was still being used as part of the existing sewer system, and traced these lines to their junctions and outfall locations. Concern was expressed that residual contaminated sludges could possibly be contributing to dioxin concentration, due to breakthrough from old lines.

In February 2000, SATA interviewed WV DEP Enforcement Richard Hackney to discuss his concerns regarding possible dioxin point sources in Kanawha and Putnam counties. One of Mr. Hackney's primary concerns was regarding the Fike Artel Superfund site. He indicated that he has reason to believe that only a portion of the Fike site stormwater was diverted to the Fike Treatment Plant during the Superfund cleanup of the site. He believes that up until 1997, when most of the cleanup operations ended, the majority of the stormwater was discharged into the River via a 66-inch line located near the Par Industrial Park near MP 42.9.

U.S. EPA and SATA members conducted a study in March 7, 2000 to identify and log all visible outfall point sources and all permitted discharge locations from MP 46.5 to MP 41. The study focused on outfalls located along the right-descending bank; however, also included five outfalls along the left-descending bank, and several private residential runoff outfalls. Flow, type of pipe, size of pipe, and registered permit holder was noted for each outfall.

On March 8, 2000, WV DEP and SATA members conducted an additional study to understand some of the source contributors and regulatory history of the numerous outfalls. SATA filmed outfalls and noted comments that WV DEP Enforcement Officer Charlie Moses offered regarding the purposes and outlet sources for many of the outfalls.

On March 21, 2000, SATA members met with Tony Tuk, Remedial Projects Manager for Solutia the Flexsys/Solutia Facility in Nitro. Mr. Tuk escorted SATA on a site visit to view the sources for the Flexsys/Solutia outfalls and discharge locations.

In conclusion, SATA plans to further review maps and information obtained during this investigation to prepare a dioxin sampling plan for the collection of surface water/stormwater and sediment samples to identify possible point sources of dioxin (Weston, 2000_2).

May 2000 [CRA Box 2]

Trip Report, Kanawha River Valley Site, Kanawha and Putnam Counties, WV, Weston, 2001

In May 2000, the Weston SATA assisted in a sampling investigation of dioxin contamination in the River near Nitro, in Kanawha and Putnam Counties. The purpose of this sampling event was to characterize dioxin contamination present in River sediments, to identify dioxin-contaminated hot spots, and to assist in the delineation of potential threats to human health and the environment by the contaminated sediments.

In the mid 1980's, WV DEP and U.S. EPA conducted studies, which revealed significant levels of dioxin in sediment and fish tissue samples. In September 1998, U.S. EPA OSC Walter Lee, Site Assessment Manager James Hargett, and WV DEP Inspector Pam Hayes conducted a windshield assessment of the Kanawha Valley near Nitro and Poca, WV. In November 1998, U.S. EPA and SATA sampled soil, sediment, and fish tissue in the River and its tributaries located near four old landfills. U.S. EPA determined that an extensive sediment sampling event was necessary to finalize the TMDL study of the River. Approximate sampling locations were determined by analyzing historical and recent data.

Sampling was conducted from May 11 to 19, 2000. A total of 151 sediment samples were collected and analyzed for dioxin. U.S. EPA reviewed the dioxin data, and determined that several concentrations were above U.S. EPA removal guideline. The guideline used for comparison was the current standard residential sediment removal guideline for dioxin, based on the 1989 interim scheme of Total Toxicity Equivalents (TEQs), which was 1 ppb.

At sample location KRSD-21, located near MP 42.7, just downstream of a 66-inch outfall, the highest dioxin concentration reported was 5,110 ppt (5.11 ppb) for 2,3,7,8-TCDD. This submerged outfall is located in the PAR Industrial Park, and serves much of the industrial area south of MP 42.9. At sample location KRSD-19, located one-half mile downstream of the left descending bank, the highest 2,3,7,8-TCDD concentration reported was 1,720 ppt (1.72 ppb). Sample location KRSD-05, located along the right descending bank at the mouth of Guano Creek near MP 36 reported a highest concentration of 1,590 ppt (1.59 ppb) of 2,3,7,8-TCDD, and location KRSD-09 reported a highest concentration of 5,020 ppt (5.20 ppb) of 2,3,7,8-TCDD.

Data obtained from this report was to be used along with data gathered from previous sampling activities for the development of the River Site Hazard Ranking System (HRS) package. The HRS package was to be used to determine future actions for the Site. Data would have also been used in the River Dioxin TMDL report (Weston, 2001).

June 16, 2000 - June 27, 2000

<u>Trip Report, Kanawha River Valley Hi-Vol. Water Sampling, Nitro, Kanawha and Putnam Counties, WV, Ecology and Environment, Inc., 2000</u>

This report is a result of an inter-agency agreement between U.S. EPA, Region III and USGS to conduct sampling of dioxin contamination in the River and its tributaries located near Nitro, WV.

USGS conducted high-volume sampling at ten locations on the River and its tributaries near Nitro from June 16 to 27, 2000. The Weston SATA assisted with the hi-volume sampling by taking custody, packing, and shipping samples. Ecology and Environment, Inc. was tasked to write the trip report.

Ten high-volume samples were collected from selected points on the Kanawha, Pocatalico, and Coal Rivers, Armour, Heizer, Manila, and Bills Creek, and also from an industrial outfall located on the right descending bank of the River. The highest concentration of 2,380 femtograms per liter (fg/L) (0.002380 ppb) 2,3,7,8-TCDD was found in sample R383814, 16, the PB&S outfall.

Ecology and Environment, Inc. concluded that data and information obtained from this sampling event would be used to identify possible point sources of dioxin to the River. The data may also be used in the TMDL study of the Kanawha River Valley (Ecology and Environment, Inc., 2000).

September 2001

<u>Kanawha River Mile Point 41 to 42.5 and Mile Point 42.5 to 46.5 Site Inspection Report, Kanawha and Putnam Counties, WV, Region III, START, 2003</u>

In September 2001, Ecology and Environment, Inc. conducted sampling and a site investigation at the River MP 41 to MP 42.5 and MP 42.5 to MP 46.5, under the direction of U.S. EPA Region III. The purpose of this investigation was to characterize potential sources, the nature of contamination, relative hazards posed by sources, and impacts to targets. U.S. EPA requested this information to determine whether the site was eligible for placement on the NPL.

Previous investigations by state and federal agencies identified an area of contaminated sediment concentrated around the Nitro Industrial Area, and certain locations downstream, between MP 31.0 and MP 44.5. Potential point sources were identified as residential, municipal, and industrial outfalls. Non-point sources of contamination included overland runoff and possible groundwater contamination.

The sampling event included collection of aqueous effluent, water, and sediment samples from both source and attribution sample locations. Sediment samples were analyzed for chlorinated herbicides. Sample location KRSO-31 (R3109709) indicated a concentration of 38.0 micrograms per kilogram (ug/kg) (38.0 ppb) of 2,4,5-T, and sample location KRSO-27 (R3109710) indicated a concentration of 31 ppt (0.031 ppb) 2,4,5-T. These results were consistent with dioxins and furans, which were also found in samples KRSO-31 and KRSO-27.

Based on the results, Ecology and Environment, Inc. determined that the surface water pathway is the major pathway of concern for the site (Region III, START, 2003).

1.2 ARMOUR CREEK

The sediments in Armour Creek were sampled in November 1998 in response to public concern that ACLF was contributing to dioxin contamination in Armour Creek (Pam Hayes, WV DEP Office of Environmental Remediation). Dioxin was detected in the sediment. Soil sampling completed in the Armour Creek watershed resulted in elevated levels of dioxin.

Armour Creek Landfill is located north of the City of Nitro along State Route 25. It is comprised of approximately 45 acres of land, and was jointly operated by Old Monsanto and Akzo Nobel Corporation. Armour Creek is located to the north of the landfill (Weston, 1999).

May 2, 2000

Letter to Anthony C. Tuk, Solutia, from Allyn G. Turner, Chief, WV DEP, Re: WV SW/NPDES Permit No. WV0077020 Armour Creek Landfill, 2000

This letter, prepared by WV DEP, was attached to Solid Waste/NPDES Water Pollution Control Permit Number WV0077020 for the Armour Creek Landfill, and presents responses to comments submitted by Solutia in a letter dated April 3, 2000.

WV DEP stated that they have received comments from the public and from U.S. EPA regarding concerns of dioxins being present in surface water runoff from ACLF, which was alluded to in the Weston report, "Trip Report Kanawha Valley-Dioxin Site, Nitro, Putnam County, WV" dated April 14, 1999. WV DEP stated that the report does not state that ACLF is the source of dioxins to Armour Creek; however, it does indicate that it may be a possible source.

The letter concluded with two additional conditions that WV DEP placed on the permit which includes:

- **C.14** The permittee shall by the time frame specified in Section B.1.b (six months) submit a plan to sample and analyze the storm water runoff from the landfill for its potential to discharge 2,3,7,8-TCDD or any form of dioxin
- **C.15** Upon obtaining any evidence that the facility is discharging or has the potential to discharge 2,3,7,8-TCDD or any other form of dioxin, the permit may be reopened and revised accordingly (WV DEP, 2000_1)

May 2, 2000

Letter to Renae Bonnett, from Allyn G. Turner, Chief, WV DEP, 2000

This letter was prepared by WV DEP in response to comments concerning the Draft Permit for the ACLF provided by Ms. Renae Bonnett of Rt. 1, Poca, WV.

WV DEP stated that regarding concerns about dioxin, the dioxin issue was discussed with WV DEP hazardous waste personnel during the period in which the previous permit was prepared. WV DEP stated that analysis of 2,4-Dichlorophenoxyacetic acid (2,4,-D) is required to monitor dioxin in water. 2,4-D is a breakdown product of most dioxin and of the dioxin group, it is the most soluble in water and weak acids, which are typical conditions in a landfill. It was noted that due to the physical characteristics of dioxin, they are not a typical water-borne substance, and therefore under landfill conditions, can't be found through water sampling. WV DEP states that typically, dioxin is only found through analysis of sediments or biological tissues, since that is where dioxin tends to accumulate. It was also reported that groundwater at the landfill was monitored for ten quarters for 2,4-D, and historical data have reported it as ND. In addition, Solutia has installed new caps on the disposal areas, which should eliminate dioxin, if present, from contacting surface water and as a result contaminating stormwater runoff.

WV DEP also stated that the Weston report entitled "Trip Report Kanawha Valley-Dioxin Site Nitro, Putnam County, WV", dated April 14, 1999, does not state that the ACLF is the source of dioxin in Armour Creek. It does indicate however, that the railroad ditch, which borders the landfill contains dioxin contaminated sediments, and that this contamination may have originated from outside the landfill.

WV DEP concluded by saying that the landfill can currently only be identified as a potential source until the U.S. EPA assessment is complete, and there is evidence to support that the landfill is discharging, or has the potential to discharge 2,3,7,8-TCDD. In response, two conditions have been incorporated into the permit which include sampling and analyzing stormwater runoff for its potential to discharge 2,3,7,8-TCDD, and upon obtaining evidence that the facility is discharging or has the potential to discharge 2,3,7,8-TCDD, the permit may be reopened and revised (WV DEP, 2000_2).

2001

Letter to Ms. Allyn Turner, from Anthony C. Tuk, Solutia, Re: 3rd Quarter, 2001 Report, Armour Creek Landfill - NPDES Permit Requirements, WV 0077020, Potesta & Associates, Inc., 2001

This report was prepared by Potesta & Associates, Inc. (Potesta) to fulfill the requirements of the Solutia's ACLF Solid Waste/NPDES Permit Number WV0077020, effective June 2, 2000.

Potesta reported that during the third quarter of 2001, the focus of the permit was a continuation of routine maintenance of final closure items completed during 1999/2000. Approximately 5,000 gallons of leachate and rainwater was treated, and groundwater and leachate samples were collected. In addition, stormwater samples were collected and analyzed for dioxin, which completed the required one-time landfill sampling event.

Stormwater sampling for dioxin was completed as per Section C. 14 of the current Solid Waste NPDES Water Pollution Permit No. WV0077020, for the closed ACLF. Section C. 14 requires the formulation of a plan to sample and chemically analyze stormwater runoff from the landfill for 2,3,7,8-TCDD or any other form of dioxin.

Potesta reported that they collected a stormwater sample from an outlet at ACLF (ACLF Stormwater Outlet 009), as well as an additional background sample at a location outside the limits of ACLF. According to Potesta, ACLF Stormwater Outlet 009 is considered the most significant surface water sampling, and stormwater discharge point for the landfill, since its location is central to the previously active portions of the landfill. This outlet is sampled on a quarterly basis and results are submitted to WV DEP as part of the permit requirements. The selected off-site point was a drainage point of an approximately 7.2 acre area near the westbound Nitro exit of Interstate 64, approximately 2,500 feet south of Outlet 009. Potesta reported that the chosen off-Site sample location is situated at the discharge point of the drainage culvert passing beneath the exit ramp. Stormwater from this area is reported to drain to Armour Creek east of the ramp.

Samples were analyzed for 2,3,7,8-TCDD and other dioxin compounds, which included the seventeen congeners considered to be the most toxic of the 210 compounds in the dioxin family. Potesta reported that sample ACLF-009 was ND for 2,3,7,8-TCDD with a detection limit of 1.8 pg/L, however 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) was detected at 38.3 pg/L, which is an estimate of the true concentration. Potesta reported that the background sample, BG-1 had a reported concentration of 6.1 pg/L of 2,3,7,8-TCDD.

Potesta concluded that sampling results indicate that 2,3,7,8-TCDD is not present in the runoff from Outlet 009 at ACLF. OCDD, a dioxin congener was reported, however Potesta stated that this detection was due to an apparent peak on the analysis chromatography, and therefore the concentration could only be estimated. The reported concentration of 2,3,7,8-TCDD in the off-site background sample was also an estimate since the calculated response peak was below the method concentration comparison curve. Potesta concluded that due to estimation of values used in the analysis method, accuracy of the results must also be considered estimates (Potesta & Associates, Inc., 2001).

1.3 MANILA CREEK/POCATALICO RIVER

The sediments in Manila Creek and Pocatalico River were sampled in November 1998 in response to public concern that this landfill was contributing to dioxin contamination in the Pocatalico River (Pam Hayes, WVDEP Office of Environmental Remediation). The results from this sampling revealed some potential off-site migration of dioxin contaminated soils. A subsequent round of sampling was conducted in September 1999 and revealed contamination of soils and groundwater at the site. The soil samples ranged from 0 to 385 pg/g 2,3,7,8-TCDD. Groundwater sampling revealed dioxin concentrations ranging from 197 to 1,470 pg/L. These reported results are from water collected from monitoring wells installed within the waste layer at the landfill. The creek sediments are also contaminated in this region (0 to 38 pg/g 2,3,7,8-TCDD).

September 1964
Memorandum – Nitro Refuse Dump on Poca River, WV DWR, 1962

WV DWR received complaints in September 1964 from residents on the Poca River regarding pollution from the City of Nitro Dump and chemical plants in the Nitro area. Concern was that wastes were entering the Poca River via a small tributary.

An inspection was conducted on September 14, 1962 by WV DWR in response to these complaints. In a memo dated September 17, 1962, Mr. John Hall, Chief Chemist of WV DWR made the following observations:

- A fish kill was occurring near the point where the small tributary from the dump entered the Poca River. Mr. Hall stated that "thousands of small fish were breaking water and appeared to be in distress".
- Chemical plant wastes of solid and semi-solid nature were disposed of in barrels at the site.
- Chemical and domestic wastes disposed of at the site were not being covered by earth, and therefore considered an open type dump.
- Acid mine drainage was present in the dump.

The memo concluded that the chemical wastes constituted a potential water pollution problem, and that efforts should be made to ensure chemical plants and dump operators disposed of waste properly. Mr. Hall noted that barrels hauled to the site often rupture when the trucks dump the barrels, which permits spillage of chemicals. Mr. Hall collected samples; which indicated pollution from the dump.

In response to these observations, a letter dated September 24, 1962, from Bern Wright, Chief of WV DWR, was sent to the City of Nitro, Ohio Apex, Old Monsanto, and Cadle Sanitary Service (who hauled waste material to the site). The letter informed the parties of the complaint, site conditions, and that stream pollution was occurring and must be stopped. Parties were given until October 1, 1962 to respond to the matter, to which most responded; the general agreement among the parties was that no serious problem existed, and that the responsibility did not rest individually with them.

WV DWR continued to receive complaints of scums and foams on the river and as a result, Chief Bern Wright wrote to Old Monsanto, Ohio Apex, and the Mayor of the City of Nitro informing them that the waste disposal problem had not been resolved. The parties were given until December 15, 1962 to develop proper disposal of refuse and waste material procedures for the Nitro Dump. If the parties did not comply, the State Litter Law would be enforced.

A re-inspection of the site was conducted on November 30, 1962 at the request of Mayor Alexander of Nitro. Representatives from Old Monsanto, Ohio-Apex, the Nitro Dump, and WV DWR were present. The companies were given more time to analyze samples on the water above and below the dump (Wright, 1962).

May 13, 1980
<u>Site Inspection Summary Sheet, Manila Creek, Site Number WV-1, WV DEP, 1982</u>

Old Monsanto notified a congressional survey that they disposed of organic, herbicide, fungicide, and miscellaneous inorganic wastes at a site in Amherst, Putnam County, WV from 1956 to 1957. On May 13, 1980, the site was inspected by a state representative who reported that dark, oily leachate was seeping from the landfill, and that the site had been abandoned. It was also noted that the landfill did not contain any vegetation.

As a result of the investigation, water sampling of an adjacent tributary occurred on June 28, 1981. Results indicated the presence of 2,4,5-T at 3.3 micrograms per liter (ug/L) (3.3 ppb). On August 27, 1981, WV DEP and U.S. EPA conducted on-site sampling, which was not completed due to shipment difficulties. On September 11, 1981, WV DEP collected off-site water samples, which did not detect the herbicide.

As a result of these investigations, WV DEP contacted property owners Amherst Coal and Old Monsanto (WV DEP, 1982).

June 29, 1981
<u>Site Inspection, Manila Creek, WV DNR, 1981</u>

On June 29, 1981, WV DNR conducted a site investigation at the Manila Creek dump site area. The area investigated was on top of a knoll adjacent to county road 5 near Washington Hollow. Inspectors observed an area of approximately 75 feet by 75 feet, which was nearly devoid of vegetation. Normal vegetation was observed around the site perimeter, except for a small area down-gradient of the site that indicated the path of water runoff.

Inspectors obtained stream grab samples from a tributary adjacent to the hill. This tributary runs from Washington Hollow into Manila Creek. Samples were taken to analyze for 2,4,5-T. Sections of the creek band showed evidence of mine seepage from springs.

The inspectors drove to a dirt road, approximately a quarter of a mile north, and traveled 300 yards to observe a partially excavated area noted earlier. No soil discoloration or odors were observed in this area. The inspectors observed a swamp-like area with scrap appliances and trash while driving back to Heizer Road. Blackish sediment was observed along the ground in this area, and a chemical odor was detected (Casdroph, 1981).

December 14, 1982

Inter-Office Memorandum – Manila Creek Benthic Survey, WV DNR, 1982

On December 14, 1982, a preliminary benthic survey was conducted in Manila Creek, Putnam County. The purpose of the survey was to determine the impact of an abandoned chemical dump site on the stream.

Five stations were sampled as part of the survey: three in Manila Creek and two in small tributaries to the creek. A standard benthic kick sample was collected at each station and rocks were turned over to examine the area for benthic macroinvertebrates. WV DNR determined that in situ examinations provided adequate information since the numbers of individuals and taxa were low at all sites. They also noted that several specimens were taken to the lab to confirm the field identifications.

WV DNR reported that the entire study area was heavily impacted by abandoned coal mining activity since iron seeps, refuse dumps, and strip benches were highly visible. Station 1, which was located below a large iron seep, yielded no organisms. Stations 2, 3, and 4 were all located in Manila Creek, and contained a limited number of taxa, with mostly the same species composition. Station 5 was located in Washington Hollow, and was observed to have escaped serious damage from mine drainage. WV DNR noted that stream size appears to limit the benthic potential more than water quality.

WV DNR concluded that mine drainage problems overshadow any biological impacts, which may be due to the abandoned chemical dump site (WV DNR, 1982).

September 18, 1984

A Field Trip Report for Manila Creek, NUS Corporation, 1984

On September 18, 1984, the NUS Corporation FIT III team conducted a dioxin screening at Manila Creek as part of U.S. EPA Region III, Tier II, Dioxin Study.

A total of 19 field samples and 5 quality assurance samples were taken. Sample locations were selected based on current site conditions, past sampling results, and lab space restraints.

Site observations included the following:

- Site sampling was restricted primarily to the unvegetated portion of the area.
- The area void of vegetation measured approximately 30 by 60 feet. The surface of this area was covered with patches of a hardened, asphalt-like material. Debris was scattered across the surface of this area.
- The leachate area near the northern perimeter of the site measured approximately 3 feet by 3 feet. The leachate was black in color and had a high viscosity.
- HNU readings above the 1 ppm background concentration were not observed either in the ambient air or in downhill measurements (NUS Corporation, 1984).

1986

<u>Manila Creek Site Water Level and Highwall Study, ERM-Midwest, Inc.</u>

In order to assess remedial action alternatives proposed for the remedial action plan at the Manila Creek site, it was important to determine if recharge was occurring from the highwall, and also to determine the slope of the highwall.

ERM-Midwest was retained to conduct test borings to determine the slope on the east side of the fill. In order to determine the water level and flow direction, ERM-Midwest installed two piezometers on the bench above the borings.

In 1984, NUS Corporation conducted sampling at the site under the direction of U.S. EPA. Surface soils were analyzed for 2,3,7,8,-TCDD to approximately a 2 foot depth. 2,3,7,8-TCDD was found at concentrations up to 52 ppb.

In January 1986, Remedial Corporation (REMCOR) conducted test borings at the site to determine the extent of fill material present. Data obtained from REMCOR's study was used for this water level and highwall study.

Work completed during this investigation included:

- Drilling and installing two piezometers to assist in determining water levels and flow direction

- Drilling 15 borings to be used to profile the slope of the highwall at the east side of the site
- Surveying the piezometer and borings and tying their locations and elevations into the REMCOR survey and establishing a benchmark off site for future reference

ERM-Midwest concluded that coal serves as an aquifer, and therefore it is probable that recharge to the fill material exists. It was also determined that water appears to be travelling in a northwest direction at the base of the coal, and appears to be confined to the eastern portion of the fill. Borings indicate that a steep wall is located on the east side of the fill area, and that in the center of the fill material, the material was placed directly on underclay and/or flyash (ERM-Midwest, 1986).

1986

Subsurface Investigation, Manila Creek Site, Nitro, WV, Remedial Corporation

In 1986, REMCOR completed a remedial investigation of subsurface conditions at the Manila Creek site in order to determine the lateral and vertical extent of fill placed at the site. This information was required to calculate the total volume of material present at the site, which is required to analyze site remedial alternatives. This study was also conducted to determine the location and extent of saturated areas that contribute to seeps. This work was completed by REMCOR at the request of Old Monsanto.

In 1984, the NUS, under contract with U.S. EPA, sampled surface soils at the site for the presence of 2,3,7,8-TCDD. 2,3,7,8-TCDD was detected at concentrations up to 52 ppb.

Seeps have been observed at the site; seep flow appears to increase proportionately with rainfall. Three seeps have been identified at the site. One was located to the north of the investigation area on a down slope. Old Monsanto has determined that this seep, which is black, oily, and tarry, contains an Old Monsanto product. The other two seeps are located at the south end of the site, and lead to a man-made pond. The seeps are viscous in nature, and are not black or oily.

Work completed during the REMCOR investigation included:

- Discussion with Old Monsanto officials to identify the area of concern
- Layout of a grid system for horizontal and vertical control
- Drilling of borings with identification of subsurface conditions encountered

REMCOR reported the following:

- Approximately 20 to 50 feet of fill material covers the investigation area
- The uppermost materials encountered were composed of mostly fill soils, which ranged from sandy/silty clays to broken siltstone fragments
- In the northern part of the site, chemical waste products were found at six boring locations
- REMCOR estimates that a total of 2,400 to 2,900 cubic yards of identified waste material exists at the site
- A large part of the site is underlain by flyash fill which lies directly beneath the visibly identified waste material
- REMCOR estimates a total of 5,000 to 7,000 cubic yards of flyash exist at the site (REMCOR, 1986)

1.4 PREVIOUS INDUSTRIAL FACILITIES INVESTIGATION

In addition to the investigations described above, a summary of investigations completed for industrial facilities upstream, in and downstream of the Study Area has been completed. The purpose of this summary was to assist in determining other potential sources of contaminants of concern (COCs) to the River. The summary is presented in Appendix C.

1.5 SUMMARY OF KANAWHA RIVER DREDGING ACTIVITY

Historical dredging activities in the vicinity of the Site were determined by reviewing dredging permits on file at the Huntington District of U.S. ACE and are summarized in Section 4.5.1 of the EE/CA Report.

According to U.S. ACE, the federal navigation channel in the Winfield Pool is virtually self-scouring and therefore requires no maintenance dredging throughout most of the pool. Some localized dredging is required in the vicinity of the Winfield Locks to maintain the upriver and down river approach lanes to the locks. Otherwise, private parties have performed dredging activities in and upstream of the Site for the purposes of building or improving waterfront structures, clearing water intake lines, or reclaiming spilled coal.

Construction Dredging. Dredging permits were issued to various parties for one-time waterfront construction projects involving maintenance and/or improvements to docks, bulkheads, marinas, and clearing water intake lines. Construction dredging permits have been issued to FMC Corporation (FMC), Old Monsanto, Allied Chemical Corporation (Allied Chemical), Union Carbide Company (UCC), Union Boiler, Midwest, and Rhône-Poulenc AG Company (Rhône-Poulenc). These projects were authorized to remove between 30 and 5,000 cubic yards of dredged material.

Reclamation Dredging. By far the most significant dredging activities in the Winfield Pool (in terms of total dredged sediment volumes) have been performed by the Kanawha Dredging and Mineral Company (Kanawha Dredging) and the Voyager Coal Company (Voyager Coal). These companies held permits in several reaches of the River during the 1980's and 1990's for the purpose of reclaiming spilled coal and sand from various locations within the River bed. Kanawha Dredging was incorporated in July 1975 and terminated in December 1992; Voyager Coal was incorporated in May 1990 and terminated in June 2002. Voyager Coal generally succeeded Kanawha Dredging as the active permittee for U.S. ACE dredging permits.

Dredged sediments were processed to remove spilled coal from the sediment bed (estimated at 38 to 85 percent of the dredged material), and the processed materials were redeposited in the River near their original location. The companies processed between 2,000 and 8,000 cubic yards of sediments per day, year round, weather permitting, using a typical dredge cut of 12 feet. Permit conditions limited such reclamation dredging activities to bands of the River located more than 150 feet beyond the federal channel, but also more than 130 feet from the shoreline. Dredging was originally performed using a 3 cubic yard clamshell bucket; however, the clamshell was replaced with a 10-inch hydraulic dredge in September 1988.

The majority of the permitted dredging areas for coal reclamation were on the left (southern) bank of the River. However, one of the permitted areas was on the right (northern) bank of the River, downstream of Pocatalico River, between River Mile (RM) 36.97 and RM 38.81.

Water Quality Certification of Reclamation Dredging. As early as 1987, WV DNR recognized that "*The proposed dredge site* [RM 40.45 to 41.70] *lies within a reach of the Kanawha River where joint WVDNR/U.S. EPA sampling has documented dioxin contamination in sediments and fish*." (WV DNR, 1987_2). WV DNR nevertheless granted conditional certification of the dredging activity based on the assumption that reclamation dredging would involve processing relatively coarse-grained channel sediments, whereas the majority of the 2,3,7,8-TCDD contamination was assumed to be associated with finer grained bank sediments. However, the file review did not produce data that would verify this assumed condition.

In subsequent years, WV DNR/WV DEP occasionally denied Section 401 Water Quality Certification for certain reclamation dredging applications on the grounds that "…*the hydraulic dredging and redepositing of 85 percent of dredged material will impact both the River's water quality and its aquatic resources by increasing turbidity and resuspending other pollutants*." (WV DNR, 1991) and "…*potential adverse affects are recognized for fish spawning sites, degraded aquatic habitat, excessive sedimentation, and resuspended pollutants*." (WV DEP, 1997). In at least some cases, the denials were successfully appealed by the applicant, and Water Quality Certification was eventually obtained for reclamation dredging.

1.6 SOURCE, NATURE AND EXTENT OF CONTAMINATION

2,3,7,8-TCDD is a common by-product of burning (including incineration) of a range of materials, the production of chlorinated organic compounds, and the bleaching step of the papermaking process. Historical industrial activities in the Kanawha River area appear to have resulted in the release of 2,3,7,8-TCDD to the River system. 2,3,7,8-TCDD at the Site may have originated in part from the production of industrial solvents and the herbicide 2,4,5-T.

Other more recent sources, such as the former American Car and Foundry (ACF) Industries site near Winfield Dam, may also have released 2,3,7,8-TCDD to the River system. Depending on the ultimate cleanup goal for the River, ongoing discharges from Flexsys/Solutia Outfalls 006 and 008, and potentially other upland facilities, may also represent potential ongoing sources.

1.6.1 POTENTIAL SOURCE AREAS

This section discusses potential upstream sources of 2,3,7,8-TCDD, other dioxin congeners, and other potential COCs in the Kanawha River Valley. Information regarding the facilities included in this section is based on documents reviewed to date, and will be updated as appropriate, based on new information. Additional potential sources exist in downstream areas. Available information related to these facilities is included in the database (in Appendix G) prepared for the Site, which has been evaluated in the EE/CA Report to which this Appendix is appended.

Potential upstream source areas are generally grouped into the following two areas where the majority of the facilities are located:

- Potential Source Area 1 – Institute and South Charleston
- Potential Source Area 2 – Marmet, Belle, and Cedar Grove

The locations of potential upstream sources are shown on Figures 3.1 and 3.2 of the EE/CA Report.

1.6.1.1 POTENTIAL SOURCE AREA 1 – INSTITUTE AND SOUTH CHARLESTON

Union Carbide Corporation

UCC was founded in 1917 from five companies producing widely different products. UCC's key fields of activity include chemicals, plastics, alloys and metals, industrial gases, welding and cutting equipment, carbon and graphite products, electronics, nuclear energy, fibers and fabrics, and packaging products (Hurley, 1979).

South Charleston Facility

In 1920, UCC constructed the world's first petrochemical plant and UCC's first chemical-producing plant at Clendenin, WV. Operations were moved to South Charleston in 1925, in order to meet demands for the manufacture of ethylene glycol. The South Charleston site eventually expanded to occupy 236 acres in South Charleston, extending across the Kanawha River onto Blaine Island (Dow, 2006). Many of UCC's current product lines were originally developed at South Charleston, including major technological advances such as olefin gas separation techniques and vinyls technology.

The UCC South Charleston Facility was acquired by the Dow Chemical Company (Dow) in 2001 through a merger with UCC. The Dow South Charleston Facility is a manufacturing facility that produces more than 500 different chemicals and plastics. The facility also serves as a redistribution center for chemicals manufactured at other locations. Products include automotive moldings, chewing gum, paint primers, brake fluids, hard surface cleaners, car wash, rinse aids, and a diverse mix of chemical intermediates for agricultural, automotive, and industrial uses. The South Charleston facility is a multi-company site. Bayer Corporation (Bayer) currently owns and operates the former UCC Polyols Production Unit, and Dow provides staffing, services, and utilities to Bayer (UCC, 1995 – 2003).

South Charleston Technical Center

The South Charleston Technical Center was dedicated in 1949. Prior to 1949, the South Charleston facility conducted research and development for petrochemicals and plastics. In 1959, two additional development labs, and an engineering building were constructed. A large data processing building was constructed in 1977.

The current center consists of a 651-acre complex, consisting of 400 labs, several chemical pilot plants, a computer operations center, and an engineering center. A majority of the major processes for petrochemicals were developed at this center by UCC. Dow acquired the UCC Technical Center in 2001 through a merger with UCC (UCC, 1995 – 2003).

North Charleston Storage Area

The North Charleston Storage Area is located in the City of Charleston. The site is bounded by 21st street to the north, Kanawha Two Mile Creek to the east, the Kanawha River to the south, and the Charleston Sewage Treatment Plant to the west.

The storage area is approximately 3 acres in size, with an area of approximately 200 by 200 ft used as a disposal area. UCC began using the storage area in the early 1950's. Materials disposed of included flyash, spent catalyst, polyethylene-pellets, drums of unknown contents, and rubble. No records were kept of the volume of materials disposed (Foster, 1982).

Institute Facility

UCC originally built and operated the Institute Plant in 1943 as a U.S. government plant for the production of butadiene and styrene. UCC purchased the plant in 1947 to produce commodity type products, which eventually changed to specialty chemicals and agricultural products. The facility was sold to Rhône-Poulenc in December of 1986, and was later purchased by Aventis CropScience, under agreements that the plant would share certain facilities. The Polyols Unit was sold to ARCO Chemical in 1990, and in 2001, Dow acquired UCC's operations through a merger with UCC and is presently a tenant at the facility. Currently, Bayer Corporation owns the plant site property, general facilities and the agricultural producing units.

The Dow Institute Facility produces approximately 500 million pounds of specialty products annually. Dow's variety of products include: shampoo, contact lens products, paint, pharmaceuticals, liquid detergent, all purpose cleaners, sinus tablets, antifreeze, hair spray, and nail polish remover (UCC, 1995-2003).

1.6.1.2 POTENTIAL SOURCE AREA 2 – MARMET, BELLE, AND CEDAR GROVE

DuPont Belle Facility

The DuPont Belle facility is located on a 100 acre site along the River, 10 miles east of Charleston, WV. Throughout its operating history, DuPont has produced nearly 175 products used in every basic industry, and has developed more than 120 chemical processes at the Belle facility.

Construction of the Belle Facility began in 1925. The facility was the first commercial ammonia synthesis plant in the U.S. to produce ammonia by fixation of nitrogen from air. The first ammonia was produced at the Belle facility on April 1, 1926, providing the raw material for chemical products such as Methanol. During the 1930's, DuPont Belle produced the first modern plastic polymers such as Lucite methacrylic polymer and Zerex ethylene glycol antifreeze. It was also at Belle that DuPont developed the technology to produce Nylon, and supported the war effort in the 1940's by producing Nylon raw materials, which were shipped to other locations to be made into parachutes and other items. In the 1950's and 1960's, the country's first synthetic urea for fertilizers and plastics were produced at Belle. In the late 1960's ammonia from natural gas feedstock was manufactured. Production of modern crop protection chemicals such as Fungicides and Sulfonylurea Herbicides began in the 1970's and 1980's. In the 1990's DuPont upgraded infrastructure and control systems, and currently continues to produce specialty chemical products, crop protection herbicide intermediates, and crop protection sulfonyl urea herbicide intermediates (DuPont, 2002). Principal products at Belle include dymel aerosol propellants, methylamines/methylamides, dimethyl sulfate, glycolic acid, and vazo initiators (DuPont, 1995-2003).

Occidental Chemical Corporation (OxyChem) – Belle Facility

The Occidental Chemical Corporation (OxyChem) facility is a multi-product chloromethane plant located on a 23.5-acre property northwest of the Town of Belle, WV. The facility is located on the River at RM 68.0, immediately adjacent to and southeast of DuPont (ERM-Midwest, 1993_2). Reynolds Branch, a small intermittent stream and tributary to the River, passes from northeast to southeast, just southeast of the OxyChem facility (ERM-Midwest, 1993_1).

The facility was founded in 1920 as Belle Alkali, and produced two common commodity chemicals, chlorine and caustic soda. In approximately 1940, the facility was converted to chlorinated solvents production. Several other chemical manufacturing and industrial facilities were operated in the eastern portion of the current OxyChem property from the early 1930's to the mid 1970's, which included the Sharples Solvents

Company, Givauden–Virginia, Inc., Reilly Tar and Chemical Corporation, and Union Concrete Pipe Company (ERM-Midwest, 1993_2).

Diamond Shamrock purchased the Belle Alkali facility in approximately 1953, and in 1977 the remainder of what is the present OxyChem property. In the late 1970's, a wastewater treatment plant was constructed adjacent to Reynolds Branch as part of a $25 million dollar process upgrade. OxyChem purchased the property from Diamond Shamrock in 1986, and has since produced the chloromethanes: methylene chloride, chloroform, and carbon tetrachloride from liquid chlorine and methanol feedstock (ERM-Midwest, 1993_2).

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APPENDIX C.2

SUMMARY OF POTENTIAL UPSTREAM SOURCE INVESTIGATIONS

APPENDIX C.2

SUMMARY OF POTENTIAL UPSTREAM SOURCE INVESTIGATIONS

KANAWHA RIVER
NITRO, WEST VIRGINIA

FEBRUARY 2015
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LIST OF ACRONYMS

2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
2,4,5-T	2,4,5-Trichlorophenoxyacetic acid
ACF	American Car & Foundry Industries, Inc.
Allstates	Allstates Environmental Services, Inc.
AOC	Administrative Order on Consent
ARCADIS	ARCADIS Geraghty & Miller, Inc.
ATSDR	Agency for Toxic Substances and Disease Registry
Aventis	Aventis CropScience
bgs	below ground surface
BNA	base neutral/acid extractable analytes
Burlington	Burlington Environmental, Inc.
CA	Corrective Action
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMS	Corrective Measures Study
COPC	Contaminant of Potential Concern
DNT	dinitrotoluene
EE/CA	Engineering Evaluation/Cost Analysis
EOC	Extent of Contamination
ERA	Environmental Risk Assessment
ERM-Midwest	Environmental Resources Management, Inc.
GML	Goff Mountain Landfill
GWQAP	Groundwater Quality Analysis Plan
HCLF	Heizer Creek Landfill
HHRA	Human Health Risk Assessment
Holz	Holz Impoundment
HRS	Hazard Ranking System
IMs	Interim Measures
KEMRON	Kemron Environmental Services, Inc.
LCAP	Landfill Closure Assistance Program
McJunkin	McJunkin Supply Company
MDL	Method Detection Limit
mg/kg	milligrams per kilogram
mg/L	milligrams per liter

LIST OF ACRONYMS

ND	Not detected
ng/g	nanograms per gram
NPDES	National Pollutant Discharge Elimination System
OxyChem	Occidental Chemical Corporation
PCBs	polychlorinated biphenyls
PCDDs	polychlorinated dibenzo-p-dioxins
pg/L	picograms per liter
POTW	Publicly Owned Treatment Works
ppb	parts per billion
ppm	parts per million
PTO	Private Trucking Operations
RBCs	Risk Based Concentrations
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
Rhône-Poulenc	Rhône-Poulenc AG Company
River	Kanawha River
Site	Kanawha River Site located in Nitro, West Virginia
SVOCs	semi-volatile organic compounds
SWMUs	Solid Waste Management Units
TC	Toxic Charateristic
TCLP	toxicity characteristic leaching procedure
TEF	toxicity equivalent factor
TEQ	toxicity equivalency quotient
TOC	Total Organic Carbon
TOX	Total Halogenated Organics
TSDF	Treatment Storage and Disposal Facility
UCC	Union Carbide Company
UCC Tech	UCC South Charleston Technical Center
ug/kg	micrograms per kilogram
U.S. DOI	United States Department of the Interior
U.S. EPA	United States Environmental Protection Agency
VI	verification Investigation
VOA	Volatile Organic Analytes
VOCs	Volatile Organic Compounds

LIST OF ACRONYMS

WCLF	Wetzel County Landfill
WCSWA	Wetzel County Solid Waste Authority
WEG	Weavertown Environmental Group
WV	West Virginia
WV DEP	WV Department of Environmental Protection
WV DHHS	WV Department of Health and Human Services

1.0 INDUSTRIES LOCATED UPSTREAM OF SITE

This section provides a summary of industries that are located upstream of the Kanawha River (River) Site located in Nitro, West Virginia (WV) (Site). This information was utilized in conjunction with the potential source areas and Conceptual Site Model (CSM) information to focus the investigative efforts of the Extent of Contamination (EOC) Study. The Site extends 45.5 miles from the confluence of the Coal River to where the River enters the Ohio River. The Pocatalico River and Armour Creek segments of concern each extend two miles upstream of their respective confluences with the River (Limno-Tech, Inc., 2000). A detailed summary of each property upstream of the Site is provided in the following sections.

1.1 BAYER CROPSCIENCE (FORMERLY AVENTIS CROPSCIENCE, FORMERLY RHONE POULENC COMPANY)

Located in Institute, WV along the River, the Rhône-Poulenc AG Company (Rhône-Poulenc) site encompasses approximately 350 acres. The facility was built in 1943 by the U.S. government for the production of rubber for World War II. The plant was then bought and utilized by Union Carbide Company (UCC) in 1947 until 1986 when Rhône-Poulenc purchased it for the production of agricultural chemicals.

From 1987 to 1999 the land was owned and operated by Rhône-Poulenc. From approximately 2000 until 2005 Aventis Cropscience used the land. Aventis Cropscience operated as a manufacturer of pesticides and agricultural chemicals and industrial organic chemicals. Bayer CropScience purchased the Institute site in June 2002.

Resource Conservation and Recovery Act (RCRA) Corrective Action (CA) activities at the Rhône-Poulenc site are being conducted under the direction of the United States Environmental Protection Agency (U.S. EPA) and the West Virginia Department of Environmental Protection (WV DEP). The investigation and any necessary cleanup activities are being implemented in accordance with a U.S. EPA RCRA CA permit. The main contaminants in the groundwater and soils are benzene, chlorobenzene, chloroform, carbon tetrachloride, and tetrachloroethane (U.S. EPA Region III, 2008$_1$).

January 1991

<u>Bayer CropScience (Formerly: Aventis Cropscience USA; formerly Rhone Poulenc Company) Region 3 GPRA Baseline RCRA Corrective Action Facility, U.S. EPA Region III, 2008.</u>

In January 1991, U.S. EPA issued a RCRA CA permit to the company to proceed with site cleanup. U.S. EPA and the facility are working jointly to complete the requirements of the permit which include the following:

- Conduct a Verification Investigation (VI) to determine if hazardous waste or contaminants have migrated into the soil or groundwater
- Conduct a RCRA Facility Investigation (RFI) of 24 Solid Waste Management Units (SWMUs)
- Implement Interim Measures (IMs)/stabilizations to address known releases or threats
- Conduct a Corrective Measures Study (CMS) to address areas where contaminants pose a threat to human health or the environment

The facility has implemented an air sparging/soil vapor extraction system to remediate soils and groundwater, which are contaminated with volatile organic compounds (VOCs) (U.S. EPA Region III, 2008_1).

August 9, 1995

<u>Letter to Mr. Mike Zeto, WV DEP, from Kevin H. Keys, Rhone-Poulenc, Rhone-Poulenc, 1995</u>

On August 9, 1995, Rhône-Poulenc reported a release of 207 pounds of hazardous waste, which was identified as multi-source leachate, with waste code F039. The release occurred at Rhône-Poulenc's Goff Mountain Landfill (GML), and was released to a storm water runoff ditch that flows to a tributary of the River.

Rhône-Poulenc reported that the release occurred as a truck operator was off-loading excess leachate at the truck weighing station. While connecting the off-loading hose, leachate began flowing out of the pipe and splashed onto the berm of the asphalt secondary containment. During investigation of the incident, it was determined that approximately 50 gallons of leachate had been discharged, half into secondary containment, and the other half flowing onto the asphalt roadway. The asphalt roadway slopes toward a grassy shoulder that borders a storm water runoff ditch, leading to a tributary of Goff Branch.

Rhône-Poulenc reported that the release exceeded the Reportable Quantity limits for F039 waste, which is one pound (Rhone-Poulenc, 1995).

August 2001

State of WV Discharge Monitoring Report for the Month of August 2001, Aventis, 2001

Aventis CropScience (Aventis) submitted this State of West Virginia National Pollutant Discharge Elimination System (NPDES) Discharge Monitoring Report for the month of August 2001, to the WV DEP. Carbofurans were reported at an average monthly concentration and maximum daily concentration of 0.293 milligrams per liter (mg/L) (Aventis, 2001_1).

September 2001

State of WV Discharge Monitoring Report for the Month of September 2001, Aventis, 2001

Aventis submitted this State of WV NPDES Discharge Monitoring Report for the month of September 2001, to the WV DEP. Carbofurans were reported at an average monthly concentration and maximum daily concentration of 0.119 mg/L (Aventis, 2001_2).

October 2001

State of WV Discharge Monitoring Report for the Month of October 2001, Aventis, 2001

Aventis submitted this State of WV NPDES Discharge Monitoring Report for the month of October 2001, to the WV DEP. Carbofurans were reported non-detect (ND) at a method detection limit (MDL) of 0.0357 mg/L (Aventis, 2001_3).

November 2001

State of WV Discharge Monitoring Report for the Month of November 2001, Aventis, 2001

Aventis submitted this State of WV NPDES Discharge Monitoring Report for the month of November 2001, to the WV DEP. Carbofurans were reported ND at a MDL of 0.017 mg/L (Aventis, 2001_4).

2001

Newspaper Article: Bayer CropScience to pay more than $1 million to settle federal charges, Daily Mail, 2008

Multimedia inspections of the Institute site by U.S. EPA in 2001, from May 15 to 24, Aug. 13 to 16 and Nov. 6 to 9 revealed several nonconformances including the following:

- Discharges of toluene, isophorone, chloroform, ammonia-nitrogen, carbofuran, fecal coliform, methylene chloride, cyanide and other regulated substances in excess of permitted limits
- A failure to report measured outflows from several discharge locations
- Disposal of wastewater treatment sludge in the GML without meeting applicable land disposal restriction treatment standards with respect to p-cresol or 4-Methylphenol (Daily Mail, 2008)

March 2002

State of WV Discharge Monitoring Report for the Month of March 2002, Aventis, 2002

Aventis submitted this State of WV NPDES Discharge Monitoring Report for the month of March 2002, to the WV DEP. Carbofurans were reported at an average monthly concentration and maximum daily concentration of 0.1778 mg/L (Aventis, 2002).

1.2 OLD MONSANTO LANDFILL

The Old Monsanto Landfill site is located approximately two miles north of Nitro, WV, on the east side of the River. The site is located on Old Monsanto's property, to the north of the wastewater treatment plant, and is bounded to the east by Armour Creek, to the west by the Penn Central Railroad, and to the south by State Route 25.

Old Monsanto owned and operated this landfill from 1964 to 1980, and used it to dispose of industrial and non-hazardous waste. The landfill was upgraded in 1980; a new secure cell was constructed and used only for non-hazardous wastes. The inactive portion of the site was capped with clay, graded, and re-vegetated. In September 1984, NUS Corporation conducted sampling for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) at the site. As a result, Old Monsanto determined additional sampling was required to determine the extent of the 2,3,7,8-TCDD contamination. In March 1995, Old Monsanto took seventeen samples and six additional samples at ground surface.

2,3,7,8-TCDD was found at a depth of greater then 21 inches, however was not found at the ground surface, which indicated that the cap was effectively preventing 2,3,7,8-TCDD migration. Sampling conducted in Armour Creek, which is adjacent to the site, also supported this conclusion. Four sediment samples were collected from Armour Creek, and all four were ND for 2,3,7,8-TCDD (Wilson, 1986).

1979

U.S. EPA to Inspect Monsanto Dump at Nitro, The Charleston Gazette, 1979

The Charleston Gazette printed this article prepared by staff writer Robert Morris on May 25, 1979.

The article reported that U.S. EPA planed to inspect a dump site at the Old Monsanto Nitro plant, where it had been reported that Old Monsanto buried chemicals associated with the production of 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T). The Gazette reported that the most toxic byproduct that has been found is dioxin.

The article quoted an Old Monsanto spokesperson that reported decontaminated equipment that was used in the manufacturing of 2,4,5-T was buried at the site after production of the herbicide ended. However, 2,4,5-T, and associated byproducts had never been buried at the site. It was reported that a U.S. EPA spokesperson stated that U.S. EPA planed to inspect the site, which is located under a building near the plant's waste treatment facility, near the River.

The Gazette stated that reports indicating that chemicals may had been buried at the site surfaced at a recent public meeting held by the Kanawha Valley Committee of Environmental and Occupational Health. It was reported that an Old Monsanto employee present at this meeting, stated that Old Monsanto drilled holes and deposited 2,4,5-T or its byproducts in the landfill. This employee was also quoted as saying that Old Monsanto does not believe that there is any remote chance that dioxin is going into the River or ever was.

The Gazette reported U.S. EPA officials as stating the monitoring of water supplies down River of Old Monsanto in Huntington and Cincinnati, has not found traces of 2,4,5-T or byproducts (Morris, 1979).

1.3 GOFF MOUNTAIN LANDFILL

The GML is located to the north of the Bayer Cropscience facility across Route 25, in Institute, WV, approximately 4 miles upstream of the Site.

October 23, 1989

DRAFT - RCRA Part B Permit for Rhône-Poulenc AG Company's Institute Plant, Rhone-Poulenc, 1989

The GML is located in a small valley near the Rhône-Poulenc Plant, on the north side of Highway 25. The GML is approximately 12.5 acres in size and is bordered to the north, east, and west by steep hills, and to the south by Highway 25, which runs between the landfill and the plant.

The landfill is a triangular shape and was built on a slope. It consists of an active, and an inactive area. The inactive area is the lower, narrow end, and the active area is the wider, upper end of the site. The landfill was built on a clay line, and upon closure will have an approved RCRA cap.

Rhône-Poulenc and UCC use the GML. The majority of waste within the landfill comes from the Rhône-Poulenc Plant, however waste is also received from the UCC South Charleston Facility, and UCC South Charleston Technical Center (UCC Tech). The majority of the waste sent to the GML was non-hazardous, however hazardous wastes such as 2,4,5-T have been accepted. Hazardous wastes that may be deposited at the landfill, however were not routinely received, were listed in Tables C-1c-2, C-1c-2, and C-1c-3 of the draft RCRA Permit B Report (Rhône-Poulenc, 1989).

1.4 SOUTH CHARLESTON LANDFILL

The former South Charleston Municipal Landfill site received wastes from many of the industries in the area. A 1999 sampling event reflected dioxin, polychlorinated biphenyls (PCBs) and arsenic. This landfill is one of 29 landfills receiving assistance from the Landfill Closure Assistance Program (LCAP) and is scheduled to receive a state regulated closure cap. A perimeter leachate drainage system is to be installed to collect leachate from the landfill with subsequent discharge to the South Charleston Sanitary Department for treatment.

1.5 DON'S DISPOSAL SERVICE

Don's Disposal Services is located in Charleston, WV is located approximately 6 miles upstream of the Site. This 80-acre closed landfill is suspected to have caused ground water contamination. Don's Disposal Service accepted 500 tons of waste for 14 years. After 1994, the owners' terminated the disposal operation, capped the landfill and installed a monitoring well(s), a vent(s) and a leachate collection system. This landfill is one of 29 landfills receiving assistance from the LCAP and was due to receive a state regulated closure cap starting in 2004. A perimeter leachate drainage system was to be installed to collect leachate from the landfill with subsequent discharge to the Charleston Sanitary Department for treatment. A new passive gas system was also to be installed during construction, consisting of one vent per acre of land.

1.6 CLARK PROPERTY

The Clark Property is located adjacent to U.S. Route 62 at the intersection of Dutch Hollow Road, in Kanawha County, approximately 4 miles upstream of the Site. The Site covers approximately 20 acres, most of which appear to be an abandoned strip mine. The site contained two ponds, four buildings and a salvage area. Originally the site contained over 500 drums, several compressed gas cylinders and containers of various sizes. Samples collected from six drums by the U.S. EPA Region 3 Technical Assistance Team contractor identified the following substances: benzene, ethylbenzene, toluene, chlorobenzene, acetone, xylene, 2-butanone, 4-methylpentanone, isophorone, acenaphthene, acenapthalene, anthracene, bis (2-ethylhexyl) phthalate, dimethyl phthalate, flourene, napthalene and 2-methyl napthalene. No dioxin sampling has been preformed.

1.7 MCJUNKIN CORPORATION (1971 - PRESENT)

The McJunkin Supply Company (McJunkin) was founded in Charleston in 1921, as an oil and gas supplier for WV. The opening of UCC in 1932 allowed McJunkin to become involved in the chemical industry with UCC becoming a major customer. A large central warehouse was opened in Nitro in 1971 when McJunkin became more involved in the refining and petrochemical industries. In 1998, the hub and spoke operation in Nitro was expanded by 16,000 square feet to total of 75,000 square feet (McJunkin, 2007).

1.8 HEIZER CREEK AND HEIZER CREEK LANDFILL

The Heizer Creek Landfill (HCLF) is located approximately 1 mile northeast of Poca, off Heizer Creek Road. The Landfill is approximately 1 acre, and is bounded to the south by Heizer Creek Road and to the north, east, and west by trail roads. The City of Nitro used this landfill from the late 1950's until the early 1960's.

Old Monsanto used the HCLF in 1958 and 1959 to dispose of approximately 170,000 cubic feet of unknown plant trash and waste. According to state officials, wastes included 2,4,5-T manufacturing wastes and floor sweepings. Old Monsanto entered into a consent agreement with U.S. EPA in April 1987, after a sampling investigation conducted by the NUS Corporation in 1984 found elevated levels of 2,3,7,8-TCDD. The consent agreement called for the removal of contaminated soil, and directed Old Monsanto to store the contaminated soil at its Nitro plant pending licensing of a dioxin disposal facility (Weston, 1999). A total of 9 fifty-five gallon drums of excavated material were removed from the site and transported to Old Monsanto's Nitro facility (U.S. EPA Region III, 2004).

September 15, 1983
A Site Inspection for the Heizer Creek, NUS Corporation, 1985

On September 15, 1983, NUS Corporation performed a site inspection of Heizer Creek. NUS Corporation, FIT III team members observed 8 drums in various stages of decay, and a black tar-like substance.

Six aqueous and nine solid samples were collected during the investigation. Samples indicated the presence of 2,4,5-T at approximately 21 milligrams per kilogram (mg/kg) (21,000 parts per billion (ppb)).

The following conclusions were drawn:

- Re-sampling of the on-site spring and home wells should be conducted to verify the release of contaminants
- A Hazard Ranking System (HRS) should be conducted under separate cover
- The site should be properly closed, which may involve the removal of on-site wastes (visible waste and drums) (NUS Corporation, 1985)

September 1984, October 1985

Feasibility Study of Heizer Creek Site, Monsanto Engineering, 1986

This report was prepared by Old Monsanto Engineering in order to review remedial action alternatives, and to recommend one which best addresses site conditions at Heizer Creek.

Investigations to determine the presence of 2,3,7,8,-TCDD in soil were conducted in September 1984 by NUS Corporation and in October 1985 by Old Monsanto Engineering. The Old Monsanto Engineering study reported that 2,3,7,8-TCDD concentrations ranged from ND or less than 1.0 ppb to 3.79 ppb.

Three Remedial Action Alternatives were developed based on the Old Monsanto Engineering study findings. They included: no action, capping, and excavation.

Old Monsanto Engineering concluded that no action was the most favorable action for this site. Due to the isolated nature of the site, there was only a small chance that significant human exposure would occur. The 2,3,7,8-TCDD concentrations found at this site were below recommended levels for sites of this type (Wilson, 1986).

2000

Engineering Evaluation/ Cost Analysis, Heizer Creek Landfill Site, Putnam County, WV, ARCADIS, 2000

See the following section for a summary of this report.

September 29, 2001 – October 1, 2001

Engineering Evaluation/ Cost Analysis Addendum, Heizer Creek Landfill Site, Putnam, WV, 2001

ARCADIS Geraghty & Miller, Inc. (ARCADIS) prepared this addendum to the Engineering Evaluation/Cost Analysis (EE/CA) Report for HCLF site dated September 2000. ARCADIS was retained by Old Monsanto to prepare the EE/CA, which addressed the presence of 2,3,7,8-TCDD at the site pursuant to Administrative Order on Consent (AOC) Docket No. 99-036-DC, dated September 30, 1999, issued by U.S. EPA Region III. On July 3, 2001, Old Monsanto received a letter from U.S. EPA Region III requesting further characterization of the nature, concentration, and extent of 2,3,7,8-TCDD in residential wells, and was accompanied by an Agency for Toxic Substances and Disease Registry (ATSDR) report recommending a full groundwater evaluation. The addendum to the EE/CA summarizes findings of the groundwater investigation, and addresses the requirements of the AOC.

The EE/CA, dated September 2000, presented the results of the field investigation conducted in May 2000, and the preferred remedial action alternative, full vegetative soil cover with consolidation. The field investigation involved soil, surface water, and sediment data, and is summarized below:

- A total of 36 soil samples were collected, 27 from 0 to 6 inches below ground surface (bgs), 7 from 6 to 12 inches bgs, one from 12 to 18 inches bgs, and one background sample from a topographically high area east of the site, outside the waste limits. 2,3,7,8-TCDD concentrations in soil ranged from 0.011 micrograms per kilogram (ug/kg) (0.011 ppb) at the southwestern corner of the site, to 100 ug/kg (100 ppb) inside the southeastern corner. The background sample was reported as 0.093 ug/kg (0.093 ppb).
- Three surface water and sediment/soil samples were collected from the drainage swale along the western site boundary. The 2,3,7,8-TCDD concentrations ranged from 0.865 ug/kg (0.865 ppb) at the head of the swale, to 0.034 ug/kg (0.034 ppb) immediately upstream of the confluence with the perennial stream. Immediately downstream of this stream, 2,3,7,8-TCDD was reported at 0.0065 ug/kg (0.0065 ppb).
- An Ecological Risk Assessment (ERA), and a Human Health Risk Assessment (HHRA) were performed to determine the incremental risk associated with the presence of 2,3,7,8-TCDD at the site. It was determined from the HHRA that the incremental cancer risks for exposure to soil/sediment were within the U.S. EPA target risk range of 1x10-4 to 1x10-6 for the following receptors: adult trespasser/visitor, teenage trespasser/visitor, excavation worker, and maintenance worker. The ERA concluded that potential adverse effects are not expected to be present for population level terrestrial invertebrates, aquatic life, or terrestrial wildlife due to the limited area of the site within a similar, neighboring habitat.

The EE/CA concluded that there is a potential for migration of 2,3,7,8-TCDD through erosion and surface water run off from the site; however, it does not pose a significant threat. Implementation of the full vegetative cover with consolidation would mitigate human and ecological exposure, and potential releases to surface water and sediment from the site.

Four monitoring wells were installed in order to characterize conditions in the water table aquifer. Three wells were installed to characterize groundwater conditions immediately downgradient of the landfill, and one to characterize cross-gradient groundwater conditions. Groundwater samples were collected between September 29, 2001, and October 1, 2001. Samples were analyzed for 2,3,7,8-TCDD using U.S. EPA SW-8476 Method 8290. Groundwater sampling results reported that 2,3,7,8-TCDD was not detected in any of the samples. The detection limits ranged from 1.6 to 2.3 picograms per liter (pg/L) (0.0000016 to 0.0000023 ppb).

It was concluded that since 2,3,7,8-TCDD was not detected in any of the samples, it is not migrating from the site via groundwater. It therefore poses no threat to the Pocatalico River, or to nearby residents using groundwater as a potable water supply (ARCADIS, 2000 and 2001).

1.9 MILLER SPRINGS REMEDIATION MANAGEMENT INC. (OCCIDENTAL CHEMICAL CORPORATION (OXYCHEM), DIAMOND SHAMROCK)

The former OxyChem facility is located in Belle, West Virginia, approximately 15 miles southeast of Charleston, West Virginia, on a 23-acre site adjacent to the Kanawha River. The Belle Facility is located in a mixed industrial/residential area, which includes the DuPont Belle plant located immediately adjacent to the site's northern property boundary. Chemical production operations began at the site in 1920 by Belle Alkali Company and continued through a succession of owners and tenants until OxyChem purchased the facility in 1986. OxyChem manufactured multi-product chloromethanes from chlorine until the plant shutdown in October 1994. All process equipment and buildings have been taken down and removed from the site (U.S. EPA Region III, 2008_2).

Diamond Shamrock began chlorine production in 1919 at a facility located in Belle approximately 20 miles upstream of the Site. Chlorine production was phased out by 1946 and was replaced by production of chlorinated methanes, including methylene chloride and chloroform. Chlorine production is a source of polychlorinated dibenzo-p-dioxins (PCDDs). They are formed from the reaction of the chlorine with graphite electrodes and the linseed oil or phenolic resins used to bind the electrodes. They can also be formed from the reaction of chlorine with greases used to seal joints; from organic materials used in the cell header pipes and from trace organic chemicals present in the feed water used to dissolve the salt. The PCDD from the chlorine process are dominated by higher chlorinated PCDD, but 2,3,7,8-TCDD would be expected to be present. PCDDs are typically expected to be byproducts from any chlorinated organic manufacturing process. The chlorinated methane production would be expected to produce some PCDD, which would be concentrated in the residuals and distillation bottoms. A preliminary review of Diamond Shamrock patents was performed. One patent was for production of chlorophenols from chlorobenzenes, specifically pentachlorphenol, which is a known source of PCDD. Another patent was for the dehydrochlorination of benzene hexachloride to produce chlorobenzenes. There was also a patent for production of vinyl chloride form ethylene dichloride. These processes are likely to produce PCDD. Many other patents were for chlorinated chemical products including chlorinated paraffins. All could produce PCDD. It is not known if processes utilizing these patents were in use at this facility.

VOCs are the main constituents found in the site's soil and groundwater. These compounds primarily consist of methylene chloride, chloroform, and carbon tetrachloride. Semi-volatile organic compounds (SVOCs) and metals were also detected.

August 9, 1993

<u>RCRA Corrective Action Program Bimonthly Progress Report, Occidental Chemical Corporation, Belle, WV, 1993</u>

On June 5, 1993, rainwater surge storage tank T-101 collapsed releasing approximately 111,250 gallons of rainwater that contained small amounts of chloromethanes. Analysis determined that the tank contained: methylene chloride at 146 parts per million (ppm) (146,000 ppb); chloroform at 103 ppm (103,000 ppb), and carbon tetrachloride at 24 ppm (24,000 ppb). Due to discoloration of surface gravels, impacted surface soil and gravel was removed and stock piled in areas designated as Stockpiles A through E.

Environmental Resource Management, Inc. (ERM-Midwest) collected 12 random, discrete soil samples on August 9, 1993. Among other constituents, samples were analyzed for 2,4,5-T. Analysis reported that all samples were ND or less than the quantitation limit of 0.020 mg/l (20.0 ppb) for 2,4,5-T (ERM-Midwest, 1993).

May 1994, November 1994, and February 1995

<u>Updated Section 4 of the Phase I RFI Report, Occidental Chemical Corporation, Belle, WV Facility, ERM-Midwest, 1996</u>

This document, prepared by ERM-Midwest, serves as a replacement to the previous Section 4 for OxyChem, Belle. The changes reflect the addition of statistical parameters such as detection limit per sample, positive detections, total number of samples collected, and maximum, geometric, and mean concentrations.

Constituents found in all media sampled during the site investigation were identified, and concentrations were compared to U.S. EPA Region III Risk Based Concentrations (RBCs). Samples collected from the boundary wells were discussed in Section 4.3.4.3, and corresponding results were presented in Table 4-14 of the Phase I RFI Report. Table 4-14 presents a comparison of the alluvium groundwater boundary wells sampling results with applicable standards. Table 4-14 results for dibenzofurans included:

- MW-2: May 1994, November 1994, and February 1995, all reported as 10.0 ug/L (10.0 ppb)
- P-2: May 1994, November 1994, and February 1995, all reported as 10.0 ug/L (10.0 ppb)
- MW-5: May 1994, reported 10.0 ug/L (10.0 ppb)
- P-5: May 1994, reported 10.0 ug/L (10.0 ppb)
- MW-8: May 1994, November 1994, and February 1995, all reported as 10.0 ug/L (10.0 ppb)
- P-8: May 1994, November 1994, and February 1995, all reported as 10.0 ug/L (10.0 ppb)
- MW-17: May 1994, and February 1995, both reported as 10.0 ug/L (10.0 ppb).
- P-17: May 1994, November 1994, and February 1995, all reported as 10.0 ug/L (10.0 ppb)
- MW-18: May 1994, November 1994, and February 1995, 2,300.0 ug/L (2,300.0 ppb), 220.0 ug/L (220.0 ppb), and 94.0 ug/L (94.0 ppb) respectively
- P-18: May 1994, November 1994, and February 1995, 27.0 ug/L (27.0 ppb), 52.0 ug/L (52.0 ppb), and 24.0 ug/L (24.0 ppb) respectively

ERM-Midwest noted that the majority of exceedances for U.S. EPA RBCs were associated with concentrations detected in wells MW-2, P-2, MW-18, and P-18 (ERM-Midwest, 1996).

January 22, 1997

<u>Compliance Schedule Evaluation Inspection Report, Occidental Chemical Corporation, Belle, WV, WV DEP, 1997</u>

WV DEP Inspectors John R. Fredericks and Talal Fatallah conducted an inspection at the OxyChem facility in Belle, WV on January 22, 1997. This inspection was conducted to observe sampling sites on dikes at the facility, and to determine if sites were representative. OxyChem planned to demolish the dike walls, and bury the concrete on site.

OxyChem representative Mr. Ed Midkiff accompanied the inspectors during the investigation. Mr. Midkiff provided information describing sampling sites and analytical results, which indicated that the sampled dike walls do not contain hazardous materials associated with OxyChem's production processes. Samples were analyzed for 2,4,5-T, and were reported as ND at a quantitation limit of 0.020 mg/L (20.0 ppb).

WV DEP Inspectors observed sampling sites and determined that they were representative. Areas of concern the WV DEP noted was that concrete in some of the dikes may be considered a "U" type waste due to spillage of commercial chemical products may have occurred in this area over the lifetime of the plant. It was also noted that the concrete is at least an industrial waste and should therefore be disposed of in an industrial landfill (Fredericks, 1997).

2001

<u>Human Health Risk Assessment for Surface Water and Sediment - Fish Ingestion Evaluation, Former OxyChem Facility, Belle, WV, Environmental Resources Management, Inc. 2001</u>

ERM-Midwest prepared this assessment on behalf of Glenn Springs Holding, Inc., and Miller Springs Management, Inc. [The first several pages of this report were missing].

This assessment examined the uptake of River sediment and surface water by fish to evaluate potential risks associated with human ingestion of fish from the River. In order to determine if potential risks were related to the OxyChem Facility, analytical data of sediment and surface water adjacent to the facility were as a basis of evaluation.

Table 1.0, Kanawha River Sediment Contaminants of Potential Concern (COPC), reported that a total of 38 samples were analyzed for dibenzofurans. Five of the samples detected dibenzofurans at a reported concentration range of 45.0 ug/kg (45.0 ppb) to 200.0 ug/kg (200.0 ppb). This table also reported that dibenzofurans are not considered an important bioaccumulative constituent as defined in U.S. EPA, 2000a.

The assessment concluded that both carcinogenic and non-carcinogenic risks were at or below acceptable levels. In regard to risks associated with human consumption of fish from the River, it was concluded that the facility does not impact sediment or surface water such that risks are at unacceptable levels (ERM-Midwest, 2001).

1.10 UNION CARBIDE CORPORATION (UPSTREAM)

The UCC Alloy Plant is located in South Charleston approximately 10 miles upstream of the Study Area. The UCC Alloy Plant began producing aluminum in 1901. Metals production is a potential source of PCDD. Particulate emission control of the submerged arc furnaces was installed in 1962, suggesting that significant particulate emissions occurred before that date. In 1929 UCC began production of vinyl chloride from ethylene dichloride at South Charleston. Manufacturing of ethylene dichloride is known to produce significant quantities of PCDD containing wastes, including still bottoms and waste catalyst. Ethylene chlorohydrin and tetraethyl lead were also produced at the UCC Alloy Plant. In 1937 the Fine Chemicals piloting unit was expanded on Blaine Island, and in 1960 it was producing 30 million pounds of 200 different organic chemicals, some of which were likely chlorinated. Bakelite, a phenolic resin, production began at Bound Brook, NJ in 1939. UCC produced phenol using the Raschig process, which involves the production of phenol by the hydrolysis of chlorobenzene. The process is known to produce PCDD, particularly dioxins including 2,3,7,8-TCDD. This production could have occurred at one of the UCC Kanawha Valley Plants. A coal hydrogenation plant was built at Institute in 1951 and produced aromatic hydrocarbons and coke.

1985

<u>Groundwater Quality Assessment Plan, Union Carbide Corporation, 1985</u>

UCC had completed the analysis of three surface impoundments at the Private Trucking Operations (PTO) site. IT Corporation was retained by UCC to conduct sampling and analysis and to implement the Groundwater Quality Assessment Plan. The objectives of the investigation were to:

- Determine the direction and rate of groundwater flow
- Determine if hazardous constituents were entering the groundwater
- Evaluate the existing hydro-geological conditions

In July 1985, five additional monitoring well were installed at PTO site as required by the Ground Water Quality Analysis Plan (GWQAP). Fieldwork and laboratory analyses were carried out through September 1985. A total of ten monitoring wells samples and two composite sludge samples were collected during the sampling event. The samples were analyzed by selected hazardous constituents, which may have resulted from wastes handled at PTO. This included all volatile, semi-volatile, pesticides, and PCB priority pollutants as well as the non-priority hazardous substances. The two sludge samples were also analyzed for 2,3,7,8-TCDD, which were measured below the detection limit.

According to the analyses of the samples from the wells nearest to the surface impoundments, no compounds appeared to be migrating from this area, and no contaminant migration plume was originating from the impoundments. Results also indicated that no imminent hazard to human health or the environment exists from the three surface impoundments (UCC, 1985).

1988

Union Carbide Corporation – South Charleston Plant, Holz Impoundment Delisting Petition (Volume I of II), Union Carbide, 1988

UCC submitted this petition to U.S. EPA Delisting Office to request for the contents in Holz Impoundment (Holz) be excluded from the hazardous waste lists of 40 CFR Part 261. Holz was owned by UCC and was operated as a RCRA hazardous waste disposal impoundment. Holz mainly accepted three types of waste streams in slurry form:

- Boiler flyash from UCC's South Charleston plant – Energy System Department
- Sludges from South Charleston Waste Treatment plant at Rhone-Poulenc's Plant
- Sludges from the South Charleston Waste Treatment Works, which treated wastewater from UCC's South Charleston plant and municipal wastewater from the City of South Charleston

In August 1987, U.S. EPA conducted an audit of Holz Impoundment by collecting eighteen groundwater samples from surrounding wells. 2,3,7,8-TCDD dioxin was among the many compounds analyzed and was found to be below the detection limit. No significant levels of volatiles and semi-volatiles organics were detected in the eighteen groundwater samples.

UCC had conducted a comprehensive program to obtain representative samples of the impoundment contents and analyzed the collected samples for hazardous waste characteristics. The average groundwater concentrations of all the compounds and metals detected were consistently lower than U.S. EPA's health-based standards. With the absence of contaminants in any of the monitoring wells installed as part of an on-going groundwater program, UCC submitted this petition to grant that the contents of Holz be excluded from the hazardous waste lists (UCC, 1988).

1991

Groundwater Protection Procedure Evaluation Phase Report, Union Carbide Chemicals & Plastics Co., Inc., 1991

UCC and Plastics Company Inc., conducted an evaluation phase investigation at the dinitrotoluene (DNT) facility located in Institute, WV. The investigation included the sampling and analysis of soil, surface water, air and groundwater to determine whether the inactive DNT manufacturing site had resulted in contamination.

Samples were collected at the following areas at the DNT facility: toluene storage tank, toluene transmission line leak, DNT product storage, burning pit, waste disposal basin, and DNT sump. Seven surface water samples and five soil samples were collected and three groundwater monitoring wells were installed at the DNT facility. All samples were analyzed for metals, volatile and semi-volatile organics.

Review of analytical results for samples collected from the burning pit, toluene storage tank area and DNT product storage area showed no contamination at these units. DNT pond had caused contamination of the surrounding soil and groundwater. Groundwater concentrations of 25 ppm of 2,6-DNT and 19 ppm of 2,4-DNT were detected in the vicinity of the DNT pond. These concentrations had exceeded the Toxicity Characteristic (TC) regulatory level of 0.130 ppm for 2,4-DNT. The soil sample collected from the DNT pond also contained low ppm (<10 ug/g) of 2,6 DNT and 2,4-DNT.

Based on the results of the evaluation phase of the groundwater protection procedure, it was recommended to conduct additional soil borings and to continue to monitor the groundwater wells after the closure of the pond (UCC, 1991).

1991

Compliance Evaluation Inspection Report – Union Carbide Chemicals & Plastics Co., State of West Virginia Department of Commerce, Labor, and Environmental Resources, 1991

UCC conducted a sludge characterization study at the South Charleston Waste Treatment Works. The results from the study were submitted to the U.S. EPA Department of Natural Resources in conjunction with other information as per requested during the compliance inspection. 2,4,5-T was among the chemicals analyzed, which was found to be below the detection limit (10 ppm). All other constituents analyzed were also below the Toxicity Characteristic Leaching Procedure values (WV DCLER, 1991).

July 10, 1992

Trip Report: Site Visit of the #20 Sump Area, Union Carbide Chemicals and Plastics Company, Inc., Plant 514, WV DEP, 1992

On July 10, 1992, WV DEP Inspectors conducted a site visit of the #20 sump area at UCC and Plastics Company, Inc. – Plant 514 in South Charleston, at the request of UCC officials. The purpose of the investigation was to view a contaminated area from an old production unit on Blaine Island. The area is located near the ARCO – Polyols Unit.

According to UCC, historical time frames of processes are uncertain. From the 1920's to the 1940's a small crude oil refinery was in operation at the site, and from 1940's to the 1960's, a dripolene distillation process. The WV DEP stated that the dripolene distillation process was associated with a decanting sump, and that evidence suggests that a discharge pipe connected it to the River. The WV DEP reported that the sump is no longer present, and approximately 15 feet of fill material is present on top of the old production area.

The WV DEP reported that UCC has determined groundwater contamination is present in the ARCO – Polyols Unit area. The upstream edge of the contamination plume has been defined; however, investigations are still underway to determine the downstream edge. Inspectors also viewed the River channel adjacent to this area, where oil-like seeps from the bank have been observed, and sheen develops on the River. Inspectors reported that UCC has installed a curtain and an absorbent boom in this area.

WV DEP inspectors reported that UCC is concerned about reporting requirements to the National Response Center for spillage to the River. UCC officials would like to obtain a variance from the requirements, since seepage is minimal and somewhat continuous during the summer (WV DEP, 1992).

July 8, 1993

Compliance Evaluation Inspection, Union Carbide Chemicals & Plastics Co., Inc. - Holz Impoundment, WV DEP, 1993

On July 8, 1993, WV DEP Inspectors conducted a RCRA Compliance Evaluation Inspection at the UCC Holz Impoundment, located in South Charleston on Route 214.

Holz is a permitted hazardous waste land disposal Treatment Storage and Disposal Facility (TSDF). It receives fly ash and bottom ash from UCC Plant 514, and sewage treatment sludge from the City of South Charleston Publicly Owned Treatment Works (POTW). The South Charleston POTW treats domestic wastewater from the City of South Charleston, and industrial wastewater from UCC Plant 514.

WV DEP Inspectors conducted a physical inspection of the impoundment by observing the new groundwater recovery well system, which was installed due to detected groundwater contamination in monitoring well cluster 502 in August 1992. This system consists of a series of five wells equipped with a pump/recovery system. WV DEP inspectors reported that the #3 recovery well has shown trace contamination of metals and volatile organics (WV DEP, 1993).

January 17, 1996
<u>Signed Consent Order HW-491-95 for the UCC PTO Facility</u>

This Order was issued by the Director of the WV DEP, and has an effective date of January 17, 1996.

The basis of the order is that the UCC PTO is a closed facility located in Institute, WV. The PTO is currently undergoing closure requirements, which include semi-annual monitoring of groundwater monitoring wells. Seven recovery wells are present at the PTO, which pump contaminated groundwater to a common sump, and then to the Rhône-Poulenc Wastewater Treatment Facility. East of the site there are two additional recovery wells, which initially discharge into an oil/water separator, and then the medium continues to a common sump which also serves the seven recovery wells. If oil media were present, it would then be pumped to 55-gallon drums and handled as a hazardous waste.

A Compliance Evaluation conducted at the facility on September 14, 1994 by the WV DEP concluded that the "PTO failed to make a proper hazardous waste determination on all wastes generated or stored on-site, in violation of 40 CFR Section 262.11, as referenced by Section 5.1 of the Regulations".

Some of the requirements of the order included:

- That the PTO continues annual toxicity characteristic leaching procedure (TCLP) analysis of wastewater produced from recovered groundwater from the recovery wells (WV DEP, 1996)

- That if wastewater analysis indicates a significant change in the sludge, which is generated, such that it may have become hazardous, a TCLP analysis of the sludge must be performed (WV DEP, 1996)
- That the PTO determines if there is affirmative evidence that phthalate parameters recovered from PTO wastewater/sludge is from listed wastes (WV DEP, 1996)

May 28, 1998

Memorandum to Tom Fisher, WV DEP, from Jim McCune, Re: Stolen Vehicle Situation, WEG, 1998

This memorandum was prepared by Jim McCune of Weavertown Environmental Group (WEG) to notify various Kanawha County agencies that a vehicle and roll off container containing waste bearing waste code D005 was stolen on May 18, 1998. Newspaper articles prepared by the Charleston Gazette and a Kanawha County Sheriff's Department report were attached to the WEG memorandum.

The truck and roll off container were stolen from WEG's Charleston transfer station. The container, a dark brown, 20 by 8 by 5 foot box containing about 2,200 pounds of soil UCC South Charleston facility to a waste disposal facility in Model City, NY. WEG reported that the truck had been parked overnight in an area of the transfer station that was not fenced in. The WV DEP stated that WEG stored the truck improperly, explaining that since it was too tall to fit inside the bay properly, they parked it outside the enclosed area.

On May 19, 1998, the truck was discovered damaged and abandoned on 40th street in Nitro, however the container was not found until May 23, 1998. The container was eventually found at the public stream access on River Bend Road along the Coal River outside of St. Albans. The Kanawha County Sheriff's Department report stated that the tarp on the container had been sliced in several places (WEG, 1998).

May 6-7, 2002

Letter Report: Building 603 Geoprobe Investigation, DOW South Charleston Facility, Kemron Environmental Services, 2002

Kemron Environmental Services, Inc. (KEMRON) was retained by UCC to evaluate environmental conditions at Building 603, Doe South Charleston Facility.

On May 6th and 7th, 2002, KEMRON conducted a Geoprobe soil investigation at the site. Laboratory analytical results for soil samples included analysis for 2,4,5-T and dibenzofurans. Analytical results indicated that sample L0205151-09 contained 1220 µg/kg (1220 ppb) 2,4,5-T and 1230 µg/kg (1230 ppb) dibenzofuran. Sample L0205151-10 contained 631 µg/kg (631 ppb) 2,4,5-T, and 722 µg/kg (722 ppb) dibenzofuran (KEMRON, 2002).

1.11 AMERICAN CAR & FOUNDRY INDUSTRIES, INCORPORATED

American Car & Foundry Industries, Inc. (ACF) was located in Putnam County, approximately 20 miles northwest of Charleston, WV near the communities of Red House, Eleanor, and Buffalo, WV. The ACF site consisted of a 21.81 acre tract of land adjacent to the right descending bank of the River. The site is located immediately upstream of the Winfield Locks and Dam and is bordered by Highway 62 to the north and the west.

The site of the ACF facility was originally prime agricultural land that was part of the Noffsinger farm, as documented by aerial photographs taken in 1950. ACF constructed and operated a railcar service and repair facility at the site from 1952 until closure in March 1986. In their prime, ACF maintained a fleet of over 47,000 tank and covered hopper railcars, which were leased to various companies to haul liquid and solid chemical products. Shop facilities required for cleaning and repairing railcars, a paint shop, and an on-site wastewater treatment system were also located on-site. The wastewater treatment system consisted of a series of lagoons adjacent to the River.

The site remained idle until December 8, 1989, when U.S. ACE filed a Declaration of Taking for the 21.81-acre tract in order to construct an upstream approach for the new lock and gate bay at the Winfield Locks and Dam. U.S. ACE took possession of the site on May 1, 1990, after ACF had completed a limited excavation and removal activity on-site (U.S. ACE, 1992_1).

U.S. ACE added a new lock chamber, and straightened and widened the River channel through the former ACF site in 1997. The ACF site is located approximately 1 mile upstream of the Lock and Dam.

October 29, 1985
Preliminary Assessment of Shippers Car Line, NUS, 1986

On October 29, 1985, NUS, FIT III members conducted a preliminary assessment of the Shippers Car Line site located one half mile southeast of Eleanor, WV. The Shippers Car

Line site is a railroad tank cleaning facility, which ACF has owned and operated for 29 years.

NUS, FIT III presented Data Exhibit 3.1, Confirmation Sampling Test Results for Soil, Excavation Pit No. 1, Allstates Environmental Services, Inc. (Allstates) Data in the appendices of their report. This table reported an estimated concentration of 180 ppb for dibenzofuran in pit bottom sample 313-F1 (NUS Corporation, 1986).

November 30, 1988 - 1992

Engineering Evaluation/Cost Analysis (EE/CA) for Removal and Treatment of Contaminated Soil at the former ACF Industries, Inc. Site, Red House, WV, U.S. ACE, 1992

This EE/CA Report, prepared by U.S. ACE, summaries site background and analytical data collected to date, identifies removal action objectives and alternatives, and recommends a removal action alternative for the site.

Several water and soil sampling investigations have occurred at the site and are summarized in the following subsections:

- Initial U.S. ACE Evaluation: On November 30, 1988, U.S. ACE initiated environmental investigations at the ACF site to determine if hazardous and toxic wastes were present. On December 1, 1988, U.S. ACE representatives met with the ACF Corporate Manager for Environment and Safety to discuss the proposed environmental testing. The ACF representative stated that they wished to be present for any sampling or reconnaissance activities, and would require two weeks notice before access to the property would be granted. The U.S. ACE, along with their contractor, conducted the initial site investigation on December 14, 1988. The former ACF Plant Manager was present, however sampling was not completed as ACF denied entry and sampling on the site.
- WV Division of Natural Resources Compliance Investigation: On December 4, 1988, the WV Department of Natural Resources (WV DNR) conducted a Complaint Investigation, and on February 14, 1989 they conducted a Compliance Evaluation Inspection at the site. The focus of this inspection was to determine the status and condition of various on-site drums of waste materials. ACF agreed to sample the drums and several areas devoid of vegetation that had been noted by the WV DNR.
- ACF Environmental Site Investigation: On May 12, 1989, Allstates hired by ACF, began an environmental site investigation. The purpose of the investigation was to determine the extent of soil contamination within a localized portion of the site. The

investigation also defined the geographic boundaries of soil contamination, and the chemical contaminants.

Allstates determined that the area of primary contamination was 21,600 square feet, with an estimated volume of 3,200 cubic yards of contaminated soil. Allstates recommended excavation and landfill disposal. The organic contaminants detected in the soils were tetrachloroethylene, chloroform, dichloroethane, trichloroethane, chlorobenzene, methylene chloride, trichloroethylene, benzene, ethyl benzene, and toluene.

- ACF Remediation Activity: On October 27, 1989, WV DNR issued Administrative Order No. HW-225-89 requiring ACF to clean-up the identified contaminated areas. Remediation activities occurred from January 22, 1990 to April 11, 1990 and included the excavation, removal, and disposal of 9,151 cubic yards of contaminated soil. Approximately 100 empty containers, the majority of which were 55-gallon drums with minor chemical residues, were unearthed, crushed, and shipped for disposal in a chemical landfill. Organic compounds detected in samples included: methylene chloride, 1,1-dichloroethene, 1,2-dichloroethene, chloroform, 1,2-dichloroethane, trichloroethene, chlorobenzene, 1,1,2-trichloroethane, 1,1,2,2-trichloroethane, tetrachloroethene, benzene, toluene, and ethylbenzene.

- Preliminary Residual Contamination Survey: In May 1990, U.S. ACE observed contaminated water seeping from the pit walls of an excavation that had been left open following ACF's remediation activities. Surface water samples were obtained from the former ACF facility, piezometer installations within the Winfield Locks and Dam area approximately one half-mile downstream of the site, and from the Town of Eleanor's water supply wells.

  Groundwater contamination was not detected; however, seeps in the excavation had high contaminant levels indicating contamination in adjacent soils. Organic compounds detected during sampling included: methylene chloride, 1,1-dichloroethene, chloroform, trichloroethene, 1,1,2,2-trichloroethane, toluene, ethylbenzene, 1,2-dichloropropane, 1,2-dichlorobenzene, dibenzofuran, 1,2-dimethlybenzene, 2,4-dimethlyphenol, 2,4-dichlorophenol, and acetone.

- Confirmation of Contamination: On August 17, 1990 during the Lock construction, an equipment operator experienced skin and throat irritation after encountering unknown material while removing pavement with a backhoe. The unknown material was determined to be coming from a buried vault separate from the ACF excavation pit noted earlier.

  An initial site investigation was developed, which included soil gas surveys, soil sampling, and any necessary groundwater monitoring. Due to the nature of the identified contaminants, confirmation activities were expanded to include dioxin sampling, and a total site characterization.

- Soil Sampling: Soil sampling was conducted to confirm the presence and to identity the types of contamination present. Twenty-seven soil samples consisting of soil borings and surficial samples were collected and analyzed for VOCs, SVOCs, pesticides/PCBs, RCRA metals, cyanide, and dioxin/furans (3 samples).

  Results indicated that high concentrations of VOCs and SVOCs were detected in several areas of the site along with pesticides, PCBs, and dioxins. U.S. ACE determined that due to the number and concentrations of contaminants found in the soil matrix, groundwater contamination was possible and should be further investigated. U.S. ACE also determined that since dioxin was detected in two of the three samples, additional sampling was required to determine if dioxin contamination is localized or widespread.

- Groundwater Monitoring: Four groundwater monitoring wells were installed at the site. Groundwater monitoring was conducted by testing these wells along with three existing water supply wells in the area. Water samples were analyzed for VOCs, SVOCs, pesticides/PCBs, and RCRA metals.

  Low concentrations of volatile organics were detected in shallow perched groundwater, and no contaminants were detected in the deeper aquifer indicating that groundwater contamination is not a major concern.

- Soil Sampling for Dioxin: During initial sampling, dioxin was detected in two of the three soil samples. Thirteen additional soil sample locations were selected for dioxin analysis in order to determine if dioxin contamination was localized or widespread.

  Analysis determined that over 50% of the soil samples contained dioxin contamination at a significant level, which concluded that dioxin contamination was widespread and present at levels to cause a major concern. U.S. ACE determined that due to disposal problems associated with dioxin contaminated soils, a total site characterization was necessary to determine the quantity of dioxin-contaminated soil.

- Site Characterization: During November and December 1991, soil, groundwater, and River sediment samples were collected and analyzed in order to complete a total site characterization for the ACF site. Site characterization included soil sampling, groundwater sampling, and River sediment sampling.

  In order to define the excavation limits for remediation activities, U.S. ACE designed a soil sampling program to detail both the lateral and vertical contamination. Soil samples were collected from 134 soil borings. Samples were analyzed for the presence of volatile, semi-volatile, and dioxin contamination. Certain samples were also analyzed for pesticides/PCBs, metals (8 RCRA plus iron and manganese) and dioxins/furans. U.S. ACE analysis determined that the extent of contamination is within the site boundaries except along the northern border. Dioxin contamination was detected above action levels between the railroad tracks and the exclusion zone fence north of the maintenance building. Other organic contamination above action levels is present and the majority of which is located within the dioxin plume.

A total of 14 groundwater samples were collected from selected wells screened in the shallow perched water and the deep aquifer. Samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, and dioxins/furans. Results indicated that halogenated organic solvents are present in the shallow perched aquifer. Other contaminants were not detected above current action levels.

River sediment samples were collected from the River in 16 locations in the vicinity of the ACF site. Sampling was conducted to determine the extent and nature of any off-site contaminated migration. Sediment samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, and dioxin/furans. Results indicated that all analytes were detected below action levels.

U.S. ACE recommended on-site thermal treatment for the removal of contaminated soils at the site. U.S. ACE also recommended that this treatment be used in conjunction with temporary storage of the contaminated material, to avoid delay in construction of the Winfield Locks and Dam (U.S. ACE, 1992_1).

August 1989

Phase I: Contamination Evaluation at the Former American Car & Foundry Site, TCT - St. Louis, 1991

In August 1989, U.S. ACE, Huntington District hired TCT - St. Louis to perform environmental contamination assessments at the former ACF site. The ACF property was contaminated by hazardous waste as a result of ACF operations that included cleaning and maintenance of railroad tank cars. U.S. ACE acquired a tract of land from ACF that would be excavated during the construction activities associated with upgrading the Winfield Locks and Dam Project.

During 1989, ACF contractors performed an environmental assessment of the site and excavated and removed 9,151 cubic yards of contaminated soil. After the remedial actions, WV DNR notified U.S. ACE that additional soil and groundwater contamination was believed to exist at the Site. In response to WV DNR, U.S. ACE collected several soil and water samples that confirmed the presence of high levels of organic compounds in the soil. The objective of this study was to assess the potential presence of contamination resulting from ACF operations. The assessment consisted of the collection of 16 soil samples from 8 soil borings. Samples were analyzed for Total

Organic Carbon (TOC), Total Halogenated Organics (TOX), volatile organic analytes (VOA), total metals, dioxin, and PCBs. Dioxin analyses were only performed on soil samples WB-91-1 and WB-91-7 (TCT-St. Louis, 1991).

June 26th – 27th, 1991

Dioxin Sampling at the Former American Car & Foundry Site, Winfield Locks & Dam Project, Red House, WV. Attachment to letter from U.S. ACE to WV Air Pollution Control Commission, 1991

This summary, reporting the results of dioxin sampling, was included as an attachment to a letter requesting the WV Air Pollution Control Commission to be present at a meeting with WV DEP on October 10, 1991. This meeting was held in order to discuss remediation of hazardous substances at the former ACF Industries site. U.S. ACE stated that due to the presence of dioxin, on-site remediation alternatives such as incineration were being discussed.

Dioxin contamination was detected in two of the three samples analyzed during Phase I of the Contamination Evaluation conducted in the spring of 1991. Due to the significance and toxicity of dioxin, additional sampling was conducted to confirm its presence and the extent of dioxin contamination. Sampling was conducted between June 26, 1991 and June 27, 1991.

A total of 15 samples were collected, which included 11 samples (including 1 duplicate) from the former ACF site, one from an area near the River bank, and two near building foundations upstream of the ACF site (site blanks and matrix spike). An additional sample was collected from the Bank Property site.

U.S. ACE concluded that the reported data indicates dioxin contamination is widespread at the site. Results were compared to U.S. EPA sources, which stated concentrations greater than 1 nanogram per gram (ng/g) (1 ppb) of the total toxicity equivalent quotient (TEQ) is considered high. Six of the samples analyzed exceeded this criterion (Vandevelde, 1991).

July 22, 1991

Decision Document, Winfield Locks and Dam, Kanawha River, Former ACF Industries Facility, Red House, WV, U.S. ACE, 1991

U.S. ACE prepared this document to summarize site history and actions conducted to date at the Winfield Locks and Dam, River, Former ACF Property in Red House, WV. This information was used by U.S. ACE to support their decision to proceed with a removal action under the authority of Comprehensive Environmental Response, Compensation, Liability Act (CERCLA), Subpart E – Hazardous Substance Response.

U.S. ACE purchased a 22-acre parcel from ACF on December 8, 1989, as part of a project to modernize the existing Winfield Locks and Dam. This facility was formerly used by ACF to repair and service their fleet of tank and covered hopper railcars, which were leased to various companies to haul liquid and solid chemical commodities.

On August 18, 1989, WV DNR issued an Administrative Order requiring ACF to perform an environmental remediation at the property, due to the possibility of the presence of hazardous and toxic waste. In response, ACF removed and disposed of approximately 9,000 cubic yards of contaminated soil, and 100 metal drums during January 1990 through April 1990.

U.S. ACE observed discolored water seeping from the excavation pit walls, and discolored soils in May, 1990. Analysis confirmed the presence of contaminants including VOAs, base neutral/acid extractable analytes (BNA), pesticides, PCBs, and dioxins. U.S. ACE stated that the majority of contamination is limited to the soil matrix; however, detectable levels of contaminants have been reported in a perched groundwater aquifer.

On January 14, 1991, U.S. EPA, Region III, issued an Order under Section 104 (e) of CERCLA requiring ACF to provide all information and documents in their procession regarding hazardous substances, which were transported to, stored, treated, or disposed of at the ACF site (U.S. ACE, 1991_1).

October 2, 1991

<u>Draft – Memorandum: Winfield Additional Lock and Gate Bay, Meeting with WV DNR to Discuss On-site Alternatives for Cleanup of Contamination on the Former ACF Property, U.S. ACE, 1991</u>

On October 2, 1991 representatives from the Nashville, Omaha, and Huntington Districts of the Ohio River Division met with WV DNR to discuss on-site disposal alternatives for cleanup of hazardous wastes at the former ACF site.

U.S. ACE stated that their primary focus was to keep construction of the new lock underway while developing the quickest practical approach to remediating the site. Due to the presence of dioxin, on-site disposal alternatives were examined.

An overview of site contamination was presented by U.S. ACE, which stated that contamination was the worst in the lagoon area, so this area was identified as a hot spot. The highest concentration of dioxin was 2,212 ppb, which was found in sample number 103. The Nashville District office stated that they do not believe dioxins are all over the ACF property, however they confirmed that dioxins have been found along the bank of the Kanawha River. Their objective for upcoming sampling events is to define the limits of contamination, and to separate soils containing dioxin from other contaminated soils (Kessinger, 1991).

October 4, 1991

Letter to Dale Farley, Director, WV Air Pollution Control Commission, from Charles E. Vandevelde, U.S. ACE, 1991

U.S. ACE prepared this letter in response to a telephone conversation between Mr. Mark Kessinger of U.S. ACE, and Ms. Lucy Pontiveros and Mr. Bob Weiser of the WV Air Pollution Control Commission regarding the remediation of hazardous substance on the former ACF property.

U.S. ACE states that a wide range of contamination remains on the property, including dioxin. Due to the presence of dioxin, on-site remediation is necessary, and incineration is being considered as an alternative. With this letter, the U.S. ACE provided a list of contaminants that have been identified at the site. The U.S. ACE also attached a summary report on the results of the dioxin sampling entitled, "Dioxin Sampling at the Former American Car & Foundry Site, Winfield Locks and Dam Project, Red House, WV", and a summary table of other soil contamination (U.S. ACE, 1991_2).

January 22, 1992

Letter to Riad Tanner, WV DNR, from R.J. Conner, U.S. ACE, Re: Advance Copy of Action Level Letter on Winfield Site, 1992

R.J. Conner, Chief, Engineering-Planning Division, U.S. ACE, prepared this letter to propose soil action levels for the response action involving hazardous substances at the former ACF property at the Winfield Locks & Dam site, Red House, WV.

U.S. ACE stated that the anticipated response action will involve excavations of contaminated materials, placement of materials in one or more above ground, enclosed storage buildings, and thermal destruction of contaminants using a mobile, on site incinerator. Other potential actions included constructing an on site landfill, and off site disposal of non-dioxin contaminated materials.

U.S. ACE calculated proposed soil action levels based on sampling data available to date, and therefore it was noted that the action levels may be updated as new data becomes available. Consultation with regulatory and private agencies may also alter the action levels. To calculate soil action levels, contaminants were characterized according to the following groups: Dioxins, Carcinogens, and Systemic Toxicants.

U.S. ACE established the action level for dioxins to be 1.0 ppb, as 2,3,7,8-TCDD equivalents. U.S. ACE received information from U.S. EPA, which recommended using this level for clean-up at Superfund Sites. U.S. ACE stated that a review of literature revealed that 1.0 ppb was used as the action level for dioxin at several Superfund sites, including Denney Farms, and Shenandoah Stables (Conner, 1992).

January 31, 1992

Letter to Colonel James R. Van Epps, from J. Edward Hamrick III, Director, WV Department of Commerce, Labor & Environmental Resources, Waste Management Section, 1992

J. Edward Hamrick III, Director, WV Department of Commerce, Labor & Environmental Resources, Waste Management Section, prepared this letter to address the "substantial hazardous and toxic waste problem involving dioxins at the former ACF property".

Mr. Hamrick stated that WV DNR supports the storage/ incineration alternative, and vigorously opposes the landfilling alternative for the following reasons:

- The dioxins and other wastes would have to be pre-treated before landfilling. The pre-treatment required for dioxins, and some of the other wastes, is incineration, and therefore the incineration is necessary for both alternatives
- The proposed landfill is immediately adjacent to the Town of Eleanor, and also located in a floodplain
- Landfilling requires continuous maintenance and monitoring. The dioxins would still exist, and may at some future date need to be removed and disposed (Hamrick, 1992)

May 15, 1992

U.S. ACE Tries To Get Company To Pay Costs Of Dioxin Cleanup At Site Of Ohio River Project, Environment Reporter, 1992

This newsletter states that according to U.S. ACE, ACF used their property to clean and maintain railroad cars, including chemical tankers from the 1950s to 1986. In the early

1980's ACF installed a U.S. EPA approved treatment plant. However prior to this, substances washed out of rail cars were channeled into three ponds connected by a ditch to the River.

The newsletter also states that U.S. ACE has reported dioxin contamination that is substantially above federal limits of 2 ppb (Environment Reporter, 1992).

June 1, 1992

Letter to James R. Van Epps, U.S. ACE, from William L. Finn, ACF, 1992

William Finn prepared this letter on behalf on ACF, in response to U.S. ACE's May 6, 1992 letter requesting comments on the U.S. ACE recommendation for removal of approximately 61,000 cubic yards of contaminated soil.

ACF stated that they have ongoing concerns that make it necessary for soil conditions to remain undisturbed at the site. ACF's concerns include:

- The quantity of soil that U.S. ACE claims is contaminated, the method that U.S. ACE used to calculate this quantity of contaminated soil, and whether the site has been accurately characterized
- Indications that cross contamination occurred due to the presence of dioxin in sample blanks, and that this dioxin was used to calculated the volume of dioxin in soil
- Very little dioxin was found, most toxicity equivalent factor (TEF) found were furans
- No formal hydrogeological study or risk assessment was conducted at the site to support U.S. ACE's claim that there is a threat to public health
- The administrative record has been deleted in certain portions, impeding ACF and the public's review (ACF, 1992)

June 2, 1992

Memorandum: Winfield Additional Lock and Gate Bay, Meeting With WV DNR to Discuss U.S. ACE/WV DNR Coordination During Removal Action on the Former ACF Property, U.S. ACE, 1992

This memorandum summarizes the minutes of a meeting between U.S. ACE and WV DNR on June 2, 1992 to discuss coordination efforts between the two agencies during the cleanup of hazardous substances at the former ACF property in Red House, WV.

Item nine, WV DNR Comments on the EE/CA, included information about a dioxin plume that had been referenced in the EE/CA prepared by U.S. ACE. Mr. Dave Meadows of U.S. ACE explained that most dioxin was found between the surface and depths to 2 feet; however, in one area dioxin was found at depths of 6 feet. U.S. ACE sampled sediments in the River, and dioxin was below action levels in all tested samples. Mr. Meadows stated that it is U.S. ACE's opinion that there are two sources of the dioxin: spillage, and residue from burn pits.

Groundwater contamination was discussed under item eleven. Mr. Meadows stated that contamination had not been detected in groundwater, and that U.S. ACE had developed an extensive groundwater monitoring program, which included fourteen wells between the ACF site and the Town of Eleanor. Mr. Lewis Baker, WV DNR Geologist, suggested that there was a large distance between the site and Town's wells, and that additional wells should be installed beside the lock construction area. Mr. Baker noted a report by International Technology Corporation that indicated volatile contamination is present at depths below the water table. He stated that a review of boring data showed there is not a single clay layer across the site, and therefore perched water may not be confined. Mr. Baker concluded that sands below the water level are contaminated, and therefore the groundwater in the sands is also contaminated, only to a lesser degree.

Item sixteen (summary) discussed the public's perception regarding incineration of contaminated soils. Mr. Terry Clarke of U.S. ACE stated that U.S. ACE had promoted landfilling the materials, but the State was strongly opposed to this alternative. Item sixteen also noted that U.S. ACE is receiving comments from the public regarding why WV DNR did not analyze for dioxin, and why WV DNR allowed dioxin contaminated soils to be taken off-site. This item was later included as an action item at the conclusion of the memorandum. Specifically, it was decided that WV DNR should prepare a position paper that documents "why dioxin were not tested for under ACF's cleanup and why dioxin-contaminated soils were landfilled off-site". This paper is to be submitted to U.S. ACE, which would allow U.S. ACE to respond in a manner, which is consistent with the WV DNR's position on the matter (U.S. ACE, 1992_2).

June 8, 1992

<u>Letter to Colonel James R. Van Epps, U.S. ACE, from J. Edward Hamrick III, Director, WV Department of Commerce, Labor and Environmental Resources, 1992</u>

This letter was written by J. Edward Hamrick III, Director of the WV Department of Commerce, Labor and Environmental Resources in response to a public meeting held in

Eleanor, WV, on May 25, 1992 concerning the former ACF property. During this meeting, a representative of U.S. ACE stated to the assembly that WV DNR had certified that the ACF property was clean.

Mr. Hamrick stated that this allegation has caused great concern, and in response to this statement, Mr. Hamrick noted that "the West Virginia Division of Natural Resources does not now nor has it ever certified any site as being clean". In response, WV DNR Waste Management office has allowed the Citizens Action Group, and members of the local media access to ACF files, telephone logs, and daily planners of staff members that document communication between WV DNR and U.S. ACE as early as January, 1990.

Mr. Hamrick noted that tank car cleaning facilities are known to be sources of potential environmental liabilities, and that it was no secret that materials handled at the facility were potentially hazardous. He also stated that WV DNR personnel informed U.S. ACE personnel of potential problems at the former ACF site as early as December 1989 (Hamrick, 1992).

June 18, 1992

Letter from Rolley Moore, Chairman, Wetzel County Solid Waste Authority, to Mike Dorsey, Public Information Office, WV DNR, 1992

Rolley Moore, Chairman of the Wetzel County Solid Waste Authority (WCSWA) prepared this letter in response to the May 5, 1992 EE/CA for Removal and Treatment of Contaminated Soil; the Former ACF Site, Red House, WV, prepared by U.S. ACE.

The above mentioned report is a source of great concern to WCSWA, since soils from the ACF site were deposited at the Wetzel County Landfill (WCLF) during the period of January 22, 1990 through April 11, 1990.

WCSWA stated that their primary concern is in regard to Section 1.1.8, page five of the U.S. ACE report, regarding discolored water that U.S. ACE observed seeping into an excavation in May, 1990. WCSWA quoted the report as stating "…samples collected from seeps exiting the walls confirmed the presence of a wide range of contaminants including volatile organics and base neutral/acid extractables. Subsequent investigations have confirmed the presence of pesticides, PCBs, and dioxins in this area". WCSWA states that since the seeps were observed weeks after the area that was thought to be the most contaminated area of the site was excavated, it is reasonable to assume that soils removed from the site are contaminated with dioxin.

The Authority has determined through contact with U.S. ACE, WV DNR, and U.S. EPA that Enviro Safe of Toledo, Ohio, nor WCLF were notified of the possibility of receiving dioxin contaminated soils, even though dioxin contamination at the ACF site was reported as high as 2,000 ppb. WCSWA also noted that records they obtained from WV DNR indicated that specialty wastes were not transported to the WCLF during the period of concern. To WCSWA's knowledge, the WCLF is a sanitary landfill, and WCSWA is unaware of any provisions within WV DNR for specialty waste landfills. However, the U.S. ACE report gives two direct references to the Wetzel County "Specialty" Waste Landfill receiving 6,641 tons of soil from the ACF site during the period of concern.

WCSWA is also concerned that the waste was deposited in an unlined facility. They feel that many of the conditions, which justified a removal action at the ACF site, will apply to the WCLF if the analysis reports that soil buried at the WCLF is similarly contaminated. Groundwater and surface water contamination, and the effects on landfill workers and nearby residents are also of concern.

WCSWA concluded by officially requesting U.S. ACE, WV DNR, and U.S. EPA to take the following actions:

- Provide a specific determination of where soils were deposited
- Conduct a soil gas survey at the WCLF using the same guidelines as U.S. ACE used at the ACF site
- Conduct soil sampling, including sampling for dioxin, and a groundwater monitoring program at the WCLF using the same guidelines as the U.S. ACE used at the ACF site
- Issue a similar site characterization report, prepared by U.S. ACE, based on soil and groundwater sampling, and Peach Fork sediment sampling (Moore, 1992)

June 26, 1992

<u>Wetzel County Landfill Suspected Dioxin Investigation, Memorandum to Brad Swiger, District 1 Supervisor, and Larry Betonte, Assistant Chief Inspector, Northern Office, from Jamie Fenske, Inspector, WV DNR, 1992</u>

On June 18, 1992, WV DNR received a telephone call from WCSWA, regarding concerns that the WCLF had accidentally received soil contaminated with dioxin. The WCLF accepted approximately 6,640 tons of soil from the Winfield Locks and Dam, former ACF site, between January 22, 1990 and April 11, 1990. During the removal action at the ACF site, 9,159 cubic yards of contaminated soil were excavated, removed, and disposed. Approximately 4,466 tons of hazardous waste soils were transported to the Envirosafe, Inc. Landfill in Toledo, Ohio, and approximately 6,640 tons of soils characterized as non-hazardous were transported to the WCLF.

On July 1, 1992, WV DEP inspector Jamie Fenske, met with WCLF site Engineer Dave Brown, and Site Manager Randy Simms at the WCLF. Inspector Fenske was provided with documents regarding the approval to accept landfill materials and maps indicating the location where soil was used as a cover material. The WCLF representatives stated that no field analysis or soil samples were collected during the period when wastes were accepted.

On June 26, 1992 Technical Testing Laboratories, on behalf of WCLF, collected three downgradient monitoring well samples, and one leachate sample (Fenske, 1992).

July 2, 1992

Review of Available U.S. ACE Data, Former ACF Property, Red House, WV, Burlington Environmental, 1992

Burlington Environmental, Inc. (Burlington) was retained by ACF to prepare this preliminary technical review of available U.S. ACE data regarding environmental investigations at the former ACF facility in Red House, WV.

The majority of the information that Burlington has reviewed to date includes reports prepared by U.S. ACE and its contractors, which include International Technology Corporation and Law Environmental, Inc. Burlington also obtained a soil quantification computation sheet from U.S. ACE dated January 23, 1992, and other U.S. ACE memorandum available from the U.S. ACE Huntington office.

In conclusion, Burlington stated that the U.S. ACE has:

- Based conclusions on samples collected in such a manner that interpretation of many of the results is questionable
- Inappropriately used data from certain chemical analysis procedures for dioxin in their determinations
- Based their conclusions on inaccurate, imprecise, and otherwise flawed chemical analysis data
- Assessed the level of risk to public health and the environment at this property using procedures that are inappropriate and outdated according to U.S. EPA

- Greatly overestimated the potential risk to public drinking water supplies at Eleanor, WV, based on erroneous estimations of the groundwater flow at this property
- Inaccurately mapped the extent of contaminated soils at this property
- Substantially overestimated the quantity of soil that must, according to their own contractor's analytical data and calculations, be removed from the property
- Selected on-site incineration as the technology to be used to clean up this site even though the soil can be hauled off-site for incineration (Burlington, 1992)

July 7, 1992
<u>Letter to Colonel James Van Epps, U.S. ACE from William Finn, Vice President, ACF, 1992</u>

William Finn, Vice President of ACF prepared this letter as a formal initial response to the EE/CA report that U.S. ACE issued on May 5, 1992. Mr. Finn stated that technical expertise for ACF's review of the document was provided by Burlington, a firm whose expertise is in dioxin site investigations.

Mr. Finn states that ACF opposes U.S. ACE's planned activities outlined in the EE/CA, and concludes that the proposed activities are not consistent with the U.S. EPA National Oil and Hazardous Substance Pollution Contingency Plan under CERCLA. ACF also concluded that U.S. ACE's estimate of 61,000 cubic yards of dioxin contaminated soil is inaccurate and grossly exaggerated. Burlington has shown that the volume of dioxin contaminated soil requiring removal is potentially only 8,950 cubic yards. ACF stated that they have learned that U.S. ACE, U.S. EPA, and U.S. Department of the Interior (U.S. DOI) all had knowledge of the presence of dioxin contamination in the River as early as 1986. ACF commented that they had no such knowledge, and that this knowledge should have led U.S. ACE to conduct dioxin testing prior to instituting a condemnation of the site. ACF states that they conclude this precludes U.S. ACE from seeking to recover response costs from ACF.

ACF concluded with the following comments:

- U.S. ACE's determination that 61,000 cubic yards of soil must be excavated and incinerated is inaccurate, grossly exaggerated and based upon flawed mathematical calculations.
- U.S. ACE selected on-site incineration as the technology to be used to address the site even though the soil can be hauled off-site for incineration.

- U.S. ACE contractors (International Technology Corporation and Law Environmental, Inc.) used two chemical analysis methods to measure dioxin concentrations. One method was an isomer analysis using U.S. EPA Method 8280, SE-846. The other was the "U.S. EPA Region VII – Rapid Turnaround Dioxin Analysis" Method. U.S. ACE has used both of these methods inappropriately.
- The data U.S. ACE used to arrive at the quantity of dioxin-contaminated soil contains many Quality Assurance/Quality Control problems.
- In the site delineations performed by International Technology Corporation and Law Environmental, Inc. in January and April, 1992, the soil sampling procedures and decontamination procedures may have exaggerated the areas shown to contain dioxin concentrations due to cross contamination.
- U.S. EPA proposed action level of 1 ppb for dioxin is inappropriate.
- The method U.S. ACE used to compute the volume of dioxins and furans was inappropriate.
- The site can be further evaluated without immediately excavating the soil and storing it within buildings, due to the fact that there is a confining clay unit at a depth of approximately 15-25 feet beneath the facility, which separates an upper waterbearing zone from the deeper aquifer.
- ACF has obtained reports produced by U.S. ACE, U.S. EPA, and U.S. DOI, which indicate that all of those departments or agencies had knowledge of dioxin contamination in the River as early as 1986.
- ACF is not liable for paying the costs involved in the investigation U.S. ACE has conducted on the property from the period beginning in approximately May 1990 and continuing until the present time (ACF, 1992).

July 23, 1992
<u>Letter to Colonel Van Epps, U.S. ACE, from Jonathan P. Deason, Director, Office of Environmental Affairs, U.S. DOI, 1992</u>

This letter outlines U.S. DOI comments on the EE/CA report for the former ACF site, submitted by U.S. ACE.

Some of the U.S. DOI comments were regarding the following:

- There is no human health or ecological risk assessment included in the EE/CA, but the report documents contaminants at or near the soil surface, and also indicates the probability of the River receiving these contaminants via stormwater runoff.

- Two of the four proposed ponds to be created as fish and wildlife mitigation will be temporarily used to store contaminated soil. Not only will this delay wildlife benefits, it is possible that residual contamination within the affected pond areas could adversely affect wildlife.

U.S. DOI recommended that the presence of contaminants in all project areas be identified before wildlife mitigation is introduced. The fact that dioxin contaminated soil was found outside the northern border of the ACF property indicates the possibility of site contamination in other project areas (other than the Winfield Lock expansion area), including those potentially associated with wildlife migration (U.S. DOI, 1992)

July 24, 1992

Letter to Colonel James R. Van Epps, U.S. ACE, from Abraham Ferdas, Associate Division Director for the Superfund Program, U.S. EPA, Region III, 1992

This letter outlines U.S. EPA's comments on the EE/CA report for the former ACF site, submitted by the U.S. ACE.

U.S. EPA stated that they agree with the incineration alternative that U.S. ACE has selected. The site has, in places, significant dioxin, volatile, and semi-volatile contamination, and to date, no off-site alternative exists for disposal of dioxin contaminated waste. U.S. EPA also noted that besides incineration, no proven on-site large-scale technology exists for dioxin contamination destruction. U.S. EPA recommended that U.S. ACE conduct trial burns to ensure that all applicable requirements are met (U.S. EPA, 1992).

1992

1992 – Quality Control Summary Report for Winfield Locks and Dam Site, Law Environmental, Inc.

Law Environmental, Inc. was hired by U.S. ACE to investigate the former ACF site for the presence of hazardous material. The site investigation was designed to study the presence of soil and groundwater contamination at the site, and was approached in two phases.

Phase I activities included collecting 201 soil samples from locations across the site. Soil samples were analyzed for VOCs, SVOCs and 2,3,7,8-TCDD. Areas that were found to contain contamination were further investigated during Phase II. The objective of Phase II was to collect samples to confirm the presence of contamination, and to provide additional information concerning the extent of the contamination. Phase II activities included collecting 52 soil samples that were analyzed for PCDDs. For each phase, the results of each congener group were reported with the associated TEF (Law Environmental, Inc., 1992).

1992

Winfield Locks harbor $100 million mess, feds find, Charleston Gazette, 1992

This article written by staff writer Rick Steelhammer, was printed in the Charleston Gazette in 1992, the exact date the article appeared is unknown.

The Gazette reports that work on the new Winfield Locks has been stalled for several months due to cleanup of dioxin contaminated soil. The project, initially designed to eliminate barge traffic delays averaging 13 hours at the nation's busiest river navigation complex was estimated to cost $210 million. U.S. ACE has recently announced that clean-up of dioxin contaminated soil will cost approximately $100 million. Extent of contamination investigations has reported that there are 61,000 cubic yards of contaminated materials at the site, and most of it is soil containing a mixture of dioxins and organic contaminants.

The Gazette reports that ACF used the site from the 1950s until 1986 to wash and service railroad cars, including chemical tanks and hoppers. In the early 1980's ACF installed a U.S. EPA approved treatment plant; however, prior to this substances were washed out of rail cars and channeled into three ponds, which were connected to the River by a ditch.

Prior to U.S. ACE purchasing the property in 1989, WV DNR reported to have ordered ACF to remove more than 9,000 cubic yards of contaminated soil and about 100 empty metal drums, which were buried on site. The Gazette reports that U.S. ACE found dioxin contamination that was substantially above the federal limits of 2 ppb.

It was reported that the Inland Waterways Trust Fund will pay half of the expense of the dioxin cleanup, estimated at $98.7 million in 1991 dollars, and the remainder will be paid by U.S. ACE civil works budget. U.S. ACE is reported as stating that ACF is responsible for the cleanup and plans to pursue the matter in court to recover costs.

The Gazette also reports that there was evidence that site contaminants may have entered the River, particularly during heavy rain events,; however, recent sediment sampling in the River have reported that no harmful substances were present above federal guidelines (Steelhammer, 1992).

January 6, 1993 and March 1, 1993

Memorandum: Health Consultation: ACF Site (aka Winfield Lock and Dam) Red House, WV, Department of Health & Human Services, 1993

The WV Department of Health and Human Services (WV DHHS) prepared this memorandum which summaries background information and presents a statement of issues.

The memo states that U.S. ACE requested ATSDR to review environmental sampling data collected from the former ACF site. ATSDR was also directed by U.S. ACE to access U.S. ACE's actions to date in a health consultation that was to include a discussion of the findings of a site visit ATSDR conducted on January 6, 1993.

ACF operated a railcar service and repair facility on a 22-acre parcel of land located along the River in Red House, WV. The ACF facility was in operation from the 1950s to 1986. According to WV DHHS, it is believed that residual chemicals in the railcars were either dumped on the ground or drained into unlined ponds at the site.

WV DHHS stated that ACF conducted a limited environmental site investigation in April and May of 1989, which led to the excavation and removal of approximately 9,151 cubic yards of contaminated soil, and approximately 100 buried drums in January through April 1990. U.S. ACE took possession of the site in May, 1990; however, during the beginning stages of the project, U.S. ACE observed a colored liquid emanating from a pit wall. This pit remained from ACF's removal, which suggested that contamination still remained. Analysis found surface and subsurface soils to contain elevated levels of VOCs, SVOCs, and chlorinated dibenzodioxins/furans or dioxin. The maximum dioxin concentration in the surface and subsurface soils was reported to be 19,100 ppb 2,3,7,8-TCDD TEQ. A total of 16 sediment samples were collected from the River near the site area, and all samples were reported to contain less than 1.0 ppb 2,3,7,8-TCDD TEQ.

Vertical migration of organic compounds through soil has occurred at the ACF site. WV DHHS reports that this migration threatens to contaminate a deep aquifer underlying the site that serves as a potable water source for the Town of Eleanor. The U.S. ACE tested water from Eleanor's wells and did not report any site related contamination; however, private wells have not been sampled (WV DHHS, 1993).

March 31, 1994

Letter to David M. Flannery, Attorney-at-Law, Robinson & McElwee, from Max Robertson, Chief, WV DEP, 1994

This letter was prepared by WV DEP to state their position on the status of contaminated soils at the ACF facility at Red House, WV.

WV DEP states that due to difficulty determining the sources of specific contaminants, WV DEP concurs with U.S. EPA and ACF that contaminated soils should not be considered listed as hazardous wastes as defined by RCRA. However, WV DEP does not concur that the soils are not hazardous by their characteristics as shown by TCLP. Analysis of site samples was designed to determine risk factors and not to characterize soil for off-site disposal. Analysis reveals that many analytes regulated by TCLP, are also present in quantities large enough to warrant concern regarding their RCRA hazardous characteristics.

WV DEP concluded that before disposal options can be considered, an in depth determination of the hazardous waste status of soils is required. No soils with dioxin levels in excess of cleanup levels established for the site will be allowed into an in-state municipal waste facility (WV DEP, 1994).

July 30, 1995

Contaminated Putnam soil OK for shipment to Utah, The Associated Press, The Huntington Herald-Dispatch, 1995

This newspaper article appeared in the Huntington Herald-Dispatch on July 30, 1995.

The article states that a federal judge has ruled that an estimated 61,000 cubic yards of soil contaminated with dioxin may be transported from a Putnam County storage facility to a landfill in Utah. The soil is presently stored on a property once owned by a rail car cleaning firm, ACF, of Earth City, Missouri. The ACF property, located along the River, cleaned rail cars from 1952 to 1986.

This article reports that the project is expected to cost ACF 16 million dollars, and that ACF has 210 days to clean the area. Walsh Environmental of Denver is reported to have been hired to conduct the cleanup (Herald-Dispatch, 1995).

December 1995 & January, 1996

Closure Report for the Removal Action for the Former ACF Site, Red House, WV, Philip Environmental Services Corporation, 1996

This report summaries removal action activities conducted by Philip Environmental Services Corporation on behalf of ACF, at the former ACF railcar repair facility in Red House, WV. The removal action was performed in accordance with a Consent Decree effective July 26, 1995.

U.S. ACE acquired the 21.81-acre site in May 1990 in order to expand the Winfield Locks and Dam structure, which is located approximately 1 mile downstream. A new lock chamber will be added to the structure, and the River channel width will be widened and straightened through the former ACF site.

This closure report summarizes soil removal and verification soil sampling/testing activities preformed at Excavation Areas 1 through 10, and the deep VOC area. It also summaries other miscellaneous verification sampling conducted at the site.

Excavation Area No. 1

Dioxin exceedances were reported at locations 1-18 and 1-19 with sub-area dioxin TEF of 1.43 ppb and 1.03 ppb, respectively. The excavations of both sub-areas were deepened by approximately one foot and re-sampled. Re-sample results reported dioxin concentrations below the 1 ppb dioxin TEF action level at both locations, sub-area 1R-18 (0.06 ppb) and sub-area 1R-19 (0.05 ppb).

Sub-area 1-93 (1.90 ppb) exceeded the dioxin action level when sampled in December 1995. An additional 1 to 2 feet of soil was excavated and the sub-area was re-sampled in January 1996. Sample results were below the action level.

Exceedances were also reported in the south end of Area 1 at the following locations: 1-71, (36.00 ppb), 1-72, (30.00 ppb), 1-73, (15.00 ppb), 1-82, (1.50 ppb), and 1-90, (17.00 ppb). It was discovered that these sub-areas overly a drum pit, consequently the drum pit was excavated and the locations were re-sampled. Re-sample results were below the action level for dioxin.

The volume of soil removed from Excavation Area No. 1 for surficial dioxin removal was approximately 8,600 cubic yards, or 12,900 tons.

In addition, a pit containing trash, which included rubber tires, hoses, paint cans, gloves, and old coveralls, and crushed drums was discovered in the center of sub-area 1-73.

Samples were collected from the floor of this area in October 1995 at a depth of 8 feet for dioxin analysis. A composite sample at 6 feet (1S-DP-WALL), which consisted of aliquots from the four walls, was also analyzed for dioxin. Sample 1S-DP-WALL (13 ppb) exceeded action levels for dioxin. The pit was consequently deepened by 2 feet and extended approximately four feet to the east to allow for re-sampling of the overlying areas (1R-71, 1R-72, 1R-73, 1R-82, and 1R-90). This resulted in an additional 290 cubic yards, or 430 tons of soil removal from Excavation Area No. 1.

Excavation Area No. 2

The majority of Area No. 2 was excavated and tested in August and September 1995. Additional excavation of areas exceeding the action level occurred October 1995 through January 1996. The north end of the area was excavated and re-tested in February 1996.

The following sub-areas exceeded the 1 ppb TEF action level for dioxin:

- 2-21 (1.05 ppb)
- 2-22 (8.00 ppb)
- 2-24 (3.35 ppb)
- 2-25 (1.80 ppb)
- 2-26 (1.33 ppb)
- 2-27 (15.40 ppb)
- 2-28 (1.48 ppb)
- 2-29 (64.24 ppb)
- 52-29 (23.11 ppb)
- 2-30 (16.00 ppb)
- 2-31 (10.34 ppb)
- 2-33 (16.93 ppb)
- 2R-33 (3.31 ppb)
- 2-34 (7.89 ppb)
- 2-35 (17.28 ppb)
- 2-36 (5.54 ppb)
- 52-36 (5.26 ppb)

The approximate volume of soil removed from Excavation Area No. 2 for surficial dioxin removal was 5,800 cubic yards, or 8,700 tons.

In addition, during excavation for the removal of concrete water treatment lagoon structures, discolored soil leading toward the Kanawha River was discovered. It was noted that this material likely lied under the former discharge trench of the original treatment ponds system, which would be removed as part of the deep VOC excavation. Three samples were collected from the floor of the trench, after the stained soil was removed. Two of the three samples, 2S-DP-C, and 2S-DP-S, exceeded the action level for dioxin. These locations were not re-sampled since they were located in an area that was going to be removed as part of the deep VOC excavation, and therefore the results were not included in the report.

Excavation Area No. 3

The majority of this area was excavated in September 1995. The sub-areas around the wastewater treatment area that exceeded the dioxin action level were:

- 3-13 (1.20 ppb)
- 3-18 (3.17 ppb)
- 3-19 (1.34 ppb)
- 3-20 (2.04 ppb)
- 3-21 (1.41 ppb)
- 3-22 (1.77 ppb)
- 3-26 (23.27 ppb)
- 3-28 (2.91 ppb)

These sub-areas were re-tested in November 1995 after an additional 1 to 2 feet of soil was removed, and all sub-areas were reported below the dioxin action level. Approximately 2,400 cubic yards, or 3,600 tons of soil were removed from Excavation Area No. 3 for surficial dioxin removal.

Excavation Area No. 4

This area was excavated in August 1995, and all sub-areas were below the action level for dioxin. The majority of this area was removed during the excavation of the deep VOC area. The approximate volume of soil removed from this area for surficial dioxin removal was 2,500 cubic yards, or 3,700 tons.

Excavation Area No. 5

This area was excavated in August 1995, and all sub-areas were below the action levels for dioxin. The approximate volume of soil removed from this area for surficial dioxin removal was 2,700 cubic yards, or 4,100 tons.

Excavation Area No. 6

This area was excavated in October 1995, and all sub-areas were below the action level for dioxin. The approximate volume of soil removed from this area for surficial dioxin removal was 800 cubic yards, or 1,200 tons.

Excavation Area No. 7

This area was excavated in October 1995, and all sub-areas were below the action level for dioxin. The approximate volume of soil removed from this area for surficial dioxin removal was 100 cubic yards, or 150 tons.

Excavation Area No. 8

The majority of Area No. 8 was excavated in November 1995, and all sub-areas were below the action level for dioxin. The approximate volume of soil removed from this area for surficial dioxin removal was 5,300 cubic yards, or 8,000 tons.

Excavation Area No. 9

The southern half of Area No. 9 was excavated in October and December 1995, and the northern half in February and March 1996. All samples were below action levels except for those sampled from the decon sump area, which included samples 9-9 (1.84 ppb), 9-10 (1.15 ppb), and 9-13 (2.09 ppb). These areas were excavated an additional 2 feet and re-sample results were below action levels. Approximately 4,300 cubic yards, or 6,500 tons of soil were removed from this area for surficial dioxin removal.

Excavation Area No. 10

Sampling in this area was based on the results of an initial sample taken at location EMB-11 (1.10 ppb). Additional sampling was based on visual inspection of soil conditions during expansion of the area during excavation and removal of trash. Sample 10-01 (20.42 ppb), collected in January 1996 exceeded the action level for dioxin. An additional 2 to 3 feet of soil was excavated from this area and the resample was below action levels. Approximately 1,700 cubic yards, or 2,600 tons of soil were removed from Area No. 10 for surficial dioxin and buried trash removal.

Miscellaneous

- Steamrack Area: Excavation and removal of impacted soil in the steamrack area was part of the 45-day extension to the Consent Decree, dated February 3, 1996. It was believed that the steamrack was the source area for rinsate to drain to the former treatment ponds. Discolored soil was observed during excavation south of the southeast end of the streamrack, and under its concrete foundation. Sampling conducted in this area was analyzed for either rapid scan or full isomer dioxin. All samples, which included: B-9, ND(0.1), L-11 (ND), RHSS-315 (ND), RHSS-316 (0.78 ppb), RHSS-317 (ND), and RHSS-318 (ND), were reported below the action level for dioxin.

- Main Repair Building Area: In December 1995, an area of oily soil, approximately 20 feet by 10 feet by 3 feet deep was found adjacent to and under the floor slab in the northwest corner of the Main Building. Removal of this material became a requirement of the 45-day extension to the Consent Decree dated February 3, 1996. All samples, which included: ABRB-02 (0.01 ppb), collected from under the former abrasive blast building in March 1996, PNTS-02 (0.4 ppb), collected from under the paint shop, and verification samples REPS-03 (0.06 ppb), and REPS-04 (0.01 ppb), were below the action level for dioxin. The approximate volume of soil removed from this area was 2,400 cubic yards, or 3,600 tons.
- Pit 1: This pit was used by ACF for removal of paint wastes in 1990. The pit had a floor depth of approximately 6 feet bgs. Samples collected in December 1995 that exceeded the dioxin action level were, PIT1-03 (4.2 ppb) and PIT1-05 (5.5 ppb). In November 1995, 2 additional feet of soil were excavated from the pit, and the area was re-sampled. Re-sample results, PIT1R-03 (0.34 ppb) and PIT1-05 (0.12 ppb), were below the dioxin action level. Other exceedances included sample RD-PT1-02E (6.40 ppb) collected in December 1995 from the location of a temporary haul road in the south end of Pit 1, and sample PIT1R-13 (1.7 ppb) collected on May 15, 1996 from an area just south of the two concrete lagoons. Following additional soil removal and re-sampling, sample results RD-PT1-RR02E (0 ppb) and PIT1RR-13 (0.08 ppb) were below the dioxin action level. Approximately 1,950 cubic yards, or 2, 900 tons, of soil were removed from this area.
- Pit 2: All initial samples, PIT2-1 (9.00 ppb), PIT2-2 (11.0 ppb), and PIT2-3 (1.2 ppb), collected from the floor of the existing Pit 2 in September 1995 exceeded the action level for dioxin. After removing approximately 2 feet of additional soil, re-sample results, PIT2R-1 (0.15 ppb), PIT2R-2 (0 ppb), and PIT2R-3 (0.01 ppb), were below the action level. Approximately 250 cubic yards, or 400 tons, of soil was removed from this area.
- Sand Blast Shed: Samples collected from a dark-colored area beneath the north end of the sand blast shed were analyzed for dioxin. Analytical results reported that all samples were below action levels. Approximately 700 cubic yards, or 1,000 tons, of soil was removed from this area.

- Haul Roads: Samples were collected from the north, east, south, and deep VOC haul roads and analyzed for dioxin. All analytical results were below action levels, except for one sample collected from the haul road in Pit 1, which is discussed above.
- Batch Tank, Shallow Lagoon and East and West Lagoons: Soil impacted with paint wastes was believed to be located under the concrete foundation of the batch tank, under the shallow lagoon south of Pit 2, and under the large concrete lagoons. Samples were collected from these areas in January 1996. It was noted that the samples were analyzed for dioxin in April and May 1996, outside of the holding time. Analytical results reported that dioxin levels were below the action level. Approximately 2,700 cubic yards, or 4,100 tons, of soil were removed from this site.

  Groundwater samples were obtained from six monitoring wells on April 4, 1995, prior to site remediation, and on March 27 and 28, 1995, after site remediation was completed. The samples were analyzed for 2,3,7,8-TCDD and were reported as ND.

  The wastewater treatment plant operated between August 12, 1995 and March 13, 1996 treated a total of 1,698,152 gallons of water. The concentration of 2,3,7,8-TCDD was below the limit of 10 pg/L ($1x10^{-5}$ ppb), except for two samples collected on October 12, 1995, and October 16, 1995 which corresponded to 12.2 pg/L ($1.22x10^{-5}$ ppb) and 11.3 pg/L ($1.13x10^{-5}$ ppb) respectively (Philip Environmental, 1996).

No Date Available
State Questions Eleanor Cleanup: Water contaminated, WV DEP letter states

The name of the newspaper and date that this article was printed was not available: however, it was written by Staff Writer Rusty Marks.

According to this article, David Callaghan, director of WV DEP, sent a thirteen page letter to Colonel James Van Epps of U.S. ACE, outlining deficiencies and concerns regarding the U.S. ACE cleanup analysis for the former ACF site. Marks states that ACF formerly used the site to wash out chemical tank cars, and flooded the soil with dioxins and other chemicals.

It was reported that U.S. ACE decided to incinerate the contaminated soil, and reported that there was no contamination of the area's water supply. State officials are reported to disagree with this conclusion, stating that there was evidence of deep groundwater contamination near the site that has threatened Eleanor's water supply.

Marks reported that contractors found dangerous chemicals in a 60 foot deep well, located west of the site, and quoted WV DEP as stating that analytical data from this well indicates there is contamination in the deeper aquifer used by the Eleanor public supply. International Technology Corporation also reported that organic chemicals were found 30 feet below the water table, and dioxin 10 feet below the water table. WV DEP officials were quoted as saying that tests run by U.S. ACE were not sensitive enough to detect dangerous levels of some chemicals, and were set well above the maximum allowable limits. The state was also quoted as suggesting that pressure to build the locks may have led to hasty decisions by U.S. ACE (Marks, NA).

No Date Available

<u>Dioxin worries surface on buried soil in Wetzel, Charleston Daily Mail</u>

The Charleston Daily Mail printed this article written by Daily Mail Environmental Writer, Pat Sanders. The date this article was printed was not available.

The Charleston Daily Mail reported that Wetzel County officials are worried after learning that more than 6,600 tons of soil were taken from a dioxin contaminated property was disposed of in the WCLF in 1990. The soil was taken from the former ACF property near Winfield, where dioxin contamination in soil has been reported as high as 2,212 ppb. Dioxin levels must be no greater then 2 ppb to be accepted at a non-hazardous waste landfill.

The Charleston Daily Mail reported that the soil was classified as non-hazardous; however, was never tested for dioxin. This soil is presently 80 feet underground, and lies in a 200 square foot plot in the WCLF. State officials have told the Charleston Daily Mail that there is no way to test, or to remove the soil from the landfill at this time. The state explained that there is no way to guarantee that sampling would occur in the material that was to be tested.

The Daily Mail quotes WCSWA representative Martha Huffman as saying that the WCSWA's greatest fear is that the material was place on a single clay liner, and therefore they are extremely concerned about the potential for groundwater contamination.

In 1990, ACF's contractor, Allstates classified 4,466 tons of the soil as hazardous and transported it to a hazardous waste facility in Toledo, Ohio. The remaining 6,641 tons of soil was classified as non-hazardous, and was transported to the WCLF. The Daily Mail states that prior to being transported, soil was tested for several contaminants; however, not for dioxin. WV DEP supervised these tests. In response, the Daily Mail quotes WV DEP as stating that when they were dealing with the soil, they had no idea that dioxin contamination was present. WV DEP also stated that at the time, they had no regulatory authority to look for dioxin. They did however test for organics, and explained that dioxin is associated with organics.

WCLF operators have performed groundwater tests to determine if dioxin is leaking from the facility. Analysis has been reported as negative; however, WV DEP has noted that due to the properties of dioxin, it is rarely found in the water column.

According to the Daily Mail, U.S. ACE has said that it has no authority to test soil in Wetzel County, since Allstates took the soil to the WCLF under the authority of the WV DEP (Sanders, NA).

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APPENDIX C.3

SUMMARY OF POTENTIAL SOURCES IN STUDY AREA

APPENDIX C.3

SUMMARY OF POTENTIAL SOURCES IN STUDY AREA

KANAWHA RIVER
NITRO, WEST VIRGINIA

FEBRUARY 2015
REF. NO. 031884 (51) – APPENDIX C.3
This report is printed on recycled paper.

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LIST OF ACRONYMS

2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
2,4-D	2,4-Dichlorophenoxyacetic acid
2,4,5-T	2,4,5-Trichlorphenoxyacetic acid
ACLF	Armour Creek Landfill
AES	Automatic Equipment Sales
Allied Chemical	Allied Chemical Corporation
American Viscose	American Viscose Corporation
AOC	Administrative Order on Consent
AST	aboveground storage tank
Avtek	Avtek Corporation
bgs	below ground surface
BN/AE	base-neutral and acid extractable
CA	Corrective Action
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Coastal	Coastal Tank Lines, Inc.
COCs	Constituents of Concern
COPCs	contaminants of potential concern
CST	Cooperative Sewage Treatment Plant
Dana	Dana Container, Inc.
Elko	Elko Company, formerly Southern Dyestuff Company
ERT	Environmental Response Team
Fike	Fike Chemicals, Inc.
Fike/Artel	Fike/Artel Superfund Site
Flexsys	Flexsys America LP
FMC	FMC Corporation
HSWA	Hazardous and Solid Waste Amendments
ICF	ICF Kaiser Engineers
IMs	Interim Measures
IT	IT Group
Kearney	A.T. Kearney, Inc.
LCAP	Landfill Closure Assistance Program

LIST OF ACRONYMS

LNAPL	light non-aqueous phase liquid
Main Coastal Railroad	Main Coastal Railroad Tank Washing
MCPA	4-Chloro-2-Methlyphenoxyaceteic acid
mg/L	milligrams per liter
MP	Mile Point
ND	Not detect
NEIC	National Enforcement Investigations Center
Nitro Pencil	Nitro Pencil Company
NPDES	National Pollutant Discharge Elimination System
NUS	NUS Corporation
OCDD	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin
OSC	On-Site Coordinator
OSWER	Office of Solid Waste and Emergency Response
OVA	Organic Vapor Analyzer
PAHs	Polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
pg/L	picograms per liter
Poca Blending	Poca Blending, L.L.C
Potesta	Potesta & Associates, Inc.
ppb	parts per billion
ppm	parts per million
ppt	parts per trillion
PVD	Passive Vapour Diffusion
RCRA	Resource Conservation and Recovery Act
Republic Steel	Republic Steel Container Corporation
RFI	RCRA Facility Investigation
RI/FS	Remedial Investigation/Feasibility Study
River	Kanawha River
Roux	Roux Associates
Rubber Services	Rubber Services Laboratories
SATA	Site Assessment and Technical Assistance Team
Seydel	Seydel Chemical Company

LIST OF ACRONYMS

SWMUs	Solid Waste Management Units
Solutia	Solutia, Inc.
SVOCs	semi-volatile organic compounds
TCDF	Tetrachlorodibenzofuran
TCE	Trichloroethylene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leachate Procedure
TEQ	Toxicity Equivalency Quotient
TERRADON	TERRADON Corporation
TMDL	Total Maximum Daily Loading
TNT	Trinitrotoluene
TOC	total organic carbon
TOX	total organic halides
UCC	Union Carbide Company
µg/kg	micrograms per kilogram
U.S. ACE	United States Army Corps of Engineers
U.S. CDC	United States Center for Disease Control
U.S. EPA	United States Environmental Protection Agency
VOA	volatile organic analytes
VOCs	volatile organic compounds
WV	West Virginia
WV ABCA	WV Alcohol Beverage Control Administration
WV DEP	WV Department of Environmental Protection
WV DNR	WV Department of Natural Resources
WV DWR	WV Department of Water Resources
WWTP	wastewater treatment plant

1.0 SUMMARY OF POTENTIAL SOURCES WITHIN THE SITE LIMITS

1.1 WV ALCOHOL BEVERAGE CONTROL ADMINISTRATION WAREHOUSE SITE

The West Virginia (WV) Alcohol Beverage Control Administration (WV ABCA) property is located in the HUB Industrial Park, in Nitro, WV. The property is approximately 12.17-acres, and is adjacent to the northeast property boundary of the former Flexsys America LP (Flexsys) site. The area of concern is approximately 9.37-acres in size.

In January 1996, the WV ABCA purchased the property and existing warehouse building from Nitro Warehouse, Inc. WV ABCA presently uses the warehouse to store and distribute retail alcoholic beverages (Potesta, 2003).

March 26, 2003 – April 1, 2003
Draft - Summary of Analytical Data Results, Warehouse Area Groundwater/Soil Investigation, Potesta & Associates, Inc., 2003

Potesta & Associates, Inc. (Potesta) conducted a groundwater and soil investigation at the WV ABCA property on behalf of Solutia, Inc. (Solutia) from March 26, 2003 to April 1, 2003. The investigation was conducted in response to a telephone conference on March 4, 2003 between Solutia, Old Monsanto, WV Department of Environmental Protection (WV DEP) Office of Land Restoration, and United States Environmental Protection Agency (U.S. EPA) Region III. The primary goals of the investigation were to:

- Confirm the presence and determine the location of two buried foundations from the U.S. government munitions production facility, which were reported to extend beneath the warehouse structure from the rear of the western side. In addition, the investigation was to determine the depth to the foundations and possibly identify the presence of buried wastes in the backfill material placed above the foundations.
- Determine the subsurface lithology.
- Collect soil samples.
- Collect groundwater samples.

The investigation consisted of the advancement and construction of three paired temporary monitoring points in the following locations:

- One located upgradient along the eastern side of the existing WV ABCA warehouse (MW-1A/B)

- Two additional points located downgradient along the western side or rear of the warehouse (MW-2A/B, and MW-3AB)

Soil samples were analyzed for 17 chlorine substituted dioxin/furan congeners. Dioxin/furan congeners were detected in the following locations:

- MW-2A (6 to 28 feet) - 17 parts per trillion (ppt) (0.017 parts per billion (ppb))
- MW-2A (6 to 28 feet) - 1.3 ppt (0.0013 ppb)
- MW-3A(CR) - 0.82 ppt (0.00082 ppb)
- MW-3A (0 to 6 feet) - 20 ppt (0.02 ppb)
- MW-3A (0 to 6 feet) - 1.5 ppt (0.0015 ppb)

While installing a perimeter fence along the western boundary, behind the warehouse, several excavations for support posts were found to contain waste materials. The waste materials exhibited distinct color that was different than the surrounding soil. The materials were classified as a dark, grey to black, sandy sludge material, and a yellow material. Samples were collected and analyzed for dioxin/furan congeners. Analysis reported the concentration of 2.3.7.8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) in the dark, sandy sludge material as 1,200 ppt (1.2 ppb), and in the yellow material as 2,000 ppt (2 ppb).

2,4,5-Trichlorophenoxyacetic acid (2,4,5-T) was detected at a concentration of 0.094 ppb in the MW-1A sample, and at an estimated concentration of 0.31 ppb in the MW-2A sample. None of the groundwater samples indicated positive results for any of the 17 dioxin/furan congeners.

Potesta concluded that due to the history of the development, and the disturbance to the site prior to ownership by WV ABCA, the limited scope of this investigation could not be used to determine the sources of the contaminants of potential concern found in samples (Potesta, 2003).

1.2 ALLIED CHEMICAL CORPORATION (1947 -)

Allied Chemical Corporation's (Allied Chemical), General Chemical Division facility began production in Nitro in 1947. This plant produced sulfuric acid and 99% and 20% oleum. Nearby American Viscose Corporation (American Viscose) was the principal customer. Production increased to all grades of acid and the product was supplied to most of the other plants in the Kanawha Valley.

In 1958, a unit to produce hydrofluoric acid was built to supply the fluorocarbons unit at the Union Carbide Corporation (UCC) Institute facility.

The plant also began to produce high-purity anhydrous and 70% aqueous hydrofluoric acids for steel mills and glass plants.

In approximately 1961, the Nitro plant began to warehouse molten sulfur for Freeport Sulfur. This product was then shipped to local plants. The plant also warehoused soda ash for a short period around 1962.

Allied Chemical, General Chemical Division eventually changed its name to Allied Chemical, Industrial Chemicals Division (Johnston, 1977).

1.3 ARMOUR CREEK LANDFILL

Armour Creek Landfill (ACLF) is located north of the City of Nitro along State Route 25. It is comprised of approximately 45 acres of land, and was jointly operated by Old Monsanto and Akzo Nobel Corporation. Armour Creek is located to the north of the landfill (Weston, 1999).

The sediments in Armour Creek were sampled in November 1998 in response to public concern that ACLF was contributing to the persistent dioxin problem in Armour Creek (Pam Hayes, WVDEP Office of Environmental Remediation). No dioxin was detected at the site (soils, surface water and groundwater) though dioxin was detected in nearby soil. This detection of dioxin may not be attributable to the landfill itself.

May 2, 2000

Letter to Anthony C. Tuk, Solutia, from Allyn G. Turner, Chief, WV DEP, Re: WV SW/NPDES Permit No. WV0077020 Armour Creek Landfill, 2000

This letter, prepared by the WV DEP, was attached to Solid Waste/National Pollutant Discharge Elimination System (NPDES) Water Pollution Control Permit Number WV0077020 for the ACLF, and presents responses to comments submitted by Solutia in a letter dated April 3, 2000.

WV DEP stated that they have received comments from the public and from U.S. EPA regarding concerns of dioxins being present in surface water runoff from ACLF, which was eluded to in the Weston report, "Trip Report Kanawha Valley-Dioxin Site, Nitro, Putnam County, WV" dated April 14, 1999. WV DEP stated that the report does not state that ACLF is the source of dioxins to Armour Creek; however, it does indicate that it may be a possible source.

The letter concluded with two additional conditions that the WV DEP has placed on the permit that include:

C.14 The permittee shall by the time frame specified in Section B.1.b (six months) submit a plan to sample and analyze the storm water runoff from the landfill for its potential to discharge 2,3,7,8-TCDD or any form of dioxin.

C.15 Upon obtaining any evidence that the facility is discharging or has the potential to discharge 2,3,7,8-TCDD or any other form of dioxin, the permit may be reopened and revised accordingly (WV DEP, 2000_1).

May 2, 2000

Letter to Renae Bonnett, from Allyn G. Turner, Chief, WV DEP, 2000

This letter was prepared by the WV DEP in response to comments concerning the Draft Permit for the ACLF provided by Ms. Renae Bonnett of Rt. 1, Poca, WV.

The WV DEP stated that regarding concerns about dioxin, the dioxin issue was discussed with WV DEP hazardous waste personnel during the period in which the previous permit was prepared. The WV DEP stated that analysis of 2,4-Dichlorophenoxyacetic acid (2,4,-D) is required to monitor dioxin in water. 2,4-D is a breakdown product of most dioxins and of the dioxin group, it is the most soluble in water and weak acids, which are typical conditions in a landfill. It was noted that due to the physical characteristics of dioxin, they are not a typical water-borne substance, and therefore, under landfill conditions, can't be found through water sampling. The WV DEP states that typically, dioxin is only found through analysis of sediments or biological tissues, since that is where dioxin tends to accumulate. It was also reported that groundwater at the landfill was monitored for ten quarters for 2,4-D, and historical data have reported it as non-detect (ND). In addition, Solutia has installed new caps on the disposal areas, which should eliminate dioxin, if present, from contacting surface water and as a result contaminating storm water runoff.

The WV DEP also stated that the Weston report entitled "Trip Report Kanawha Valley-Dioxin Site Nitro, Putnam County, WV", dated April 14, 1999, does not state that the ACLF is the source of dioxin in Armour Creek. It does indicate however, that the railroad ditch, which borders the ACLF contains dioxin contaminated sediments, and that this contamination may have originated from outside the landfill.

The WV DEP concluded by saying that the landfill can currently only be identified as a potential source until the U.S. EPA assessment is complete, and there is evidence to support that the landfill is discharging, or has the potential to discharge 2,3,7,8-TCDD. In response, two conditions have been incorporated into the permit which include sampling and analyzing stormwater runoff for its potential to discharge 2,3,7,8-TCDD, and upon obtaining evidence that the facility is discharging or has the potential to discharge 2,3,7,8-TCDD, the permit may be reopened and revised (WV DEP, 2000_2).

2001

Letter to Ms. Allyn Turner, from Anthony C. Tuk, Solutia, Re: 3rd Quarter, 2001 Report, Armour Creek Landfill - NPDES Permit Requirements, WV 0077020, Potesta, 2001

This report was prepared by Potesta to fulfill the requirements of the Solutia's ACLF Solid Waste/NPDES Permit Number WV0077020, effective June 2, 2000.

Potesta reported that during the third quarter of 2001, the focus of the permit was a continuation of routine maintenance of final closure items completed during 1999/2000. Approximately 5,000 gallons of leachate and rainwater was treated, and groundwater and leachate samples were collected. In addition, stormwater samples were collected and analyzed for dioxin, which completed the required one-time landfill sampling event.

Stormwater sampling for dioxin was completed as per Section C. 14 of the current Solid Waste NPDES Water Pollution Permit No. WV0077020, for the closed ACLF. Section C. 14 requires the formulation of a plan to sample and chemically analyze stormwater runoff from the landfill for 2,3,7,8-TCDD or any other form of dioxin.

Potesta reported that they collected a stormwater sample from an outlet at ACLF (ACLF Stormwater Outlet 009), as well as an additional background sample at a location outside the limits of ACLF. According to Potesta, ACLF Stormwater Outlet 009 is considered the most significant surface water sampling, and stormwater discharge point for the landfill, since its location is central to the previously active portions of the landfill. This outlet is sampled on a quarterly basis and results are submitted to the WV DEP as part of the permit requirements. The selected off-site point was a drainage point of an approximately 7.2 acre area near the westbound Nitro exit of Interstate 64, approximately 2,500 feet south of Outlet 009. Potesta reported that the chosen off-site sample location is situated at the discharge point of the drainage culvert passing beneath the exit ramp. Stormwater from this area is reported to drain to Armour Creek east of the ramp.

Samples were analyzed for 2,3,7,8-TCDD and other dioxin compounds, which included the seventeen congeners considered to be the most toxic of the 210 compounds in the dioxin family. Potesta reported that sample ACLF-009 was ND for 2,3,7,8-TCDD with a detection limit of 1.8 picograms per liter (pg/L); however, 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) was detected at 38.3 pg/L, which is an estimate of the true concentration. Potesta reported that the background sample, BG-1 had a reported concentration of 6.1 pg/L of 2,3,7,8-TCDD.

Potesta concluded that sampling results indicate that 2,3,7,8-TCDD is not present in the runoff from Outlet 009 at ACLF. OCDD, a dioxin congener was reported; however, Potesta stated that this detection was due to an apparent peak on the analysis chromatography, and therefore the concentration could only be estimated. The reported concentration of 2,3,7,8-TCDD in the off-site background sample was also an estimate since the calculated response peak was below the method concentration comparison curve. Potesta concluded that due to estimation of values used in the analysis method, accuracy of the results must also be considered estimates (Potesta, 2001).

1.4 AUTOMATIC EQUIPMENT SALES (AES)

The AES property is a flat, approximately 3-acre parcel located south of Interstate 64 in Nitro, WV. There are no buildings located on-site; however, there are several areas that contain piles of abandoned concrete foundations, construction debris, brush, and soil. A continuous perimeter chain link fence with a locked gate restricts access to the property.

The property was originally part of Explosives Plant "C", owned by the U.S. government. Monsanto owned the property in the 1970's, but never operated any facilities on-site, and eventually sold the property to AES. In 1999 Solutia purchased the property, however Solutia has never operated any facilities on-site, nor have they altered the property other than mowing brush, stump grinding, construction of a security fence, and collection of samples for analysis.

In 1998, during development of the property by AES, WV DEP informed U.S. EPA that 14 buried drums were unearthed while grading the property. AES's environmental contractor overpacked the deteriorating drums in four overpack drum containers. WV DEP supplied U.S. EPA with a composite sample from several of the drums, which indicated that the drums contained 4.0 ppb Toxicity Equivalency Quotient (TEQ) 2,3,7,8-TCDD.

In December 1998, U.S. EPA's Site Assessment and Technical Assistance Team (SATA) conducted a magnetic survey around the AES property in order to locate any additional buried drums. The investigation indicated four suspected drum anomalies within the area. One drum was located adjacent to the excavation where the original drums were found, and the others in an additional area. SATA took samples from the four overpacks, which were noted to contain deteriorated drums and a black tar-like solid residue. Sample results verified the presence of dioxin at 4.26 ppb TEQ 2,3,7,8-TCDD. One of the overpacks was observed to contain a yellow crude solid. This solid was found to contain 639 parts per million (ppm) of 4-chloro-2-methylphenoxyacetic acid (MCPA), and 3.59 ppm of 2,4,5-T.

In June 1994, Potesta performed an investigation to evaluate and sample surface soils from 0 to 6 inches below ground surface (bgs) for the presence of dioxins and furans, with a detection level of 1.0 ppt. Eight soil samples were collected based on topographic relief, and seven of these samples were analyzed. Results indicated concentrations ranging from 0.728 ppb TEQ 2,3,7,8-TCDD to 6.403 ppb TEQ 2,3,7,8-TCDD (Potesta, 2001).

In 1999 Solutia purchased the property from AES, but did not operate any on-site facilities.

December 6, 1998

AES Complaint Response Report, WV DEP, 1988

WV DEP received a complaint in April 1998, which stated that while digging footers for a building, several 55-gallon drums were unearthed at the end of Independent Avenue toward the Kanawha River (River), in Nitro, WV. AES of Charleston owned the site. AES was completing pre-construction work on the property prior to closing of the sale of the property and reported that during excavation, four 55-gallon drums were cut open, and three others were partially exposed. The drums were over-packed and sampled by WasteTron, Inc.

Waste determination included a full Toxicity Characteristic Leachate Procedure (TCLP) analysis and screening for dioxins and furans.

On December 6, 1998, SATA and U.S. EPA Region III conducted a site investigation and overpack sampling at the site. Samples were collected from overpack drums, which contained a dark tar-like waste material and a yellow substance in one of the drums.

On January 18 and 20, 1999, WV DEP inspected the site and found that overpack drums were still on site and improperly labeled. As a result, WV DEP concluded that AES was in violation of four parts of the WV Hazardous Waste Regulations 33 CSR 20, which are summarized below:

- The facility failed to place an accumulation start date on containers holding hazardous wastes.
- The facility failed to label each container holding hazardous waste with the words "Hazardous Waste".
- The facility failed to a conduct proper inspection of all containers holding hazardous waste.
- The facility failed to properly dispose of all hazardous waste generated older than 90 days. Facility was granted an extension of 30 days, and still failed to dispose of waste properly. Facility is operating an illegal storage facility without a permit (WV DEP, 1988).

1.5 AVTEK CORPORATION (AMERICAN VISCOSE CORPORATION, FMC CORPORATION, NITRO PULP MILLS)

The Nitro Pulp Mills, which were established in 1920 by the Durham Paper Company of Regalsville, Pennsylvania, manufactured paper pulp. The Mills were located at the former cotton cellulose processing area of the explosives plant, which allowed the facility to utilize the large supply of cotton linters left over from WWI operations.

The Viscose Corporation of Marcus Hook, Pennsylvania purchased the Nitro Pulp Mills in 1921 to manufacture sheet pulp for their rayon producing facility. In 1937, the name was changed to American Viscose Corporation and the plant was converted to manufacture rayon staple fiber.

In 1939, the facility employed approximately 1,200 people, making it Nitro's largest employer since WWI. In 1948, a major plant expansion and modernization project more than doubled production. At the height of production, the facility was the largest staple fiber plant in the world, producing in excess of 150 million pounds per year.

American Viscose sold their holdings to FMC Corporation (FMC) in 1963 for a reported $116 million and operated the facility as a separate division of the corporation (U.S. EPA Region III, START, 2003). The American Viscose Division operated until 1978, when they disposed of their textile interests, partially due to a decline in the industry (U.S. EPA Region III, START, 2003).

Avtek Corporation (Avtek), a new corporation formed by a group of former Viscose management employees, purchased FMC's interests in 1978. Avtek continued production at the facility until 1980, when it became apparent that the facility could no longer remain competitive or meet current environmental standards, without major renovations (U.S. EPA Region III, START, 2003).

1.6 CHEMICAL FORMULATORS, INC. (1958 -)

Chemical Formulators, Inc. packaged insecticides for retail use. Operation began in 1948 in North Charleston, across the River from UCC's South Charleston plant. The operation was eventually moved to Nitro around 1958 and was located at the Explosives Plant "C" site.

State regulations for pesticides eventually forced the plant to switch from retail packaging to custom manufacturing of agricultural chemicals for other plants. However, changing state and federal standards and regulations for agricultural chemicals, which occurred around 1977, kept the company's future uncertain (Johnston, 1977).

1.7 CHEMICAL LEAMAN TANK LINES FACILITY

This facility is part of the WV Voluntary Remediation Program. The facility had an unpermitted discharge to the River. A wastewater lagoon facility is located at County Route 44/Scary Creek Road, Putnam County, Scott Depot, WV. The site is also known as the former Gertrude G. Elmore residence. The site is located 100 feet from Scary Creek and is located approximately 1,600 feet from the entrance of Scary Creek into the River. The site history and ownership is summarized as follows:

- Residential or vacant land prior to the late 1950s
- Chemical Leaman Tank Lines, Inc. operated a wastewater lagoon from the late 1950s to the early 1960s (total of 5 to 6 years)
- The site has been vacant since the early 1960s

Further investigation will be needed to determine the extent of groundwater and soil impact. Contaminants of potential concern (COPCs) are petroleum hydrocarbons, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), dioxins, and inorganic compounds.

March 1994, April 22, 1994, and April 26, 1994

Site Status Report #2 for The Chemical Leaman – Scary Creek Site, St. Albans, Putnam County, WV, WV DEP, 1994

This site status report was prepared by WV DEP in response to reports from local residents that a chemical dump existed on Scary Creek Road, Route 44, in St. Albans, Putnam County, WV.

WV DEP reported that the site is owned by Ms. Gertrude Elmore of 110 Scary Creek Road, and is located adjacent to Ms. Elmore's residence. Chemical Leaman deeded this site to Ms. Elmore.

WV DEP conducted site investigations in March 1994, on April 22, 1994, and on April 26, 1994. Inspectors reported that the site consists of three ponded areas. Pond No. 1, located adjacent to the Elmore residence, is the location of the chemical dump. No readings on the Organic Vapor Analyzer (OVA) above background were noted; however, a strong phenolic odor was noticed. Surface water drainage from Pond No. 1 was observed to discharge to Scary Creek. Inspectors also viewed Ponds No. 2 and No. 3.

Two groundwater samples were collected, one from the Elmore, and one from the Cathey residence. In addition, three surface water samples, and three sediment samples were also collected. Samples were analyzed for VOCs, SVOCs, and for inorganic analysis.

WV DEP reported that the area described as Pond No. 1 is the source of contamination, and that contaminant migration to the groundwater system has occurred based upon the presence of numerous identical compounds found in collected samples. WV DEP has recommended that the Elmore family discontinue use of the water from their well for any purpose (WV DEP, 1994_1).

1.8 COASTAL TANK LINES, INC (DANA CONTAINER, INCORPORATED)

Coastal Tank Lines, Incorporated (Coastal) operated a truck terminal adjacent to the western boundary of the former Fike Chemical, Inc. (Fike) site. Coastal hauled finished chemical products and raw materials interstate. The terminal was used to clean and repair tank trailers. The site is currently owned and operated by Dana Container, Inc. (Dana) (IT Group, 1999).

Dana currently operates a truck terminal adjacent to the western boundary of the former Fike site. Dana uses the property for tanker car cleaning, maintenance and repair (IT Group, 1999).

1.9 FEDERAL CHEMICAL COMPANY (EARLY 1920'S)

This plant was located on the banks of the River in Explosives Plant "C" property at Nitro in the early 1920's. Molasses brought by tank car from Louisiana were fermented in concrete tanks, and the alcohol was distilled in order to produce various grades of denatured and undenatured alcohol. This plant was only in operation for a short period of time; however, the exact operating dates are unknown (Johnston, 1977).

1.10 FIKE/ARTEL SUPERFUND SITE / COOPERATIVE SEWAGE TREATMENT, INCORPORATED

The Fike/Artel Superfund Site (Fike/Artel) is located on Viscose Road (Plant Road) in Nitro, WV, 1.1 miles south-southwest of the intersection of Interstate 64 and State Route 25. The site consists of an 11.9 acre former chemical manufacturing facility and a 0.9 acre former waste water treatment plant (WWTP) known as the Cooperative Sewage Treatment Plant (CST) (ICF, 1998).

Fike was located on the portion of the U.S. Explosives Plant "C" that was used to produce sulfuric acid. The explosives plant used the area between the Fike facility and the River for producing and colloiding nitrocellulose (U.S. ACE, 2001). Two former Old Monsanto employees, Elmer A. Fike and Harold Bruner, founded Fike in 1953 as "Roberts Chemicals". Roberts Chemicals originally produced ethyl xanthic disulfide. Xanthic disulfide was sold as a herbicide for onions, which was a development product abandoned by Old Monsanto. Roberts Chemicals also produced dithiocarbamates, which were based on carbon bisulfide, for agricultural use. Production of these derivatives was based on ethylene diamine. This production resulted in a patent litigation that resulted in Roberts Chemicals changing the emphasis of their company from agricultural chemicals to small volume industrial specialties. The company then began to produce sodium amide, sodium methylate, substituted thioureas, mercaptans, and pharmaceutical intermediates. Harold Bruner sold his interests soon after the company was founded, and Elmer Fike resigned in 1969. Elmer Fike founded Fike, in 1969, and eventually purchased financially troubled Roberts Chemicals in 1971. Both operations were consolidated at the Roberts Chemicals site. Fike specialized in medium volume specialty chemicals, with a production of a few 1,000 to a few 100,000 pounds per year. Local chemical plants provided both raw production materials, and a market for final products (Johnston, 1977). Fike operated until 1986, when the name and principal ownership changed to Artel, who operated the site until it was closed in June 1988 (ICF, 1998). More than 60 different chemicals were produced throughout the operational history of the facility, mainly by batch reaction processes (GeoSyntec, 2000).

CST was formed as a joint venture between Fike and Coastal to treat industrial wastewater through the WWI era sewer system. The CST waterwater treatment plant was located northwest of the main Fike site on land owned by Coastal which was leased to CST. The former chemical facility area can be separated into three main areas:

- Southern portion of the former Fike site – former drum burial area
- Northern portion of the former Fike site – former process area where chemical manufacturing act ivies were performed
- Former process waste lagoons – consists of Lagoons 1, 2, and 3 (ICF, 1998)

In 1978, Coastal stopped use of the CST and sold its interest to Fike. U.S. EPA constructed and operated a wastewater treatment facility at the CST as part of the 1988 Emergency Removal Action at the Fike site. In 1995 the CST was decontaminated, demolished, and closed as part of the CST Removal Response Action (IT Group, 1999).

The former Fike facility is located in the Nitro Industrial Complex, approximately 2,200 feet east of the River. The Fike facility was a small volume chemical manufacturing plant that specialized in the development of new chemicals, custom chemical processing, and specialty chemicals. The former CST is located approximately 500 feet west of the facility. Dana, a tank repair and cleaning facility, separates the former Fike facility from the former CST (ICF, 1998).

June 28, 1977 and October 3, 1977

<u>Compliance Monitoring and Wastewater Characterization of Fike Chemicals, Inc., Coastal Tank Lines, Inc., and Cooperative Sewage Treatment, Inc., Nitro, West Virginia, U.S. EPA, Region III, 1978</u>

U.S. EPA Region III and the National Enforcement Investigations Center (NEIC) prepared this report in response to a request from U.S. EPA for NEIC to conduct a study of the Fike site. The site area was defined to include Fike, Coastal, and CST. The objective of the study was to identify and quantify all toxic chemicals discharged to the River from the Fike site.

A monitoring study was conducted at the site from October 3 to 7, 1977 to determine compliance with NPDES Permit limitations, and to identify toxic chemicals being discharged.

Samples collected at the Coastal Wash Facilities from October 2 through 7, 1977 reported concentrations of 2.0 milligrams per liter (mg/L), 0.54 mg/L, and 0.27 mg/L (2,000 ppb, 540 ppb, and 270 ppb) 2,3,7,8-TCDD respectively. Samples collected in the Prerinse Tank Trailer Discharge to the new evaporation pond at Coastal, which were collected over the same dates, reported concentrations of 44.0 mg/L and 0.48 mg/L (44,000 ppb, and 480 ppb) 2,3,7,8-TCDD.

U.S. EPA concluded that organic and toxic compounds that were detected during this study were not representative of all compounds that could be discharged to the River due to batch operations occurring at both Fike and Coastal (U.S. EPA Region III, 1978).

March 29, 1983

<u>Memorandum: to Kenneth E. Biglane, U.S. EPA, Washington, from Benton M. Wilmoth, OSC, U.S. EPA, Region III, Re: Request for Assistance of ERT for a Technical Assessment of the Current Environmental Corrective Work at Fike Chemical Company, Nitro , West Virginia, U.S. EPA, Region III, 1983</u>

This memorandum was sent to U.S EPA Washington from U.S. EPA Region III in order to request assistance of the Environmental Response Team (ERT) in reviewing the environmental cleanup requirements imposed on Fike by the current U.S. EPA Consent Order. U.S. EPA Region III wants to determine if the proposed work would remedy the off-site migration of hazardous chemicals in a timely and sufficient manner.

The memorandum states that U.S. EPA Region III and Weston have detected high levels of priority pollutants migration off-site from Fike. It also reports that the U.S. Center for

Disease Control (U.S. CDC) has certified the environmental and public health risks of the off-site migration of hazardous materials.

An attachment to this memo reports that on March 29, 1983, Weston collected off-site samples of soil and water from a drainage area adjacent to the Fike facility. Analytical results report that dibenzofurans were detected in soil sample STA.05 at a concentration of 123,600 ppb (U.S. EPA Region III, 1983).

September 1989, July 1994, and April 1995, September 1995, and October 1995
<u>Information Summary: WWI Era Sewers, Fike Chemical Superfund Site, Nitro, WV, The IT Group, 1999</u>

This report was prepared by the IT Group (IT) to provide a summary of prior research and currently available information relating to the location and condition of WWI era sewers located beneath, and in the vicinity of the Fike site. IT summaries four individual sewer investigations, which have been conducted to date, and provides an overall summary of available information. The sewer investigations were designed to determine the following:

- To identify the locations of the WWI era manholes and sewers
- To determine the interconnections between manholes, drains, and sewers
- To characterize the physical condition of, and flow if any, through the sewers

IT reports that in recent months, several sinkholes have developed in the southern portion of the Fike site, approximately 60 feet north of former Lagoon #3. The sinkholes are reported to correspond with the locations of one of the WWI era main trunk line sewers, and the former aboveground sludge storage tank farm. It has been speculated that the sinkholes are due to a collapse or partial collapse of a WWI era sewer line and tank farm, which raises concern that the sinkholes present a potential pathway for the off-site migration of accumulated surface runoff.

NUS Corporation (NUS) conducted the first sewer investigation in September 1989 as part of a site wide remedial investigation. During this investigation, 5 off-site manholes and 16 on-site manholes were identified and measured for influent and effluent pipes, total depth, manhole diameters, etc. NUS noted that many of the manholes were flooded with water at the time, which inhibited data collection. The investigation also included collecting sludge samples from 5 manholes, liquid samples from 2 manholes, partial sewer dewatering and smoke testing. Smoke testing was performed to identify sewer connections, leaks, and discharges to the CST sewer system. The NUS investigation identified three major and distinct sections of the sewer system that included the WWI era gravity system running parallel to the west boundary of the site, the former cooling tower sump, and the WWI era gravity system that extends from the northeast corner of the main Fike site to the west under Dana, and to MH-1 at the CST influent sump. NUS did not provide information regarding the WWI sewers in the south end of the main Fike site where the sinkholes are located, because NUS was not able to locate any of the manholes in this area.

U.S. EPA conducted the second investigation in July 1994, which included a sewer smoke investigation and dye trace study. The investigation was conducted to address a reported inflow/infiltration problem between Fike and neighboring facilities, such as Dana. The purpose of the study was to determine if the facilities were contributing flow to the CST via the WWI gravity sewer line running east to west from the main Fike site, under Dana's property, to the CST. Smoke testing was performed at two manhole locations along the WWI era gravity sewer line on the Dana Transport property, and limited dye tracing was performed to determine if a floor drain in Dana's Service Shop was connected to the WWI sewer line that discharges to the CST. U.S EPA concluded that smoke and dye test activities indicate that roof drains on Dana's Service Shop are connected to the WWI sewer line and contribute flow to the CST. It was noted that the study did not indicate that Dana was contributing flow from any other sources, including process waste water from the Service Shop or from the tanker cleaning facility. U.S. EPA stated that smoke was observed coming from several locations on the main Fike site during testing of MH-1, however, the exact sources of the smoke could not be determined since U.S. EPA personnel were not stationed inside the Fike site fence during the investigation. U.S. EPA also noted that large piles of demolition debris and other materials from the demolition of the facility prevented access and limited visibility of the Fike site.

ICF Kaiser Engineers (ICF) conducted the third investigation in April 1995, which consisted of two parts. The first part identified and inspected on-site manholes and drains, and the second consisted of a smoke test to identify locations of WWI sewer lines, interconnections among manholes and drains at the site, and off-site sources that may be contributing flow to the site. ICF concluded that the smoke testing was inconclusive in determining the location of the WWI era sewer beneath the site. This was due to significant amounts of sediments and standing water in sewer manholes, process drains, and sewer lines. It was noted that the only sewer line that was not plugged with sediment was the main gravity line that runs from the northern portion of the Fike site west under the Dana property to the CST.

ICF conducted the fourth investigation in September and October 1995, as a follow up to their previous investigation in April 1995. The purpose of the investigation was to locate and access off-site manholes located south and west of the site, to determine the location and condition of WWI sewers beneath the Fike site. ICF used basic surveying and excavating techniques to located and access the WWI sewer manholes. ICF mapped the layout of the WWI sewer system beneath the Fike site, and the location of 15 manholes that were included in the investigation. ICF concluded that the only WWI sewer line through which there is any flow is the main gravity line extending from the northwest corner of the Fike site west under the Dana property to the CST. Off-site manholes included in this investigation were reported by ICF to be full of either sediment or standing water, or to be collapsed or destroyed. IFC concluded that this investigation supported the findings of previous sewer investigations performed at the site.

After review of the four previous sewer investigations, IT concluded that results indicate the WWI sewers beneath the Fike site were blocked either intentionally by Fike during the operating period of the facility, or due to natural accumulation of sediment in the sewer lines and manholes. IT reported that the WWI gravity line extending from the northern portion of the main Fike site under the Dana property to the CST is an exception; however, this sewer line has been taken out of service as part of the CST Removal Response Action. IT concluded that sewers are likely partially or fully collapsed due to their age, which contributes to the accumulation of sediments within the lines. IT noted that sewer lines in the southern portion of the Fike site are in poor condition, and may have been removed or destroyed during construction of waste disposal lagoons and the burial of waste material including drums. IT concluded that the presence of sinkholes in this portion of the site supports the belief that sewer lines have collapsed, and recommends that specific lines, sumps, and manholes be marked on the ground surface so that test pits can be excavated in the area of the sinkholes. IT states that excavation in these areas may indicate if sink holes are related to the former sump located within the former above ground tank farm area (IT Group, 1999).

April 11, 1994

<u>Letter to Mr. Eugene P. Wingert, U.S. EPA, from Warren L. Smull, Fike/Artel Site Trust, Re: Fike Chemical Superfund Site, OU-2 RA, Dioxin Suspect Materials, Fike/Artel Site Trust, 1994</u>

This letter prepared by Warren L. Smull, Project Coordinator for the Fike/Artel Site Trust was sent to Mr. Eugene P. Wingert, Remedial Project Manager, U.S. EPA, Region III in order to confirm topics discussed in a conversation that occurred on April 11, 1994. On this date, U.S. EPA advised the Fike/Artel Site Trust that four pieces of concrete which were found wrapped in plastic in the diked area west of the cooling tower may be contaminated with dioxin suspect materials. The Fike/Artel Site Trust stated that they would move the four items to the diked area on the site that contains dioxin suspect materials (Smull, 1994).

April, 1995

Letter to Ms. Katherine A. Lose, U.S. EPA, Region III, from Warren L. Smull, Fike/Artel Site Trust, Re: Fike/Artel Superfund Site April 1995 Monthly Progress Report #20, Fike/Artel Site Trust, 1995

The April 1995 Monthly Progress Report #20 was submitted by the Fike/Artel Site Trust in fulfillment of the monthly requirements of Section VII.D.6.a of the Fike/Artel OU-3 Order.

The results of dioxin analysis report 2,3,7,8-TCDD concentrations ranging from 2.6 pg in sample ST23215-D, to 11.2 pg in sample ST23095-D (Smull, 1995_1).

March 3, 1995

Letter to Ms. Katherine A. Lose, U.S. EPA, Region III, from Warren L. Smull, Fike/Artel Site Trust, Re: Fike/Artel Superfund Site July 1995 Monthly Progress Report #23, Fike/Artel Site Trust, 1995

The July 1995 Monthly Progress Report #23 was submitted by the Fike/Artel Site Trust in fulfillment of the monthly requirements of Section VII.D.6.a of the Fike/Artel Chemical Superfund Site OU-3 Order.

The results of dioxin analysis of samples collected on March 30, 1995 report a total 2,3,7,8-TCDD concentration of 3.40 ppb, and a 2,4,5-T concentration of 1.40 ppb (Smull, 1995_2).

March 9, 1995

Letter to Mr. Eugene P. Wingert, U.S. EPA, Region III, from Warren L. Smull, Fike/Artel Site Trust, Re: Fike/Artel Chemical Superfund Site, OU-3, February 1995 Monthly Progress Report #18, Fike/Artel Site Trust, 1995

The March 1995 Monthly Progress Report #18 was submitted by the Fike/Artel Site Trust in fulfillment of the monthly requirements of Section VII.D.6.a of the Fike/Artel Site OU-3 Order.

The results of dioxin analysis of samples collected in February 1995 were reported to range from 3.2 pg to 14.6 pg (Smull, 1995_3).

March, 1995

Letter to Ms. Katherine A. Lose, U.S. EPA, Region III, from Warren L. Smull, Fike/Artel Site Trust, Re: Fike/Artel Superfund Site May 1995 Monthly Progress Report #21, Fike/Artel Site Trust, 1995

The May 1995 Monthly Progress Report #21 was submitted by the Fike/Artel Site Trust in fulfillment of the monthly requirements of Section VII.D.6.a of the Fike/Artel Chemical Superfund Site OU-3 Order.

The results of dioxin analysis of samples collected in March, 1995 report 2,3,7,8-TCDD concentrations ranging from 0.09 ppb to 1.90 ppb (Smull, 1995_4).

April 1995

Letter to Ms. Katherine A. Lose, U.S. EPA, Region III, from Warren L. Smull, Fike/Artel Site Trust, Re: Fike/Artel Superfund Site June 1995 Monthly Progress Report #22 Fike/Artel Site Trust, 1995

The June 1995 Monthly Progress Report #22 was submitted by the Fike/Artel Site Trust in fulfillment of the monthly requirements of Section VII.D.6.a of the Fike/Artel Chemical Superfund Site OU-3 Order.

The results of dioxin analysis of samples collected in April 1995 report 2,3,7,8-TCDD concentrations ranging from 0.20 ppb to 2.0 ppb, (Smull, 1995_5).

July 14, 1995

Letter to Mr. Eugene P. Wingert, U.S. EPA, from Warren L. Smull, Fike/Artel Site Trust, Re: Fike Chemical Superfund Site, OU-2, September 1995 Monthly Progress Report, #44, Fike/Artel Site Trust, 1995

The September 1995 Monthly Progress Report #44 was submitted by the Fike/Artel Site Trust in fulfillment of the monthly requirements of Section X. A. of the Fike Chemical Superfund Site OU-2 Consent Decree.

The results of dioxin analysis of samples collected on July 14, 1995 report a concentration of 1.28 ppm 2,3,7,8-TCDD (Smull, 1995_6).

October 5, 1995

Letter to Mr. Eugene P. Wingert, U.S. EPA, from Warren L. Smull, Fike/Artel Site Trust, Re: Fike/Artel Chemical Superfund Site, OU-2, October 1995 Monthly Progress Report, #45, Fike/Artel Site Trust, 1995

The October 1995 Monthly Progress Report #45 was submitted by the Fike/Artel Site Trust in fulfillment of the monthly requirements of Section VII.D.6.a of the Fike/Artel OU-3 Order.

The results of dioxin analysis of samples collected on October 5, 1995 reported 2,3,7,8-TCDD concentration of 9.39 ppt, sample F-25-024MS, and 14.62 ppt, sample F-25-024MSD (Smull, 1995_7).

October 1995

Letter to Mr. Eugene P. Wingert, U.S. EPA, from Warren L. Smull, Fike/Artel Site Trust, Re: Fike/Artel Chemical Superfund Site, OU-3, November 1995 Monthly Progress Report, #27, Fike/Artel Site Trust, 1995

The November 1995 Monthly Progress Report #27 was submitted by the Fike/Artel Site Trust in fulfillment of the monthly requirements of Section VII.D.6.a of the Fike/Artel Site OU-3 Order.

The results of dioxin analysis of samples collected in October 1995 report a concentration of 0.2164 ppb 2,3,7,8-TCDD (Smull, 1995_8).

February 15, 1996, and March 1996

Letter to Mr. Eugene P. Wingert, U.S. EPA, from Warren L. Smull, Fike/Artel Site Trust, Re: Fike/Artel Chemical Superfund Site, OU-3, June 1996 Monthly Progress Report, #34, Fike/Artel Site Trust, 1996

The June 1996 Monthly Progress Report #34 was submitted by the Fike/Artel Site Trust in fulfillment of the monthly requirements of Section VII.D.6.a of the Fike/Artel Site OU-3 Order.

For OU-4, the results of dioxin analysis of sample FC4-S-002 collected on February 15, 1996 reported a concentration of 0.025 ppb 2,3,7,8-TCDD. For OU-3, the results of dioxin analysis for samples collected in March 1996 reported a concentration of 0.025 ppb to 1.96 ppb 2,3,7,8-TCDD (Smull, 1996_1).

March 6, 1996

Letter to Mr. Eugene P. Wingert, U.S. EPA, from Warren L. Smull, Fike/Artel Site Trust, Re: Fike/Artel Chemical Superfund Site, OU-3, April 1996 Monthly Progress Report, #32, Fike/Artel Site Trust, 1996

The April 1996 Monthly Progress Report #32 was submitted by the Fike/Artel Site Trust in fulfillment of the monthly requirements of Section VII.D.6.a of the Fike/Artel Site OU-3 Order.

The results of dioxin analysis of sample FC3-BL-001 MS collected on March 6, 1996 reported a concentration of 9.8 ppt (0.0098 ppb) 2,3,7,8-TCDD. Analysis of sample FC3-BL-001MSD reported a concentration of 9.72 ppt (0.00972 ppb) 2,3,7,8-TCDD (Smull, 1996_2).

June 1996

Letter to Mr. Eugene P. Wingert, U.S. EPA, from Warren L. Smull, Fike/Artel Site Trust, Re: Fike/Artel Chemical Superfund Site, OU-3, August 1996 Monthly Progress Report, #36, Fike/Artel Site Trust, 1996

The August 1996 Monthly Progress Report #36 was submitted by the Fike/Artel Site Trust in fulfillment of the monthly requirements of Section VII.D.6.a of the Fike/Artel Site OU-3 Order.

The results of dioxin analysis of samples collected in June 1996 report a concentration of 0.342 ppb 2,3,7,8-TCDD and 0.342 ppb TEQ TCDD (Smull, 1996_3).

July 30, 1996, August 1, 1996 and August 21, 1996

Letter to Mr. Eugene P. Wingert, U.S. EPA, from Warren L. Smull, Fike/Artel Site Trust, Re: Fike/Artel Chemical Superfund Site, OU-3, September 1996 Monthly Progress Report, #37, Fike/Artel Site Trust, 1996

The September 1996 Monthly Progress Report #37 was submitted by the Fike/Artel Site Trust in fulfillment f the monthly requirements of Section VII.D.6.a of the Fike/Artel Site OU-3 Order.

The results of dioxin analysis of sample FC3-L-120 collected on July 30, 1996 reported a concentration of 5.13 ppt total TCDD. Sample FC3-L-127 collected on August 1, 1996 reported a concentration of 1.72 ppb TEQ TCDD. Sample FC3-S-132 collected on August 21, 1996 reported a TEQ TCDD concentration of 0.655 ppb, and a concentration of 0.239 ppb 2,3,7,8-TCDD (Smull, 1996_4).

1996

<u>Letter to Eugene Wingert, U.S. EPA, Region III, from Michael I. Stratton, WV DEP, Re: Fike/Artel OU-4 RI/FS Sampling and Analysis Plan and Work Plan, WV DEP, 1996</u>

This letter was prepared by WV DEP after observing the removal of buried drums, cylinders, and other containers during the spring 1996 field season of the OU-3 Remedial Action.

WV DEP noted concern with page 1-27 of the work plan, under section 1.6 that states "During the OU-3 RA subsurface soil samples will be collected from the base of excavations following removal of all drums and soils visibly impacted by drum contents to support the OU-4 RI/FS effort". According to WV DEP, this statement implies that all visibly contaminated soil will be removed, which justifies not considering removal areas in the Remedial Investigation/Feasibility Study (RI/FS) as sources of contamination.

WV DEP reported that under ICF's direction, contaminated soils were only removed from areas where they could be directly traced to a particular drum or container. Soil was not removed from areas surrounding drums that had deteriorated to the extent that they no longer maintained their shape or contents. Soil was also not removed from the areas surrounding drum nests, where possible simultaneous rupturing of drums made it impossible to determine from which drum the contamination occurred. WV DEP reported that in several instances, soil surrounding drum nests was heavily contaminated with a black, oily substance, and that this semi-liquid material was placed on the spoil pile to be used to refill the excavations. WV DEP reported that this issue was discussed with the ICF on-site contractor; however, no change in procedure occurred. WV DEP also reported that in several instances, there was such a large quantity of fluid released from the drums that the area had to be diked. WV DEP reported that they observed this fluid material being mixed with soil from the excavation and then placed on the soil pile.

In conclusion, WV DEP wants the excavation areas considered potential sources of contamination, which should be sampled after being refilled. WV DEP stated that samples taken by the Fike/Artel Site Trust do not properly characterize the excavations. The samples are taken in visibly clean soil before the area is backfilled. WV DEP also noted that the samples taken were only 18 inches deep, which do not properly characterize a disposal pit that may be as much as 20 feet deep (WV DEP, 1996).

1998

Letter to Ms. Katherine Lose, U.S. EPA, from Warren L. Smull, Fike/Artel Site Trust, Re: Fike/Artel Superfund Site, Waste Water Management System Analytical Report

The Fike/Artel Site Trust submitted this fourth quarter 1998 waste water management system analytical report to U.S EPA, pursuant to Section IX., Paragraph 32 of the Consent Decree with the trust.

The Fike/Artel Site Trust reported that 20.5 pg/L 2,3,7,8-TCDD was found in the Baker Tanks, Fike WWTP. The sample was collected on July 27, in the third quarter of calendar year 1998 (Smull, 1998).

October 1999, December 1999, and March 2000

Draft Soil Feasibility Study, Fike Chemical Superfund Site, Nitro, West Virginia, GeoSyntec, 2000

GeoSyntec prepared this Draft Soil Feasibility Study on behalf of The Fike/Artel Site Trust. The study summaries the results of previous investigations and source removal efforts that have been performed at the site, as reported in the Soils RI Report.

GeoSyntec reported that previous investigations and source removal efforts have resulted in the removal of the following items from the Fike site:

- 167 gallons of polychlorinated biphenyl (PCB)-contaminated liquid
- 115 tons of asbestos-containing material
- 3,600 gallons of hazardous liquids
- Over 670,000 gallons of non-hazardous liquids
- Over 14,600 tons of hazardous and non-hazardous solids
- Over 2,100 drums

Approximately 30 surface soil samples were collected at the former Fike site and approximately 17 surface soil samples were collected at CST. Samples were analyzed for dioxins, which were converted to 2,3,7,8-TCDD TEQs. Approximately 50 subsurface soil samples were collected at the former Fike site, and approximately 17 subsurface soil samples were collected at the CST. Subsurface soil results reported a concentration of 0.00015 to 10.45 micrograms per kilogram (μg/kg) (0.00015 to 10.45 ppb) 2,3,7,8-TCDD TEQ.

GeoSyntec reported that a summary of previous investigations that have occurred at the site was included in the draft Soil RI dated May 12, 2000. As a result, this report provides only a summary of three additional investigations that have been made available since the submittal of the draft Soil RI Report.

The first investigation focused on Lagoon 3, for the purpose of characterizing and quantifying the extent and volume of the stabilized lagoon soils. During the December 1999 investigation conducted by IT, samples were collected from 20 borings and were analyzed for 2,3,7,8-TCDD equivalents. 2,3,7,8-TCDD equivalents were detected in the stabilized lagoon material at less than 1.0 μg/kg (1.0 ppb) in ten samples, between 1.0 to 20.0 μg/kg (1.0 to 20.0 ppb) in nine samples, and above 20.0 μg/kg (20.0 ppb) in one sample, which was reported to be 24.0 μg/kg (24.0 ppb).

In March 2000, IT conducted the second investigation, a directed sampling program that included six directed surface soil samples and one duplicate. Three samples were collected at reported locations of elevated concentration that were previously sampled by NUS Corporation. Two samples were collected from at random locations at the CST, and one sample was collected near Lagoon 3. 2,3,7,8-TCDD equivalents were reported to range from less than 1.0 μg/kg to 45.0 μg/kg (1.0 to 45.0 ppb).

The third investigation GeoSyntec summarized was the U.S. EPA Total Maximum Daily Loading (TMDL) Study conducted in October 1999. Weston conducted soil, sediment, and surface water sampling in the region on behalf of U.S. EPA. This information was collected in order to develop a TMDL for dioxin for the River basin. Weston collected 17 soil and 3 sediment samples from the former Fike Site during this investigation. Directed soil samples were also collected from the area immediately adjacent to concrete building foundations remaining on site. 2,3,7,8-TCDD equivalents were reported to be below 1.0 μg/kg (1.0 ppb) for all samples collected. GeoSyntec noted that the average 2,3,7,8-TCDD equivalent concentration detected at the Fike site was 0.0015 μg/kg (0.0015 ppb), which is more then 100-fold lower then the average concentration detected in the other samples taken in areas of Nitro and the Kanawha Valley. The average 2,3,7,8-TCDD equivalent concentration for these areas was reported to be 0.48 μg/kg (0.48 ppb).

To conclude the Soil FS, GeoSyntec identified volumes and areas of impacted soil and recommended alternatives for each area. The total surface area for surface soil was identified as approximately 79,000 square feet. This area includes the former process area of the Chemical Plant, two elevated 2,3,7,8-TCDD equivalent concentrations located near the access road in the northern portion of the former Fike site, and an isolated arsenic detection. The total surface area for subsurface soil is approximately

137,000 square feet. This area includes an area of approximately 58,000 square feet located on the southern portion of the property which includes Lagoon 3 and nearby areas, and an approximately 79,000 square foot area in the northern portion of the property which has the same limits as defined for the surface soil impacted area. In regard to the Lagoon 3 area, the volume of stabilized waste was reported to be 5,500 cubic yards.

GeoSyntec concluded that Remedial Alternative 4, an asphalt cap over the entire Chemical Plant, including Lagoon 3, was the best alternative for the former Chemical Plant site, and Remedial Alternative 2, asphalt cap over the entire CST, was the best alternative for the CST area (GeoSyntec, 2000).

May 29, 2001

Letter to Kate Lose, U.S. EPA, Region III, from Mark L. Slusarski, WV DEP, Re: WVDEP Trip Report - Offsite Sewer System Investigation (May 29, 2001), Fike/Artel Site, Nitro, West Virginia, WV DEP, 2001

This letter report was prepared to document a site visit conducted by WV DEP at the Fike/Artel site on May 29, 2001. The site visit was conducted to determine the relationship between the site and the off-site sewer system. The objectives of the visit included:

- Examining the existing sewer system in the vicinity of the Fike/Artel site
- Comparing field observations with historic records and maps
- Determining if sufficient evidence existed to suggest dioxin contaminated wastes related to historic Fike/Artel chemical manufacturing operations, prior to the construction of the CST may have been discharged to the River

WV DEP reported that historic maps and records indicate sewer lines associated with Fike/Artel may have been connected to the Nitro WWI era sewer system prior to the construction of the CST in the late 1970's. There is concern that dioxin related wastes were discharged to the River via a 66 inch diameter trunk line during this period. WV DEP concluded that the presence of residual dioxin contaminated waste, potential distribution, accumulation, and points of discharge have not been determined and should become a task under the Record of Decision (WV DEP, 2001_1).

1.11 FLEMING LANDFILL

Fleming Landfill (Mundy [Monday] Hollow Landfill) is an inactive state permitted 16 acre landfill on the 75-acre landfill. This landfill is one of 29 landfills receiving assistance from the Landfill Closure Assistance Program (LCAP) and received a state regulated closure cap in 2002. A perimeter leachate drainage system was installed to collect leachate from the landfill, with the leachate collected and stored in a vertical storage tank and trucked to the Charleston Sanitary Department for treatment. A passive gas system was also installed, consisting of one vent per acre of land. Mundy Hollow Creek's sediment reflects an observed release of mercury, dioxin, other heavy metals (from U.S. EPA March 2000 samples), and 4-methylphenol (from WV DEP July 1985 samples). Fleming Landfill is downgradient of Holmes & Madden Landfill; however, attribution of dioxin contamination is uncertain until better sampling locations are used.

1.12 FLEXSYS AMERICA, L.P. AND SOLUTIA, INCORPORATED (RUBBER SERVICES LABORATORY, SOUTHERN DYESTUFFS CORPORATION, ELKO, OLD MONSANTO)

The Solutia Inc. Nitro Plant is located on the east bank of the River, approximately one-half mile north of the City of Nitro in Putnam County, WV, in a heavily industrialized region. The site encompasses approximately 116 acres. Production areas, warehouse buildings, parking, or open storage had covered about 60 percent of the site. The facility is bordered to the east and northeast by commercial properties on State Route 25, to the south by industrial property, to the west and northwest by the River, and Interstate Highway 64 divides the facility (U.S. EPA, 2008a).

Old Monsanto purchased Rubber Services Laboratories (Rubber Services) in June 1929. Rubber Services was organized in December 1928 by four ex-Goodyear employees from Akron, Ohio in order to supply the large number of small rubber companies across the U.S. with manufactured rubber chemicals. The plant's first products were aldehyde-amine accelerators. They also supplied anti-oxidants, softeners, and tackifiers, which comprise only a small, but quite essential, part of the rubber compound. Old Monsanto purchased the nearby Southern Dyestuff Company, which operated a synthetic phenol process, in 1927. At that time, this was the second largest synthetic phenol operation in the U.S. The plant's name was changed to the Elko Chemical Company (Elko), and was made a subsidiary. Elko produced thionyl chloride, phosphorous oxychloride, chlorophenols, triphenylphosphate, phenol, and other chemicals. Operations at Nitro continued to expand during the 1930's by branching out into flotation agents, chemicals for copper mining, pickling inhibitor for steel plate, anti-oxidants for toilet soap, anti-skinning agents for varnishes and enamels, wetting agents, and anti-oxidants for unsaturated fats and oils.

Old Monsanto continued to expand in the 1940's and 1950's. New synthetic rubber that was developed during WWII created a demand for new rubber chemicals. In 1947, Old Monsanto's production of a wide variety of products reached 60 million pounds per year. The agricultural chemicals 2-4-D and 2,4,5,-T were added in 1948, and compounds such as methyl parathion were added in the late 1950's. In 1958, Old Monsanto began using a unit for refining Tall Oil for the production of rosins and fatty acids. These products were used primarily as raw materials for a variety of other products. Old Monsanto acquired the total assets of the Nitro Industrial Corporation (the entire remains of the Explosives Plant "C" property), in 1959 (Johnston, 1977).

The Nitro plant expanded its products over the years, and in addition to rubber chemicals, began to produce an animal nutrition chemical used for vulcanization accelerators, a vulcanization inhibitor for the rubber industry, antioxidants for miscellaneous rubber products, and general animal feed. Raw chemical materials used included inorganic compounds, organic solvents, and other organic compounds (Roux, 1995). As of May 1, 1995, management, operation, and substantially all assets of the Nitro facility, except the improved real estate and certain limited manufacturing assets, were transferred to Flexsys, a partnership of Old Monsanto (Roux, 1995).

May 16, 1986

Phase II, RCRA Facility Assessment of the Monsanto Company, Nitro, WV, A.T. Kearney, 1986

In 1986, A.T. Kearney, Inc. (Kearney) completed a Resource Conservation and Recovery Act (RCRA) Facility Assessment of the Old Monsanto Nitro, WV facility. Information for the Kearney assessment was obtained from a site inspection conducted on May 16, 1986, from U.S. EPA Region III files, Parts A and B of the RCRA Permit Application, and a response to the 1984 Hazardous and Solid Waste Amendments (HSWA) Solid Waste management Units (SWMUs) response letter.

This assessment identifies 34 SWMUs located at the facility, 11 of that are RCRA regulated hazardous waste management units. It is Kearney's recommendation that a remedial investigation be conducted for the following SWMUs:

- Teepee Incinerator
- Inactive Landfill Area
- Process Residue Fill

- City of Nitro Dump
- Decontaminated 2,4,5-T Building
- Niran Residue Pits
- Past Disposal Area
- Active Landfill Cell
- Sludge Pit No. 1
- Sludge Pit No. 2
- Facility Sewer System

October 2, 1990
<u>Compliance Evaluation Inspection Report, WV DCLER, 1990</u>

On October 2, 1990, inspectors conducted a Compliance Evaluation at Old Monsanto in Nitro, WV. Inspectors noted that a second tier pallet supporting two overpack containers of F027 dioxin waste was tilted and as a result, the containers were leaking. Facility representatives assured inspectors that the situation would be corrected promptly. Upon further investigation of the inspection logs, inspectors discovered that the "highly tilted pallet" had been noted six days prior to the inspection; however, Old Monsanto had not taken any action to correct the situation (Wright, 1990).

September 19, 21, and 23, 1994
<u>Compliance Monitoring Evaluation, Monsanto Chemical Company, WV DEP, 1994</u>

On September 19, 21, and 23, 1994, inspectors from the WV DEP Office of Waste Management visited the Old Monsanto facility to conduct a Compliance Monitoring Evaluation. The inspection was conducted in conjunction with work by Roux Associates, Inc. on Old Monsanto's RCRA Facility Investigation (RFI). Old Monsanto sampled approximately 65 wells as part of the RFI.

On September 19, 1994, the inspectors observed the purging and sampling of monitoring well No. MW-1A and 1B at the southeast corner of the facility property. WV DEP split six of these samples with Old Monsanto. The team then proceeded to wells MW-6A and 6B, located along the River bank on the northeast corner of the Old Monsanto production facility. It was noted that similar to most of the "A" wells located along the riverbank, MW-6A had a very slow recharge rate. Liquid obtained from this well was very black in color, had contained a great deal of solids, and a very strong chemical odor similar to the ambient air at the facility. These samples were also split, and were analyzed for volatile organic analytes (VOA), base-neutral and acid extractable (BN/AE)

SVOCs, metals, total organic carbon (TOC) and total organic halides (TOX). MW-6B was also sampled, and liquid from this well appeared clear and normal in color.

On September 23, 1994 inspectors observed sampling of wells located near the Old Monsanto waste treatment unit and decontaminated 2,4,5-T building. Wells WT-5A, 5 B, and 6A were purged and samples were split. The group then observed the sampling of well TD-3, which is located on the River bank behind the decontaminated 2,4,5-T building. The water level and recharge rates of this well were so low that it had to be hand bailed instead of pumped. Liquid from this well was brackish and had a chemical odor. Samples from this well were analyzed for dioxins and dibenzofurans, in addition to the parameters analyzed for the other wells. Samples were also split from well WT-13A.

WV DEP concluded that the compliance evaluation for this facility is pending, until further completion of the RCRA Corrective Action (CA) process can occur (WV DEP, 1994_2).

August 1994, September 1994

<u>RFI Report and Stabilization/Corrective Measures Plan, Volume I of II, Monsanto Nitro Plant, Roux, 1995</u>

In August and September 1994, Roux Associates conducted an investigation at the Old Monsanto Nitro facility to fulfill the requirements of the facility's RCRA CA and Waste Minimization Permit. The permit specifies 14 SWMUs that are subject to RCRA. It further specifies that soil, sediment, and surface water must be investigated for 3 of the 14 SWMUs, and that groundwater must be investigated for all but one SWMU.

The emphasis of the permit is on groundwater investigations due to findings of the RFI conducted at the site in 1986, which found that groundwater across the site contains VOCs. Additionally, the Facility Sewer System SWMU is the focus of its own stabilization measure evaluation program, due to the fact that it historically conveyed many of the VOCs as part of the normal process wastewater flow to the wastewater treatment plant.

The objectives of the RFI Report were to:

- Characterize the nature, extent, concentration, and migration of hazardous constituents released from SWMUs into groundwater and surface water
- Identify actual or potential receptors

- Provide a detailed geologic and hydrogeologic characterization of the area surrounding the SWMUs
- Determine the need for and scope of corrective measures

The following activities were performed as part of the RFI Work Plan:

- Collection of soil samples at the Building 46 Incinerator
- Collection of riverbank soil samples along the bank of the River
- Collection of sediment samples from the Past Disposal Area
- Collection of surface water samples from the Past Disposal Area
- Installation of monitoring wells at the facility
- Collection of groundwater samples from selected monitoring wells
- Performance of aquifer tests

Surface water sampling results indicated that hazardous constituents were not present above levels of concern. Sediment sampling results indicated low levels of BN/AE compounds and inorganic metals. BN/AE compounds were also found in samples taken along the banks of the Kanawha River. Low levels of VOCs, BN/AE compounds, and inorganic metals were found in samples collected near the Building 46 Incinerator. Roux concluded that the observed low levels of detection are not indicative of residual source areas, which would require corrective action.

Dioxin and dibenzofuran compounds were not detected in groundwater, however the results indicate that shallow groundwater is impacted by VOCs, BN/AE compounds, and inorganic metals. Roux concluded that the observed inorganic concentrations are representative of typical background levels, and therefore primary groundwater constituents would include trichloroethylene (TCE), benzene, and various chlorinated phenols. From these findings, Roux identified three potential areas of concern, which included the Past Disposal Area, the former City of Nitro Dump, and the Facility Sewer System (Roux, 1995).

February 5, 1998
Compliance Evaluation Inspection, WV DEP, 1998

On February 5, 1998, WV DEP conducted a RCRA Compliance Evaluation Inspection at Flexsys. The inspection was completed in two phases, which included a review of written records and inspection of the plant area.

WV DEP inspectors reviewed Flexsys' records, which included manifests of hazardous waste shipments from the facility over the last two years, the facility's bi-annual report, waste profiles, a contingency plan, an emergency response plan, inspection logs, and personal training records.

Mr. Tony Tuk, a Solutia representative, answered the inspector's questions regarding in-plant clean-ups, groundwater treatment activities, and corrective action projects. Mr. Tuk stated that Flexsys is currently operating a CA pump and treat system for an area of the plant that has a groundwater contamination problem. Flexsys currently pumps seven wells continuously for TCE removal and three wells continuously to remove kerosene from groundwater. After phase separation, groundwater is pumped to the facilities WWTP for further treatment. The sludge from the WWTP is then burned in an incinerator at the facility as a non-hazardous waste. The WV DEP report noted that inspectors stated, "soils in this part of the plant (the pump and treat activity area) are so contaminated with dioxin that as structures are built in and around it, the footers are being constructed above ground to prevent from having to dig into the soils and have to remove them as a hazardous waste".

During the physical inspection of the plant, WV DEP noted that there were several hazardous waste labels on drums on the permitted hazardous waste storage pad that were illegible and peeling off.

WV DEP Inspectors found Flexsys to be in violation of 40 CFR Part 264.13, which states that the "facility failed to make proper hazardous waste determination on all wastes generated". The WV DEP inspectors determined that dioxin is likely being pumped to the facility's WWTP due to the following reasons:

- The documented dioxin contamination in the soils around the pump and treat system
- The fact that the facility is continuously pumping 10 wells in the area around the pump and treat system
- Considering the solvent properties of TCE and kerosene

WV DEP concluded that the sludge from the WWTP, which is currently burned in the facility's incinerator, may be type "F020", and that Flexsys must address the following waste codes regarding this issue: F020, F027, F001, F002, D040, and D018. WV DEP gave Flexsys 30 days to complete the following: "make proper hazardous waste determinations on the groundwater being sent to the WWTP from the pump and treat system and on the sludge from the WWTP being burned in your boiler" (Cunningham, 1998).

September 1998

1998 – Results of Dioxin Sampling in Groundwater and Kerosene (Volume I of III), Solutia Inc., Nitro, WV, Roux

Roux Associates (Roux) conducted groundwater and kerosene product sampling for dioxins at the Solutia facility in September 1998. This work was performed in response to a written request from U.S. EPA Region III dated July 24, 1998.

U.S. EPA requested that three samples be collected for analysis, these samples included:

- One composite groundwater sample from recovery wells EW-5A, EW-5B, EW-6A, EW-6B, EW-7A, EW-7B, and EW-8 (composite #1) in the TCE hot spot area
- One composite groundwater sample from recovery wells EW-1, EW-2, EW-3, and EW-4 (composite #2) in the separate-phase kerosene area
- One composite sample of separate-phase product from recovery wells EW-1, MW-7, R-2, B-2, B-3 (kerosene component) in the separate-phase kerosene area

Groundwater samples were collected as separate samples on a per well basis and were composited by the laboratory and analyzed for dioxins. Composite #1, Composite #2 duplicate, and Composite #2 groundwater samples showed non detect values for 2,3,7,8-TCDD and Tetrachlrodibenzofuran (TCDF) at a method quantitation limit (lowest point of the calibration curve) of 5 pg/L. Estimated concentrations reported by the laboratory below this level were attributed by the data validator to blank contamination, and therefore the results for groundwater composites were also below the WV groundwater quality standard of 5 pg/L for 2,3,7,8-TCDD.

Analysis of the kerosene composite sample identified 2,3,7,8,-TCDD at a concentration of 369 pg/g (ppt), and 2,3,7,8-TCDF at 920 pg/g. OCDD was detected at 3310 ppt, and other penta-, hexa-, hepta-, and octa-CDD and –CDF congeners were detected at levels below their quantitation limits. The overall TCDD TEQ for the sample was 519 ppt (based on detected congeners only). Roux reported that similar levels were observed in the kerosene composite duplicate.

Roux stated that as there is no recommended standard for dioxin in a kerosene matrix in the environment, and therefore levels found were compared to typical soil cleanup levels. Using the Office of Solid Waste Emergency Response (OSWER) Directive 9200.4-26 (Approach to Addressing Dioxin in Soil at CERCLA and RCRA Sites), dated April 13, 1998 (Appendix G), U.S. EPA has generally selected a cleanup level for dioxin within the range of 5 ppb to 20 ppb TCDD TEQ for commercial/industrial soils.

Therefore, Roux concluded that the kerosene composite concentration was an order of magnitude below U.S. EPA's range, and slightly higher than what would be detected in a municipal sludge (approximately 60 ppt TEQ).

Analysis of laboratory grade kerosene identified dioxin and dibenzofuran congeners at a TCDD TEQ concentration of 24.5 ppt. Roux concluded that this is consistent with published reports that have reported dioxins in a wide variety of media, including petroleum refinery product and waste streams.

Roux concluded that while low concentrations of TCDD/TCDF and/or related congeners were identified in select site media, they were found in concentrations below the most applicable identified standard or reference. Estimated trace concentrations of dioxin found in groundwater were less than current WV Groundwater Quality Standards. Concentrations of dioxins in kerosene were less than typical U.S. EPA target values for industrial soils, and slightly higher than levels observed in a typical municipal sludge (Roux, 1998_1).

1998
<u>Work Plan for Dioxin Sampling in Groundwater Pump and Treat Wells, Roux Associates, Inc.</u>

In September 1998, on behalf of Solutia, Roux prepared a work plan to address proposed groundwater and product sampling for dioxins. The work plan is in accordance with the U.S. EPA request in their July 24, 1998 letter that the extracted groundwater in the "TCE Hot Spot Area" and "Separate-Phase Kerosene Area" be sampled for dioxins (Roux, 1998_2).

September 13, 2001 and September 14, 2001
<u>Compliance Evaluation Inspection, Flexsys Nitro Plant, WV DEP, 2001</u>

WV DEP inspectors performed an unannounced inspection of the Flexsys Nitro facility on September 13 and 14, 2001.

Inspectors examined a permitted storage pad, where 19 containers of hazardous waste were stored. Two of the drums were marked with accumulation start dates that exceeded one year, dated August 14, 1999 and July 11, 2000, and both drums belonged to Solutia. Solutia is responsible for groundwater remediation at these locations on plant property. Plant personnel told inspectors that the drums contained waste contaminated with dioxin containing compounds, and that disposal options were limited, therefore making it necessary to store the material for long periods.

Samples of leachate coming from ACLF were taken and analyzed for dioxin. Samples were obtained in the leachate flowing to Flexsys WWTP prior to the carbon beds. Sample results were not included in the WV DEP inspection report (WV DEP, 2001_2).

2001

Report on Phase 1A Activities – Corrective Measures Study, Roux Associates, Inc.

In September 2001, Solutia hired Roux and Potesta to conduct surface water and sediment sampling in the River. All surface water and sediment sampling activities were conducted as directed by U.S. EPA in the August 17, 2001 letter to Solutia and in accordance with the U.S. EPA approved work plan.

A total of 23 sediment samples and 13 surface water samples were collected from the River, as directed by U.S. EPA. The surface water and sediment sampling locations targeted three segments along the River:

- Segment A – located adjacent to the Process Study Area (10 sediment and 5 surface water samples were collected)
- Segment B – located adjacent to the light non-aqueous phase liquid (LNAPL) Area (4 sediment and 3 surface water samples were collected)
- Segment C – located adjacent to the Waste Treatment Study Area (9 sediment and 5 surface water samples were collected)

Based on the sampling results, it was concluded that the constituents of concern (COCs) in site ground water that discharges to the River do not present an unacceptable risk with respect to impact to surface water or sediments.

In addition to the COCs, U.S. EPA has requested the collection of discrete ground water samples to confirm the absence of dioxin in ground water. However, composite groundwater samples collected previously in 1998 by Roux detected no significant level of dioxins in groundwater. Since dioxins were absent from the composite sample, it was concluded that the potential presence of extremely low concentration in discrete groundwater samples would not affect future remedial actions. Therefore, collection of discrete groundwater samples for dioxin analyses was not warranted (Roux, 2001).

March 15, 2002

Letter to Ms. Jennifer Shoemaker, U.S. EPA, from D.M. Light, Solutia, Re: Notification of Potential Release, Solutia, 2002

Solutia sent this letter to U.S. EPA to report a potential release of hazardous constituents from the Flexsys facility.

Solutia reported that during a visit to the facility by WV DEP, a localized slough/slide was discovered near the toe of the Riverbank adjacent to the Flexsys facility. The slough/slide area is approximately 75 feet long, 5 to 6 feet deep measured into the Riverbank, and was located near Mile Point (MP) 42.1 in the vicinity of MW No. 22-R. Failure of the River's edge caused shifting of the slough material, exposing an unidentified black material. The exposed scarp was reported to be 6 to 8 feet in height, with the estimated 2 inch seam of black material located near the top of the scarp. The 2 foot by 75 foot long layer of black material was reported by Solutia to be overlain by construction rubble and debris. Solutia stated that the material had been disposed of in the Past Disposal Area, which is an identified Permit SWMU. It was estimated that approximately 30 to 40 cubic yards of material were displaced by the slough/slide mass.

On March 15, 2002, WV DEP and Solutia sampled the unidentified material, and analysis has indicated the presence of hazardous materials. Solutia reported that the physical appearance of the material and preliminary analytical results are consistent with pitch from the NaMBT process. Solutia is preparing a scope of work to collect and dispose of the black material that will also include stabilizing the bank in the area of the slough (Solutia, 2002).

March 15, 2002

Interim Measures Work Plan – Final - Kanawha River Bank Stabilization and Residue Cleanup, Flexsys Nitro Plant Facility, MP 42.1, Nitro, WV, 2002

In 2002, Potesta prepared an Interim Measures (IMs) Work Plan for the Flexsys Nitro Plant Facility to remediate a localized slough/slip that occurred along the River bank near MP 42.1.

In early March 2002, WV DEP notified Solutia that a recent inspection of the Riverbank resulted in the finding of a black tarry residue seeping from the bank of the River. The area of concern was located along the River outside the fenced limits of the Flexsys Nitro production facility.

WV DEP, Flexsys, and Potesta representatives performed a site visit on March 15, 2002. There was a thin lens of discolored material present near the top of the resulting scarp, which was intermingled with a black tar residue. The residue appeared to be under a layer of construction demolition material that covered the exposed sloping Riverbank. Some of the residue material mobilized during warmer periods and migrated down the scarp. In one location, it was noted that the residue had entered the water at the edge of the River. The material appeared to be upon entering the River. The exposed material, located below the stained lens, appeared to be native alluvial silt, which is tan to light brown in color and consistent in composition.

To determine the nature and extent of contamination, 18 sediment core samples were collected at recoveries ranging from 3.75 to 19.75 inches. Six samples were collected from each of the following areas: 8 feet from the water's edge, 15 feet from the initial set of samples, and 15 feet from the second. No residue was observed in the core samples, or otherwise, during the investigation.

The residue samples from the initial site visit with WV DEP conducted on March 15, 2002 were split between WV DEP and Potesta for independent analysis of VOCs, SVOCs, and 2,3,7,8-TCDD. An additional split was also provided to Solutia for analysis. A third sample was collected and submitted to Flexsys' laboratory for source characterization testing. The preliminary results indicated that the material was similar to a waste material generated from a production process at the plant facility. Results were obtained for analine, n-nitrosodiphenylamine, methylene chloride, and 2,3,7,8-TCDD. Aniline presented the most immediate concern. The short-term effects of exposure to n-nitrosodiphenylamine were unknown but it was mentioned that n-nitrosodiphenylamine was a primary pollutant. The methylene chloride concentration detected was suspected to have originated from laboratory contamination. The 2,3,7,8-TCDD concentrations reported appeared to be representative of background levels of surrounding areas.

A detailed site topographic survey was completed following the initial site visit. The survey included the approximate location of any buried utilities in close proximity to the slide area. The fieldwork was conducted on March 27, 2002.

Included in the IMs Work Plan is the proposed abatement and removal of tar residue material from the Riverbank, which was based on the visual examination of the site soils. The proposed collection of confirmatory samples was also included in the plan (Potesta, 2002_1).

March 15, 2002

Sampling Inspection Report – Solutia, Inc., DWM, WV DEP, 2002

As part of River patrol activities on March 6, 2002, WV DEP field staff discovered a blackish-brown residue like substance protruding from the River bank, approximately 15 feet up from the River edge. Field staff investigated this River bank area, which approximately 15 ft by 10 ft in surface area, 1 to 3 inches in depth, and located between the Flexsys/Solutia plant property and the River.

The material observed was hard and solid, appeared temperature sensitive, having oozed from the bank into the River due to warm temperatures.

On March 15, 2002, WV DEP conducted a sampling investigation of the area described above. Split samples were taken on the bank midway between the stormwater holding tanks, and the back gate the locked the blacktop access road to plant property. Results confirmed the presence of 2,3,7,8-TCDD along the River bank at a concentration of 599 pg/g.

Because of the presence of 2,3,7,8-TCDD in the sampling data, the residue material should be removed from the riverbank to prevent contamination to the River; and Solutia needs to submit a Sampling and Remediation Plan for addressing the contaminated area on the riverbank. The staff of WV DEP will review the plan and a work plan schedule will be established (Gatens, 2002).

January 2001, and July 26, 2002

2002 – Summary of HUB Drainage Ditch Dye Study, Flexsys America L.P. Production Facility, Potesta

The Hub Industrial Park is located along Interstate 64 in Nitro, WV. A drainage ditch running parallel to the main access road collects and conveys storm water runoff from the approximately 84 acres of developed properties located within the industrial park. The runoff is conveyed to an area of impounded water near the Flexsys Plant boundary, near the LNAPL recovery area.

On December 30, 2000, Solutia entered into an Administrative Order on Consent (AOC) to construct a soil cap on a 3-acre parcel of land located immediately north of the ponded area. During development of design plans, an assessment was conducted in order to determine the effects of increased stormwater runoff due to the capped area. The assessment determined that the majority of the flow would be directed and discharged to the existing adjacent storm water drainage ditch.

Potesta conducted fieldwork in order to determine if a discharge culvert or structure was located within the ponded areas of the drainage ditch. A structure was never located; however, water levels in the ditch fluctuated with rainfall events and increased runoff, indicating that some type of outlet structure exists. Potesta conducted a dye study around January 2001 in order to determine if there was a connection between the ponded ditch areas and a potential outlet point located along the River, or in portions of the old City of Nitro sewer, which exists in the area.

Results of the dye study identified a seep located along the edge of the River. A discharge was visible, which entered the River from underneath a large slab on concrete rubble along the riverbank. Potesta was not able to determine the exact nature of the discharge, as the concrete obstructed the view. As a result of this discovery, Potesta collected water samples both in the HUB storm water drainage ditch, and at the location of the seep. Additional samples were collected from both locations on July 26, 2002 and analyzed for VOC's and SVOC's.

Potesta concluded that there is some level of connection between the discharge of water from the HUB storm water drainage ditch, and the riverbank seep. Although the flow mechanism is unknown, dye test results indicated that at least a portion of flow migrates from the storm water ditch to the seep location. Potesta noted that a portion of the flow from the seep might be due to stored water from the old City of Nitro sewer. Direct storm water runoff from the Flexsys plant does not contribute to the ditch flow. The dye study results also indicated that there is a connection between the HUB storm water drainage ditch discharge and manhole 414, which is located within portions of the old City of Nitro sewer system (Potesta, 2002_2).

August 6, 2002
<u>Letter to Michael Light, Solutia, from David Farley, WV DEP, 2002</u>

This letter prepared by WV DEP presents sampling results from a sampling event on August 6, 2002 at the Flexsys facility in Nitro, WV.

WV DEP conducted sampling in conjunction with Potesta of a solid waste material present on the Riverbank near the Flexsys facility. It was reported that the material appeared to be grease or some type, and had significant potential to pollute State waters during higher River water levels. A priority pollutant scan for organic chemicals determined that none of the chemicals were present at the prescribed practical quantitation limits, indicating that the material may be a type of hydrocarbon or animal fat-based grease.

WV DEP collected a sample of the material for dioxin analysis; however, the sample was mishandled during transport and therefore was not analyzed. However, Potesta analyzed their sample for dioxin, and the results are pending.

The letter concludes by WV DEP noting that this material is currently being addressed in a work plan for the facility, and that this letter serves to reiterate that the waste material must be removed from the Riverbank to prevent contamination of the Kanawha River (WV DEP, 2002).

2002

Dioxin seep discovered at Nitro plant, The Charleston Gazette, 2002

This article written by staff writer Ken Ward Jr., and was printed in the Charleston Gazette, in 2000 (the exact date the article appeared is unknown).

The Gazette reports that WV DEP has discovered dioxin seeping from a waste pile at the Flexsys facility in Nitro, and that an undetermined amount has already seeped from the waste pile into the River. It was reported that Flexsys sent a letter to WV DEP, describing the seep as a 2-inch wide, by 75-foot long seam of black material.

It was reported that the seep was first spotted by WV DEP in early March as they inspected the Flexsys plant from a boat on the River. The seep was visible due to the fact that Flexsys and other area facilities had recently removed brush and other debris from the Riverbanks for security reasons following the September 11, 2001 terrorist attacks. It was reported that the seep adds to evidence that the Flexsys plant, which was formerly operated by Old Monsanto Company, is the source of unsafe levels of dioxin found in fish from the River.

The Gazette reports that U.S. EPA has recently released Old Monsanto's proposal for the cleanup of Heizer Creek Landfill, which was reported to be one of numerous sites where Old Monsanto dumped wastes from the manufacture of the herbicide Agent Orange. The article states that making the herbicide in Nitro created the toxic chemical dioxin as a byproduct, and that Old Monsanto disposed of wastes containing dioxin in dumps at Heizer and Manila Creeks, north of Old Monsanto's Nitro plant.

It was reported that D.M. Light, Remedial Project Manager for Solutia, sent a letter to U.S. EPA, stating that the state had found a localized slough/slide near the toe of the Kanawha Riverbank, adjacent to the facility. Solutia reported that the material was suspected to be pitch, which is a waste connected to the production of the chemical

NaMBT, used in rubber making. The slough/slide was reported to be 75 feet long, 5 to 6 feet deep, and it was estimated that a total of 30 to 40 cubic yards of the material had been displaced by the slough/slide. Samples indicated a concentration of dioxin greater than 650 ppt.

U.S. EPA was reported as stating that there is no exposure to humans or to the River. However a WV DEP Inspector who was present when the seep was discovered was reported as stating that the material has already reached the River (Ward, 2002).

June 12, 2003

Letter to Jon W. McKinney, Plant Manager, Flexsys, from Belinda Beller, Permitting Section, WV DEP, Re: Permit Application No. WV0000868 Putnam County, WV DEP, 2003

This letter prepared by WV DEP, was sent to Flexsys June 12, 2003 along with a draft copy of WV/NPDES Water Pollution Control Permit No. WV0000868, and a Fact Sheet for the permittee. The permit allows Flexsys to operate and maintain a disposal system for the direct discharge of treated industrial wastes, or effluent into the River via Outlet 001 at MP 41.9. The permit also grants operation of disposal systems for the direct discharge or untreated stormwater from non-process areas into the River via Outlets 005 and 008.

The permit states that Flexsys is authorized to discharge a maximum daily concentration of 0.014 pg/L of 2,3,7,8-TCDD from Outlets 001, 005, and 008 to be monitored annually. Requirement C.21 of the permit states that compliance with permit limits for dioxin in Outlets 001, 005, and 008 will be determined by the following:

- Collecting a composite sample of effluent from Outlet 001 annually using high volume sampling, and analyzing the sample using EPA Method 1613. The permit states that the first sample be taken within three months of the effective date of the permit, and if results of two sampling events are in compliance, then the permittee may discontinue sampling.
- Collecting grab samples from Outlets 005 and 008 annually and analyzing the sample using EPA Method 1613. The permit states that the first sample be taken within six months of the effective date of the permit, and if the results are within compliance, the permittee may discontinue sampling.
- Submitting the analytical results to the agency within 30 days of their receipt.

Section 10. C, Major Concerns, of the attached WV DEP Fact Sheet for the Flexsys facility states that WV DEP has concerns regarding the leaking underground sewer system, and its impacts on groundwater. The fact sheet reports that the facility sewer system has been in operation since 1918, and drained process wastes, sanitary waste, steam condensate, and stormwater runoff from the Flexsys facility. The WV DEP Fact Sheet reported that the sewer system contains more than 6000 feet of piping, lift stations, and pump stations to transfer wastewater to the wastewater plant, to be discharged through Outlet 001. The concern is due to the possibility of the system leaking during the manufacture of 2,4,5-T at the facility, which may have polluted groundwater with dioxin and other contaminants. Another concern listed was the possibility of contaminated groundwater infiltrating into the sewer system, and reaching the wastewater treatment system through normal operation, or being discharged directly into the River during bypass occurrences. The Fact Sheet also states that due to the potential presence of dioxin in the discharge, the proposed permit limit for dioxin shall be 0.014 pg/L, the applicable water quality standards for dioxin. This is due to the fact that the River is on the 303(d) list for dioxin, and the fish in the River contain unsafe levels of dioxin for human health (WV DEP, 2003).

February 2004

Interim Measures – Final Report: Kanawha River Bank Stabilization and Residue Cleanup, Flexsys Nitro Plant Facility, MP 42.1, Nitro, WV

Potesta prepared this report for Solutia under Section E.2; IMs of the current RCRA CA permit (EPA ID. No. WVD039990965) for the Flexsys facility. The purpose of this investigation was to achieve the following:

- Safely contain the contaminated area
- Remove the construction/demolition material from the affected area
- Remove the visually impacted residue from the site resulting in a final regraded stable Riverbank

The area of concern is located along a steeply sloped (1:1) section of Riverbank on the eastern bank of the River (MP 42.1). The site is located outside both the fenced limits of the plant facility, and the limits of an adjacent SWMU, the Past Disposal Area.

The area was discovered by WV DEP on March 6, 2002, during a site inspection of the plant from the River. A blackish-brown residue material was observed in the soil in the limits of a surface slough along the Riverbank. The inspectors reported that the material appeared to have flowed down the bank and had entered the River in at least one location. Potesta sampled the residue on March 15, 2002 at the request of U.S. EPA and WV DEP. Residue samples revealed the presence of aniline, n-nitrosodiphenylamine, methylene chloride, and 2,3,7,8-TCDD. Potesta reported that the area of concern was centered on a slough or shallow side near the toe of the existing bank at the water's edge. Solutia formally notified U.S EPA of the potential release on April 15, 2002, and an IMs Work Plan was submitted on August 2, 2002.

Potesta reported that in the immediate vicinity of the area of concern, the River is shallow and gently sloping near the edge of the bank with water depth approximately 6 to 8 feet in depth 20 feet from the edge. The majority of the failed slide mass was reported to have been eroded from the toe along the River's edge. Potesta determined that since a located area of residue had migrated into the River, sediment coring samples would be retrieved from the area in order to determine the nature and extent of the residue material.

Potesta conducted core sampling near the toe of the slide/slough area on June 9, 2002. A total of 18 sediment core samples were collected with recoveries ranging from 3.75 to 19.75 inches. Samples points were taken from three transects, with each transect being made up of six individual sediment sample locations. The first transect was located in the River approximately 8 feet from the water's edge, the second was advanced 15 feet from the first, and the third and additional 15 feet from the second. Potesta reported that none of the recovered cores showed any visual signs of residue materials. Residue samples were split between WV DEP and Potesta and were analyzed for SVOCs (method 8270), VOCs (method 8260) and 2,3,7,8-TCDD high-resolution dioxin analysis (method 8290) at REIC Laboratories in Beaver, WV. Solutia submitted an additional split sample to Test America, Inc. in Nashville, Tennessee for the same analysis. Flexsys submitted an additional sample to their in-house laboratory for potential source characterization testing. Preliminary results reported by Flexsys indicated that the material was similar to NaMBT pitch, which is a waste material generated at the plant. Analysis conducted at REIC and Test America Labs reported 2,3,7,8-TCDD concentrations of 656 pg/g (0.656 ppb) and 550 pg/g (0.55 ppb), respectively (Potesta, 2004_1).

May 2004

<u>Kanawha River Surface Water/Sediment/Passive Vapor Diffusion Sampling Results: Appendix G from Revised Data Report, CA-750 Groundwater Environmental Indicators, Flexsys America L.P. Facility, Nitro, WV</u>

This Appendix prepared by Potesta for Solutia, summarizes the results of surface water, sediment, and passive vapor diffusion sampling of the River conducted in 2002.

Potesta reported sediment dioxin results ranging from 1.8 pg/g 2,3,7,8-TCDD at sample location GSD-3-N to 190,000 pg/g 2,3,7,8-TCDD at sample location DSD-1-N (Potesta, 2004_2)

June 17, 2004

<u>Letter to Jeffrey Waldbeser, Monsanto, from Mike House, Solutia dated June 17, 2004, Re: Flexsys Nitro, West Virginia Facility – River and Riverbank Data</u>

Mike House of Solutia sent this letter to Jeff Waldbeser of Monsanto on June 17, 2004 in response to Monsanto's request for data from investigations conducted by Solutia at the Flexsys facility. Attached to the letter were the following reports:

- Interim Measures – Final Report: Kanawha River Bank Stabilization and Residue Cleanup, Flexsys Nitro Plant Facility, MP 42.1, Nitro, West Virginia, February 2004
- Kanawha River Surface Water/Sediment/PVD Sampling Results: Appendix G from Revised Data Report, CA750 Groundwater Environmental Indicator, Flexsys America L.P. Facility, Nitro, West Virginia, May 2004

Mr. House stated that the IMs Report documents the cleanup of a slough on the River bank, sampling procedures, and results. The second report is an appendix to Solutia's CA750 Environmental Indicator Data Report, which was recently submitted. This appendix includes figures and tables for surface water, sediment, and passive vapor diffusion sampling results that are the result of the implementation of two work plans previously approved by U.S. EPA. These work plans include:

- Kanawha River Sediment and Surface Water Sampling Work Plan, dated September 2001
- Supplemental Surface Water and Sediment Sampling Work Plan, dated September 2002

Solutia provided a summary of the implementation of the work plans that involved the following items; 2001 Sediment and Surface Water Sampling, 2002 Sediment and Surface Water Sampling, 2003 Surface Water Sampling, Sediment and Surface Water Analytical Results, and Passive Vapour Diffusion (PVD) Samples (Solutia, 2004).

<u>2001 Sediment and Surface Water Sampling</u>: A total of 23 sediment samples and 13 surface water samples. Samples were collected from three segments, B, and C, all of which were located along the River. Each segment was biased to detect any possible groundwater discharge impacts to the River in these segments. Solutia collected surface

water samples during both average flow conditions (September 2001), and during low flow conditions (October 2001). Two background samples were also collected. Sediment and surface water sampling began with the most downstream point and proceeded upstream to minimize the potential of cross-contamination of upstream and downstream points. Sediment samples were collected from an area approximately 10 feet from the River's edge, however in two locations; samples were collected from an area farther from the bank due to the existing riprap in the vicinity of the existing WWTP. The TCE extraction wells that are located immediately along the top of the Flexsys Riverbank were shut off prior to and during sampling.

<u>2002 Sediment and Surface Water Sampling</u>: In December of 2002, a total of 29 sediment samples were collected from the River immediately adjacent to the Riverbank. Eighteen samples were collected from four new stream segments D, E, F, and G to address U.S. EPA concerns regarding areas not sampled in 2001. Sampling began with the most downstream point and proceeded upstream to minimize the potential of cross-contamination of upstream and downstream points. Ten samples were collected at three 2001 locations for dioxin and furan analysis, and seven samples (three from Segment A, one from Segment B, and three from Segment C) were collected at 2001 sampling location to confirm 2001 results. Two upstream background samples were collected, one at a previous 2001 sample location, and also at a point upstream along the bank adjacent to the industrial site.

Surface water samples were collected at eighteen locations, Segments D, E, F, and G, including background samples at two locations. Samples were collected at five locations in Segments A, B, and C for dioxin and furan analysis. The TCE extraction wells at the Flexsys facility were turned off during the sampling event.

<u>2003 Surface Water Sampling</u>: On August 28, 2003, a second low flow sampling event was conducted in accordance with procedures described in the Supplemental Surface Water and Sediment Sampling Work Plan dated September 13, 2002. This sampling event included four segments of the River previously sampled in 2002 that are described as follows:

- Segment D – from the upriver property boundary near well MW-23A to the upriver portion of Segment A near MW-20A
- Segment E – from the downriver portion of Segment A near MW-24A to the upriver portion of Segment B near the LNAPL unit
- Segment F – from the downriver portion of Segment B near MW B-7 to the upriver portion of Segment C near MW WT-13A

- Segment G – From the downriver section of Segment C near MW WT-7A to the downriver plant property boundary

A total of twenty-one samples were collected from the River including two background samples. A boat was used to access all sampling locations, and all samples were collected approximately 10 feet from the Riverbank. Surface water and sediment samples were analyzed for VOCs, SVOCs, dioxin, and furans.

Passive Vapor Diffusion Samples: PVD was included in this investigation at the request of U.S. EPA in order to determine the volatilization of VOC constituents in the hyporheic zones along the River. A total of forty PVD sampling devices were installed in sediment along the River bank at 19 distinct points on December 19, 2002. Two PVD samples were positioned at each sample location, except at sample location DSD-4, which had four PVD samplers (second set required for field duplicate). The installation of PVD samplers began from the furthest downstream point and moved upstream. PVD samplers were retrieved on January 9, 2003, which resulted in a sample collection period of 21 days. All samples were analyzed for Target Compound List (TCL) VOCs (Solutia, 2004).

1.13 GREAT LAKES CHEMICAL SITE

The Great Lakes Chemical Corporation (GLCC) site, formerly FMC Corporation (FMC), was located in the Kanawha Valley in Nitro, WV. The Former Flexsys Facility is adjacent to the north of the GLCC site and the River is located directly west of the GLCC site.

The former FMC plant manufactured phosphorus-based organic and inorganic chemical intermediates for commercial use. FMC operated from 1987 until 1999 when GLCC purchased the plant and continued chemical manufacturing operations. The plant discontinued operations and closed in 2001 (U.S. EPA, 2008b).

In May 2005, Blasland, Bouck, & Lee (BBL) collected surface soil samples along the northern and eastern perimeter of the GLCC site. Samples were submitted for analysis of PCBs, pesticides, dioxins, chloride, percent solids, phosphate, and total phosphorus. Concentrations of 2,3,7,8-TCDD were measured in soil at concentrations between 0.0025 B μg/kg to 0.59 J μg/kg. The highest concentration, 0.59 J μg/kg, was observed near the northeast corner of the GLCC site, approximately 830 ft from the River (BBL, 2007).

In May/June 2006, BBL collected surface soil samples in the area of the former lab and warehouse buildings located approximately 700 ft east of the samples collected in 2005, adjacent to the east of the Former Flexsys Facility. Samples were submitted for analysis of PCBs, pesticides, dioxins, chloride, percent solids, phosphate, and total phosphorus. Concentrations of 2,3,7,8-TCDD were observed to range from 0.0034 J μg/kg to 3.3 J μg/kg. The two highest concentrations, 1.7 μg/kg and 3.3 μg/kg, were located outside the lab and warehouse buildings approximately 40 ft and 80 ft east of the northern property boundary, respectively (BBL, 2007).

1.14 HECK'S WAREHOUSE PROPERTY

Heck's Warehouse property is located to the immediate north of the Flexsys Facility main office parking lot, and to the east of the Flexsys Past Disposal Area.

In 2002, a "black, tar residue" was discovered adjacent to an old bunker foundation. The waste material was fully contained, and there did not appear to be an imminent threat of the material moving (Light, 2002).

1.15 HEIZER CREEK LANDFILL

Heizer Creek landfill was operated by City of Nitro from late 1950's to early 1960's and accepted municipal and industrial rubbish. Information available to U.S. EPA indicates that Monsanto used the landfill for approximately one year (1958-1959) for disposal of plant wastes. In 1983, surface soil samples showed dioxin concentrations as high as 9.6 ppb. In approximately 1988, Monsanto excavated nine 55-gallon drums of soil contaminated with dioxin from certain areas of the landfill. A 1998 sampling event showed 21.54 ppb 2,3,7,8-TCDD from a composite landfill sample. Another sample collected from the surface runoff stream indicated elevated 2,3,7,8-TCDD levels of 0.021 ppb, possibly indicating the migration of dioxin from the Heizer Creek landfill. 2,4,5-T, methylene chloride, phenols, benzene compounds and heavy metals have also been found (U.S. EPA, 2008a).

1.16 MAINE COASTAL RAILROAD TANK WASHING SITE

The Maine Coastal Railroad Tank Washing (Main Coastal Railroad) site is located approximately 1 half mile east of the River, immediately adjacent to the Fike property. The site is owned by Fike, and has been leased to the Maine Coastal Railroad Tank

Washing Company since November 1980. Prior to 1980, the site was used to store tanks belonging to Fike and 300 feet of railroad tracks.

Maine Coastal Railroad washed railroad tank cars for various companies such as U.S. Steel, Koppers, Uniroyal, FMC, and Monsanto. Tanks were cleaned when a product was being changed, or when tanks cars were overweight. Wastewater was sent to the Fike WWTP, and excess waste materials were shipped to Cecos International in Williamsburg, Virginia.

The site is a RCRA generator, and generates approximately 76 drums of waste every 6 to 8 weeks. No major spills are known to have occurred at the site; however, WV Department of Natural Resources (WV DNR) inspectors report that a great deal of accidental spillage occurs daily. During an inspection by NUS in September 1985, several tanks belonging to Fike were found on-site. One tank, located near the office, was leaking and pooled liquid was observed (NUS Corporation, 1986).

1.17 MANILA CREEK LANDFILL

Manila Creek Landfill is located approximately 2 miles north of the Pocatalico River, along County Route 5 in Putnam County. Old Monsanto used this landfill as a disposal dump for general organic chemical wastes during 1956 and 1957 (Weston, 1999). Prior to the 1950's, the area was mined for coal using surface and auger mining methods. Many of the mines were abandoned and consequently there is an abundance of mine seeps in this area (ERM-Midwest, 1987). The site was originally owned by the Amherst Coal Company of Charleston, and was purchased by Amherst Industries of Charleston around 1983 (NUS Corporation, 1983_1).

A Hazardous Waste Site Notification Form submitted by Old Monsanto in June 1981 stated that Old Monsanto used the landfill to dispose of one hundred and seventy thousand cubic feet of general organic chemical waste. No records or documents containing the exact amount or types of waste were available (NUS Corporation, 1983_1).

There are several streams near the site, with Manila Creek and Washington Hollow being the closest. Washington Hollow is a tributary to Manila Creek, which flows southwesterly to a confluence approximately 200 feet west of the disposal area. Manila Creek borders the landfill site to the west, and flows southerly to the Pocatalico River approximately three miles south of the site (NUS Corporation, 1983_1).

The landfill site is approximately 0.5 acres and is located on a small hillside within 100 feet of the eastern bank of Manila Creek (NUS Corporation, 1983_1). An earthen dike and highwall surround the landfill. Waste material was placed inside the dike on a layer of flyash. The site was left undisturbed for many years until seeps from the dike area were observed (ERM-Midwest, 1987). In April 1983, NUS conducted a field investigation under the Field Investigation Team III contract. The investigation determined that surface soils contained 2,3,7,8-TCDD at 3.72 ppb. As a result of this finding, U.S. EPA entered into a consent agreement with Old Monsanto in April 1987, under which Old Monsanto was directed to dewater the landfill, block off an underground seep, cap and fence the area, and monitor the landfill on an ongoing basis (Weston, 1999).

August 18, 1982
<u>Federal On-Scene Coordinator's Report, Immediate Removal Action, Poca, WV, U.S. EPA, 1982</u>

This report prepared by U.S. EPA, outlines federal, state, and local site clean-up operations that occurred at the Manila Creek dump site between August 18, 1982 and October 15, 1982.

On August 18, 1982, WV DNR inspectors investigated a citizen's complaint that 50 to 60 drums had been dumped into a mine tailings pile along Manila Creek Road near Poca, WV. The investigation revealed that there were 77 drums, several of which were leaking, with labels indicating contents may have included poisons, corrosives, germicides, and organic compounds.

WV DNR reported this discovery to U.S. EPA's Region III Wheeling, WV Field Office Federal On-Scene Coordinator (OSC), Benton Wilmoth. This site presented an imminent threat to public health, which provided the legal basis for federal response activities. The declared a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Federal Immediate Removal on August 19, 1982. Contaminated materials were to be removed and safely disposed off site.

On August 21, 1982, a site visit was performed to provide photographic documentation of the site before site work began. Approximately 15 of the 77 drums were observed to be leaking liquid chemicals. The Ecology and the Environment, Inc. ERT sampled 8 of the drums to obtain a representative sample of drum contents.

Between August 23, 1982 and August 30, 1982, a heavy overnight rain occurred, which caused surface runoff to collect in the dump. This resulted in approximately 7,000 gallons of contaminated water. This water was removed using vacuum trucks and transported to the cleanup contractor's facility for treatment before disposal. Fifteen truckloads (approximately 208 tons) of material were excavated from the site and transported to a secure landfill. It was observed that three of the drums had entirely leaked their contents, which increased the chemical migration problem. On August 31, 1982, the Manila Creek drum dump site was secured and permanently closed to the public.

On September 10, 1982, the Ecology and Environment, Inc. Technical Assistance Team, sampled 72 of the drums. From September 11, 1982 to September 29, 1982, the site contractor obtained samples from all 77 drums in order to perform RCRA characterization of the contents. It was determined that 32 of the drums contained low pH liquids, which were bulked for disposal. Several drums contained high levels of cyanide and therefore required solidification before disposal (Ecology and Environment, 1982).

The RCRA characterization determined that the drums fall into four compatibility groups for solidification, transportation, and disposal. Characterization was reported as follows:

- Alkaline – cleaning waste with cyanide (11 drums)
- Alkaline – phenolic waste (3 drums)
- Dirt and clay with organics and solvents (11 drums)
- Cutting oils and organic solvents (10 drums)

All drums were emptied, triple rinsed, crushed, and transported to the cleanup contractor's landfill for disposal. The clean-up contractor was Browning – Ferris Industries.

The OSC stated that midnight dumping such as at Manila Creek would continue to occur as long as proper disposal is more expensive than illegal dumps and alternative end uses. Increased inspections and enforcement of preventative regulations would reduce the number of similar incidents occurring. The OSC concluded that increased public awareness and vigilance should result in quicker notification of similar potentially hazardous illegal dumps (U.S. EPA, 1982).

September 1984

Feasibility Study of Manila Creek Site, Monsanto Company, Corporate Engineering Department, 1985

This report was prepared by the Old Monsanto Corporate Engineering Department to review remedial action alternatives, and recommend an option that best meets concerns at the Manila Creek site.

In September 1984, NUS collected 19 surface soil samples, which were analyzed for 2,3,7,8-TCDD. Concentrations ranged from ND, or less than 1.0 ppb, to 57.2 ppb. Sampling was conducted primarily in the relatively unvegetated sections, and was chosen based on current site conditions, past sampling results, and lab space constraints.

Old Monsanto Engineering noted that the levels of 2,3,7,8-TCDD are probably due to industrial rubbish. It was noted that due to the nature and level of 2,3,7,8-TCDD in the soil and remote access to the site, there appears to be minimal threat to human exposure and the environment. Old Monsanto Engineering concluded that the problems fall into four categories:

- Air pollution
- Surface water infiltration or contamination
- Leachate generation
- Contaminated soils

Old Monsanto Engineering considered three remedial action alternatives:

- No Action - This action is attractive due to the nature, remote access, and slight degree of concentration of 2,3,7,8-TCDD. The minimal public health and environment concerns also make this an attractive option.
- Containment-Capping - This option is favored because it would effectively prevent migration of 2,3,7,8-TCDD from the source.
- Soil Removal - Excavation and removal of soil would eliminate exposure risks at that point. This action was the least desirable since there would be higher exposure to the workers, also due to the fact that there is currently no acceptable method for landfilling 2,3,7,8-TCDD contaminated soils.

Old Monsanto Engineering recommended that the site and sample point number 9 be capped with 6 inches of compacted clay, to effectively cap the area where 2,3,7,8-TCDD was identified. Twelve inches of topsoil will be placed in this area in order to re-vegetate. Old Monsanto also stated that water from the small pond should be removed. The pond bank should be modified to allow for drainage, and prevent ponding of surface water (Wilson, 1985).

April 28, 1983

Draft - Site Inspection of Manila Creek Dump, NUS, 1983

On April 28, 1983, the NUS FIT III team conducted a site inspection that included sampling Manila Creek dump site. NUS conducted the inspection and prepared a draft report for U.S. EPA under Contract No. 68-01-6699. WV DEP representative Pam Hayes, and Amherst Coal Company representative Douglas Peck were also present.

WV DNR has previously collected soil and surface water samples from the site. Analysis of samples indicated the presence of 2,4,5-T in on-site soils and nearby surface wells.

The NUS FIT III team obtained samples from nearby surface waters and sediments, leachate, on-site surface and sub-surface soils, and off-site background soils. An on-site auger was used to obtain samples from a depth of 0 to 6 inches. Analysis of these samples showed the presence of 2,3,7,8-TCDD at a concentration of 3.72 ppb. NUS noted that data from this draft report has not yet undergone a Quality Assurance review, and that the Toxicological Assessment is therefore under review.

Some of NUS's observations included:

- Except for an area approximately 30 feet by 60 feet, the site was entirely vegetated
- A hardened asphalt type material and scattered debris were observed on the surface of the unvegetated area
- Two black, highly viscous leachate seeps were observed near the northern perimeter of the site
- A slightly foul odor was present near the leachate seep; however, HNU readings of this area were not above background
- The two leachate seeps entered ponded water near the northeast portion of the site
- Acid mine drainage was observed just beyond the northern boundary of the site, and several abandoned strip mines in the surrounding area
- Moist fill material underlain by decomposed grey-black, cardboard material was observed at a depth of 3 feet bgs, at auger locations 1 through 4
- Subsurface HNU measurements at auger location 1 and 2 were 50 ppm and 140 ppm, respectively

- Ambient air HNU levels throughout the site did not exceed background levels of 0.2 ppm (NUS Corporation, 1983_2)

September 1984, December 1985, July 1986

<u>Feasibility Study of Manila Creek Site, Putnam County, WV, Monsanto Chemical Company, 1986</u>

This report was prepared by Old Monsanto to review remedial action alternatives, and to recommend the best option to address concerns at the Manila Creek Site.

In September 1984, 19 samples were collected from the relatively unvegetated area of the site, and analyzed for the presence of 2,3,7,8-TCDD. The samples were collected from the surface, at 0 to 12 inches, and at 12 to 24 inches. Results indicated that 2,3,7,8-TCDD ranged from non detect to 57.2 ppb.

A follow up remedial investigation was conducted in December 1985, to determine the depth and lateral extent of the fill. The investigation determined the dimensions are a depth of 20 to 25 feet, and area of 40 to 80 feet. The total volume of fill material was estimated to be 2,900 cubic yards.

In July 1986, an additional study was conducted to determine the source of water that was found perched in the fill. This study confirmed the results of the December 1985 investigation that concluded the source to be a coal seam. Results from both studies concluded that there is an approximately 20 to 25 foot thick, continuous layer of impermeable clay/flyash directly beneath the fill material.

Three remedial action alternatives were evaluated based on the results of the previous investigations. Alternatives included: no action, capping, and excavation. Concerns for the Manila Creek site were listed as air pollution, groundwater degradation, and soil degradation. Alternatives were evaluated based on potential for public exposure, current environmental conditions of the surrounding area, designing a permanent solution requiring little maintenance, minimizing worker exposure during construction, and cost.

Old Monsanto determined that the most favorable action for this site would be containment capping. This option was chosen due to the nature, remote location and size of the area, and the levels of 2,3,7,8-TCDD, which were detected during the investigation. Installation of a groundwater diversion, and a dewatering system was also recommended. As a result, the area where 2,3,7,8-TCDD was detected would be capped, and any movement of waste materials from the fill area due to groundwater would be eliminated (Wilson, 1986).

1987

Summary Report of Remedial Actions at Manila Creek Site, Project No. 127-06, ERM-Midwest, 1987

ERM-Midwest, Inc. prepared this report for Old Monsanto to address a consent order issued to Old Monsanto from U.S. EPA. This consent order was in regard to seeps that had been observed from a dike area at the Manila Creek Landfill site. An earthen dike and highwall surround the Manila Creek site. Waste was placed inside the dike on a layer of flyash. This site was undisturbed for many years, however, recently seeps have been observed from the dike area. The Consent Order required Old Monsanto to take action to eliminate the migration of waste from the site to protect human health and the environment.

An additional investigation was conducted simultaneously by REMCOR, to address different site issues. Numerous soil borings and two piezometers were installed to provide data to devise a plan for the remedial action. Data included waste characterization, waste and flyash depths, water levels and flow directions, and highwall location.

Results of the ERM-Midwest and REMCOR investigations are as follows:

- Dry flyash underlies the waste layer
- Perched water in the waste comes from mine seepage and surface infiltration
- The waste contains low levels of dioxin
- The highwall face is a steep grade with a coal seam near the base
- Numerous auger openings in the coal seem are located adjacent to the site
- The waste material varied in color ranging from tan to green, to gray and black. Some of the waste material from the boring cuttings has a resinous type consistency

Work performed at the site included:

- Safety training from July 29, 1987 to August 7, 1987
- Grubbing and clearing of the site from August 3, 1987 to August 10, 1987 and August 19, 1987 to August 20, 1987
- Drilling boreholes and dewatering from August 10, 1987 to August 20, 1987

- Spreading initial clay layer and site work from August 13th, 1987 to September 4, 1987
- Driving sheet piling from August 25, 1987 to September 14, 1987
- Site preparation for the high-density polyethylene cap from September 24, 1987 to September 23, 1987
- Installation of the high-density polyethylene cap from September 24, 1987 to September 27, 1987
- Covering cap with clay and topsoil from September 28, 1987 to September 30 1987
- Erecting fence and plant cover from September 30, 1987 to October 2, 1987
- Final cleanup and contract closeout from October 2, 1987 to November 2, 1987

Three remedial action alternatives were evaluated for this site, which included:

- No action
- Capping
- Excavation

Other issues considered to determine the best alternative were air pollution, groundwater degradation, soil degradation, potential for public exposure, current environmental conditions of surrounding area, designing a permanent solution, which requires little maintenance, minimizing worker exposure during construction, and cost,

Old Monsanto in a report entitled, Feasibility Study of Manila Creek, dated August 5, 1986 presented recommendations for the site to U.S. EPA. The Old Monsanto report recommended:

- Installing a groundwater diversion and dewatering system.
- Capping the fill area and ponded area with 12 inches of clay, and re-vegetating this area by adding 6 inches of topsoil. This effectively caps the area where 2,3,7,8-TCDD was detected, and eliminates any movement of waste materials from the fill area due to groundwater.
- Removing water from the ponded area, grading the pond banks, and capping the area.
- Installing a chain link fence around the site area (ERM-Midwest, 1987).

1.18 MIDWEST STEEL SITE

The site is located north of Armour Creek Landfill along State Route 25. The River flows along the northwest edge of the property. Sampling for 2,3,7,8-TCDD was conducted in May of 1999. The results of 11 to 14 soil samples ranges in concentration from 5.92 to 123 pg/g 2,3,7,8-TCDD. The remaining three samples were ND for 2,3,7,8-TCDD. Surface runoff from this site is likely a contributor of 2,3,7,8-TCDD to the River and Armour Creek.

1.19 NITRO PENCIL COMPANY (APPROX. 1920 – 1963)

The Nitro Pencil Company (Nitro Pencil) was located in the Explosive Plant "C", and made leads for lead pencils using natural graphite and clays that were mostly imported from abroad. Nitro Pencil was owned by the Joseph Dixon Crucible Company of Jersey City, NJ. The leads were used in Dixon and Ticonderoga pencils. The plant was entirely rebuilt after a disastrous fire in 1922 and operations continued until 1963.

1.20 NITRO SOAP FACTORY (1924 – 1930)

The Nitro Soap Factory was a fat-rendering outfit, which processed animal carcasses. The factory was located on the road leading to Rubber Services (U.S. EPA Region III, START, Reference 6, 2003).

1.21 NITRO MUNICIPAL LANDFILL

Also Known As:
Nitro City Dump
Nitro Municipal Dump
Poca Landfill
Poca Strip Mine Landfill
Poca Strip Mine Pits
Putnam County Drum Dump

The Poca Strip Mine Landfill is a surface mine bench located one quarter mile off Poca River Road, on an un-named tributary to the Pocatalico River. The site is approximately 3 miles east of Poca, WV, and received municipal and hazardous wastes in the late 1950's and early 1960's (WV DWR, 1984). During the period of 1962 to 1963, the landfill was known as the Nitro City Dump, and was used by the City of Nitro, FMC Corporation, Ohio Apex, and the Monsanto (Weston, 1999).

A Hazardous Waste Survey that was completed by Monsanto indicates that Monsanto used the landfill site in 1959 and 1960 to dispose of both open drummed and contained hazardous wastes. This report also states that open burning occurred at the site. Other documentation obtained by the WV Department of Water Resources (WV DWR), reports incidents of foam and scum on the River, and fish kills in the early 1960's (WV DWR, 1984).

As part of an investigation that occurred in approximately 1988, the ERM Group interviewed the landfill owner, Mr. Garnet Smith. During the interview, Mr. Smith indicated that chemical wastes were disposed in three distinct, separate areas known as: the open dump area, the chemical waste pit, and the drum storage area (ERM-Midwest, 1988).

Remedial investigations of the open dump area of the landfill focused on 2,3,7,8-TCDD. NUS conducted the first investigation under U.S. EPA Contract No. 68-01-6699; Monsanto performed an additional investigation to supplement and verify the NUS data and FMC conducted an investigation in April 1987 in response to U.S. EPA Docket No. III-87-12-DC (The ERM Group, 1988).

Monsanto conducted an RI of this landfill in order to determine the extent of dioxin contamination under a consent agreement in March 1986. Dioxin clean-up efforts and landfill capping were completed in the late 1980's (Weston, 1999).

March 30, 1983
Preliminary Assessment, Putnam County Drum Dump, WV DWR, 1984

The WV DWR, Hazardous Waste/Ground Water Branch completed this assessment.

The Putnam County Drum Dump is also known as the "Poca Strip Mine Pits". The site is located on an unnamed tributary to the Pocatalico River, approximately one quarter mile off Poca River road.

On March 30, 1983, an assessment of the site conducted by U.S. EPA and U.S. EPA Technical Assistance team. Follow-up sampling occurred on May 24, 1984.

Assessment of the site determined that chemical and municipal wastes were placed in the ravine and on the old surface mine bench. Drums were also placed in these areas, and no evidence of soil covering was observed. It was noted that most of the drums were badly deteriorated, and that portions of the dump have been burned at some point in the past. WV DWR reported that some of the drums must still be full, since they received reports from a nearby neighbor that he recently emptied some of the drums that contained liquids.

WV DWR determined that groundwater contamination is highly likely, due to the uncontained wastes and the presence of jointed and fractured bedrock. Although surface water contamination was not documented in the sampling, it was determined that it likely occurred due to the uncontained nature of the waste, and its availability for transport. On March 30, 1983, the U.S. EPA Technical Assistance Team installed air sampling pumps to evaluate a noticeable chemical odor present at the site. Results of sampling were not included, and therefore could not be summarized.

The first sampling event did not include the stream, and the second sampling event did not include soil and sediment, it was recommended that re-sampling be performed at the site. Soil, air, water, and sediment samples should be collected during re-sampling. It was also noted that although earlier sampling of the pond water tested positive for dioxin, no off-site contaminant migration has been documented.

March 13, 1985
Letter Report, Nitro Municipal Dump, NUS, 1985

The NUS FIT III performed a preliminary assessment and site reconnaissance of the Nitro Municipal Dump on March 13, 1985. FIT members met with Mr. George Garnet Smith, owner of the landfill, to obtain background information on the site.

The site is inactive, and was part of Poca Strip Mine Pits property, also owned by Mr. Garnet Smith. The site area is approximately one quarter acre in size, and was used for municipal and domestic wastes.

1.22 NITRO SANITATION LANDFILL (NITRO LANDFILL)

The Nitro landfill is located adjacent to the River. The Nitro Sanitation Landfill began operation in 1965 and was used mainly for the disposal of municipal waste through 1971, when operations ceased. During operation, FMC was permitted by WV DNR to dispose of industrial waste and plant refuse at the site. Wastes disposed in these drums included phenolic compounds, aryl compounds, heptane carbon filter cake, plasticizers, alcohols, ethers, and heavy metals. Dioxin was a contaminant of concern. The landfill is in the WV DEP's Voluntary Remediation Program and is undergoing cleanup. Homes have been purchased and currently 80% of the waste has been removed.

December 16, 1980

Field Investigation of Uncontrolled Hazardous Waste Sites, FIT Project, Nitro Landfill, Ecology and Environment, Inc., 1980

On December 16, 1980, a well located at the Mid West Corporation Facility was sampled by FIT, Region III. On December 17, 1980, the FIT III team took four soil/hazardous samples from the bank of the River.

Three soil samples were collected from the riverbank to determine if material is being leached from the landfill. Two pipes were observed to be discharging effluent near the north end of the landfill; this effluent was also sampled. Various used drums and scrap metal belonging to Mid West Corporation were observed in the landfill. Also observed were several burned and rusted drums containing charred material, and it was noted that refuse had been pushed to the edge of the River bank (Stone, 1980).

1980

Results of Site Investigation and Leachate Sample Analysis, Fred C. Hart Associates, Inc.

Fred Hart Associates, Inc. completed a site investigation of the Nitro Municipal Landfill to examine the nature and extent of potential ground and surface water contamination. Both soil and groundwater samples were taken for analysis.

From the laboratory results, it was concluded that there was no conclusive evidence that industrial waste products are present in the leachate of the Nitro Municipal Landfill. Also, assuming a dilution factor greatly in excess of ten, there was no indication of serious contamination of the River from this landfill (Hart Associates, 1980).

June 16 – 23, 1982

Field Trip Report of Nitro Sanitation No. F3-8108-14A, Ecology and Environment, Inc., 1982

Ecology and Environment, Inc. conducted an investigation of the Nitro Sanitation site on June 16, 1982 through June 23, 1982. Four monitoring wells were installed and soil and water samples were collected and analyzed. The results indicated contamination was present in groundwater under the site; however, dioxins were not detected.

Ecology and Environment, Inc. recommended the following actions be performed at the site:

- Continuous monitoring of groundwater quality
- Covering any exposed seeps or drums
- Performing regular checks for further outbreaks of drums and seeps (Ecology and Environment, 1982)

1983
Enforcement Review of Available Data for Nitro Sanitation, WV, NUS, 1983

NUS conducted a review of existing data for the Nitro Sanitation site to determine if enforcement action is required. It was concluded that the uncontrolled site is estimated to have accepted approximately 1,200 pounds of phenol (NUS Corporation, 1983).

Some of the key actions recommended by NUS include:

- Installing a security fence around the perimeter of the contaminated area
- Removing buried drums and shipping to appropriate disposal site
- Implementing a water and soil sampling program

October 18, 1985
Sampling and Investigation Report for the Nitro WV, Sanitation Site, 1985

On October 18, 1985, a site visit at the Nitro Sanitation site was made by the inspector, U.S. EPA Region III and WV DNR representatives, and the dump site coordinator. The purpose of this visit was to conduct air monitoring to evaluate the site and the possibility that releases from the site may be causing residents to be ill. HNU and OVA readings were obtained at the site, and ambient readings were not greater than 3 to 5 ppm. However, readings from sludge material and a resin-containing drum were taken and both were greater than 500 ppm on the OVA. Three deteriorated drums were found and three air samples were collected at these drums, which indicated 5 to 10 ppm for phenol. Most of the concern in the landfill appears to be the phenol, although smaller quantities of other contaminants seem to be present.

The inspector re-visited the site on October 23, 1985, as he was advised that it would be necessary to collect samples at the point of discharge from the storm drain. This was performed to determine whether leachate is leaving the site. Samples collected were analyzed for aromatics, volatiles, Polycyclic aromatic hydrocarbons (PAHs), and phenols. These samples were preserved and taken to the Guthrie Lab on October 24th, and their results will be included in a subsequent report (U.S. EPA Region III, 1985).

1988

Field Trip Report for Nitro Sanitation Landfill

NUS performed this work under U.S. EPA Contract No. 68-01-7346. The report was prepared in accordance with Technical Directive Document No. F3-8801-30 for the Nitro Sanitation site located in Nitro, WV.

On February 16th and 17th, three NUS staff members visited the Nitro Sanitation site. The purpose of the visit was to conduct a re-sampling of the site and perform a magnetometer survey to indicate where buried drums of waste may have been located (NUS Corporation, 1988).

1.23 POCA BLENDING, L.L.C. (1999 -)

Poca Blending, L.L.C. (Poca Blending) a full-service industrial chemical blending facility, is located in the Par Industrial Park off Plant Road, in Nitro. Poca Blending began operations in 1999 to produce chemicals to serve the coal mining industry. Services include: chemical formulation development; raw material storage; computer controlled blending; 5 gallon pail to 25,000 gallon railcar packaging, and bulk transportation via tank truck or railcar. The facility produces 23 million gallons of finished product annually. The following products comprise the majority of volume produced; inorganic salt-based freeze conditioning agents, glycol-based freeze conditioning agents; belt de-icers, and side release agents; alcohol based flotation reagents; water treatment polymers for thickeners, acid mine drainage, belt press dewatering, and effluent treatment; defoamers; process dust control surfactants; road dust control chemicals; railcar veneer treatment; and binders for coal briquetting/pelletizing. Poca Blending also produces specialty chemicals for use in the following industries: coke and steel production; refining/petrochemical; cement; iron ore mixing; and zinc oxide refining (Poca Blending, 2002).

1.24 RALEIGH JUNK COMPANY

The Raleigh Junk Company is located on the north bank of the River along Route 25 in Sattes, WV, east of the Nitro/St. Albans Bridge. The site is a 12-acre active scrap yard bounded to the south by the River, to the north by a railroad bed, and is fenced to the east and the west (Hass, 1995).

The site was owned by Jerome Goldberg and used as a junk and salvage yard from approximately 1949 to 1960. The Raleigh Junk Company purchased the property in 1960, use of this site prior to 1949 is unknown (NUS Corporation, 1988_2).

Raleigh Junk Company purchases scrap metals from the Kanawha Valley, and other facilities in WV and outside states. The facility has previously purchased scrap metal from Allied Chemical in Ironton, Ohio, and from Monsanto and UCC (Robertson, 1985). In April 1985, a Raleigh Junk Company employee received dermal burns from an unknown substance, coated on metallic scrap shipped to the yard from the Allied Chemical Plant in Ironton. An Investigation conducted by WV DEP revealed that the Ironton Plant was a Superfund site, and that the unknown material was residue from coal tar products residue (Robertson, 1985).

Various types of metals are shipped to the junkyard, and sorted on site. Materials observed on site by NUS during an August 1987 inspection included drums, railroad tank cars, batteries, electrical transformers, copper, brass, and aluminum metals (NUS Corporation, 1988_2). A preliminary assessment of the junkyard prepared by WV DNR stated that there are several hundreds of batteries stored in a building near the entrance to the facility. Spillage from the batteries is visible, and an acid odor is present inside the building. WV DNR also noted the presence of an unknown sludge material in several areas of the yard. A burning ground is located near the office buildings, where approximately 200 drums were found. The source and contents of the drums were unknown. Other waste materials observed on site include a sludge type material contained in process lines, an old Monsanto tanker, filter media, and several large tanks, one of which contained a black sludge-like material caked on its inside (Blake, 1987).

Documentation shows that sulfuric acid and coal tar are present at the site. Other possible contaminants include PCBs, dioxin, solvents, acids, metals, pesticides, and other organic compounds. There is the possibility of a fire or explosion due to other wastes that may be explosive. The potential for injury is great, since there has already been one documented injury of an employee, and also there is a concern of injury to the public, since the site is not secured, and there are homes and businesses nearby (Blake, 1987).

April 6, 1985

Incident Report, Burns received by Leroy Whit after handling scrap metal from Allied Chemical Plant, Ironton, OH, WV DNR, 1985

WV DEP received a telephone call on April 27, 1985 from the Putnam County Sheriff's Department to inform them that an employee of Raleigh Junk Company had been hospitalized after receiving burns on his arms and face from handling metal grating. The metal was heavily coated in a tar like substance, and had been shipped to the yard from Allied Chemical in Ironton, Ohio.

Investigation revealed that the Allied Chemical Facility at Ironton was a Superfund site that had been sold on two different occasions, and then re-purchased by Allied. The WV DEP contacted the corporate office and spoke to representatives at the Ironton facility who reported that the substance was a "coal tar products residue". It was reported that the material was possibly present on the grating as a result of employees scraping their feet on the gratings after walking through process areas. The Allied Chemical representative stated that the material had no acute toxic effects, and is a by-product of coke manufacturing. Allied Chemical treats the coal tar as a hazardous waste and transports the coal tar to a secure landfill in Michigan for disposal.

WV DEP inspected the Raleigh Junk Company Yard on April 6, 1985. An HNU was used to take readings of the material on the metal grading, and were reported as 0.1 to 0.3. As a result, WV DEP advised Raleigh Junk Company to place the contaminated material in an area where it could not be handled.

WV DEP inspectors returned to the site on April 8, 1985 to collect samples of the material on the gratings and inside a process line. They reported that following analysis of samples, they will advise Raleigh Junk Company of how to dispose of the materials properly. The Raleigh Junk Company employee was hospitalized for several days for burns to his face, arms, and eye area (Robertson, 1985).

August 1987

Site Inspection of Raleigh Junk – Sattes, NUS, 1988

In April 1985, WV DNR investigated an accident at the Raleigh Junk Company facility in Sattes, WV. A Raleigh Junk Company employee received dermal burns from an unknown substance that was found coating some metallic scrap. The scrap had been shipped to the yard from Allied Chemical, located in Ironton, Ohio. WV DNR obtained samples of the material, which was identified by a laboratory as coal tar residue. This material was shipped as a hazardous material back to Allied Chemical for disposal.

NUS conducted a site inspection of the Raleigh Junk Company – Sattes facility in Kanawha County in August 1987. This work was performed under U.S. EPA Contract No. 68-01-7346, and was prepared in accordance with the Technical Directive Document No. F3-8707-23.

NUS collected nine soil samples, including a background and a duplicate. Split samples were also collected, and the site was photographed. Observations made at the site include the following:

- No HNU readings were above the background reading of 0.2 ppm (200 ppb).
- The radiation mini-alert was on the X1 position; no readings above background were recorded.
- The entire facility was actively used as a scrap yard and huge piles of metallic scrap were observed throughout the yard.
- A dirt road circled the scrap yard.
- Two to three transformers and transformer parts were observed on the extreme southwestern corner of the facility.
- Stained soil was observed near the transformers and two surface soil samples, one composite and one of the stained soil, were collected from the area.
- An area of stained soil was observed on the site perimeter road west of the barge dock and a soil sample was collected from the stain.
- A 6 inch pipe that seemed to be a discharge pipe was observed on the river embankment east of the barge dock. The pipe appeared to lead toward the middle of the site. A soil sample was obtained from the pipe's point of discharge.
- Three drainage patterns were observed in the soil near the river bank. Soil samples were obtained from each area.
- The riverbank was approximately 30 feet high, very steep, and heavily overgrown (NUS Corporation, 1988_2).

August 26, 1987
1987 – Site Visit Summary Report for Raleigh Junk Company – Sattes, NUS

NUS conducted a site inspection of the Raleigh Junk Company – Sattes site on August 26, 1987. NUS was accompanied by Robert Levine and Bud Simmons of Raleigh Junk during the inspection.

A total of seven solid samples were obtained, including duplicates and blanks. Several deviations from the sampling plan were noted, which included:

- No aqueous and sediment samples were obtained from the River because of the steepness of the embankment and the hazards present on the embankment. Embankment hazards include scrap metals and vegetation.
- Only three drainage pathways were identified and sampled during the site inspection.
- Only two surface soil samples were obtained. The majority of the site's surface soil was covered with scrap metal and the surface soil that was not covered was highly compacted from heavy equipment use.

The site visit summary report concluded with the following observations:

- The HNU was used during the pre-sampling site reconnaissance and sampling. No readings above the background reading of 0.2 ppm were recorded.
- The radiation mini-alert was used during the site inspection. The meter was on the X1 setting and no readings above background were recorded.
- The entire yard was actively being used as a junkyard. Metallic scrap was observed throughout the site and numerous cranes and crushing machines were being operated.
- The site is bordered on the east and west by fences, on the north by a railroad track, and on the south by the River.
- Two or three electrical transformers were observed on the northwestern corner of the property, and numerous oily stains were observed nearby. Two surface soil samples were obtained in this area.
- The site slope is nearly flat but three drainage patterns were observed leading into the River.
- Residential/commercial zones surround the site on three sides (NUS Corporation, 1987).

October 26, 1988
<u>Investigation of Complaint at Raleigh Junk, Sattes Yard, WV DEP, 1988</u>

On October 26, 1988 WV DEP investigated a complaint at the Raleigh Junk Company Facility that some materials were being stored in the basement of the office building, and also in a tank on site. The inspectors were unable to locate the tank, however were able to locate the materials in the basement of the office building, which included 20 to 39 five gallon cans, and 30 to 40 fifty-five gallon drums, contents of which are unknown.

The Inspectors spoke to James Noffsinger, Foreman, who advised them that there were possibly 4 or 5 drums of paint received from Kaiser Aluminum of Ravenswood, approximately 10 years ago. It was noted that these materials could possibly be hazardous. Some of the containers were marked with a variety of labels; however, Mr. Noffsinger could not identify them.

The WV DEP Inspectors requested that the materials not be moved until they could be sampled, and identified (Robertson, 1988).

December 10, 1996

Summary of Site Investigation and Remediation Activities, Raleigh Junk Company, Sattes, 1996

TERRADON Corporation (TERRADON) prepared this report on behalf of the Raleigh Junk Company in response to a Multimedia Compliance Evaluation Inspection conducted by WV DEP at the Raleigh Junk Company site on April 19, 1995. The inspection noted areas of concern at the site, and cited Raleigh Junk Company for failing to make determination on a number of wastes generated and stored at their facility.

TERRADON has summarized the major investigative and corrective activities that have occurred to date at the site into the following categories:

- The "ELMER" Tank: A tank with the word "ELMER" written on one end was found in the northeastern area of the site. Mr. Elmer Fike was contacted and identified this material as lauryl alcohol/soap mixture that could be used as a hand soap. A sample was collected from the tank for analysis. The sample was not analyzed for dioxin.

- The "UCAR" Tank: A railroad tank car containing residues, and identified as "UCAR" is located in the northeastern area of the site. A sample of the residue was scrapped from the bottom of the railcar for analysis. The sample was not analyzed for dioxin.

- Petroleum Hydrocarbon Impacted Soil:

  Non-Operating Baler
  A 2000-gallon aboveground storage tank (AST) is located in the southwest center of the facility at the non-operating baler. The AST is used for diesel fuel storage. Stained soil was observed around this tank, and was excavated and placed in an on-site bio-cell for remediation.

  Petroleum Release Site – River Bank
  On June 6, 1996, a release of petroleum to the River occurred. Emergency response activities included placing containment booms in the River, excavating impacted soil from the Riverbank and placement in an on-site bio-cell for remediation, evacuation of drain lines, plugging of drains in the basement of the office/warehouse building, and collection of samples for analysis.

The following samples were tested for dibenzofuran and 2,4,5-T. They were all reported as ND.

- River Inside Boom (Sample ID 9612976)
- River Outside Boom (Sample ID 9612977)
- Pit #1 and Pit #2 (Sample ID 9612978)
- Bailer (Sample ID 9612979)
- Fill Discharge (Sample ID 9612980)

TERRADON concluded that no corrective action is recommended for the site (TERRADON, 1996).

1.25 REPUBLIC STEEL CORPORATION CONTAINER DIVISION

Republic Steel Container Corporation (Republic Steel) is located on Viscose Road in an industrial section of Nitro, WV. The facility consists of approximately 5 acres, and manufactures 55-gallon steel drums. Fike Chemicals is located along the north boundary, the railroad and State Route 25 are located to the east, NAPA Auto Parts Distribution Center is located to the west, and vacant land is located to the south. The U.S. government owned the property prior to 1957 (WV DNR, 1984).

The areas of concern at this facility are three unlined pits that were used for the disposal and burning of on-site wastes from 1958 to 1963. Two of the pits are located on the northern boundary of the site, and the other is located in the northeast corner. Site representatives stated that housekeeping wastes such as paint sludge, thinner, solvent, and plant trash were disposed in the pits. There may also be drums buried in the pits, however they would be open and would contain the same material that is located in the pits (NUS Corporation, 1985_2). The pits were filled, graded, and seeded in 1963 (WV DNR, 1984).

May 11, 1984

<u>A Preliminary Assessment on Republic Steel Corporation Container Division, Nitro, WV, WV DEP, 1984</u>

On May 11, 1984, WV DEP inspector, Pamela Hayes conducted a preliminary assessment of the Republic Steel facility in Nitro, WV. The area of concern for this investigation was the disposal pits that were utilized prior to the implementation of RCRA hazardous waste requirements.

Republic Steel is located on Viscose Road in Nitro, and manufactures 55-gallon steel drums. On May 13, 1983 a compliance evaluation inspection was completed at this facility, which determined that the facility produces hazardous wastes. Wastes handled presently include D001, F017, and K078. Other wastes that have been reported to be placed in the pits include F003, F005, and D001 (WV DEP, 1984).

1985

<u>Non-sampling Site Reconnaissance Summary Report, Republic Steel Corporation, Nitro, WV, NUS</u>

In November 1984, NUS visited the Republic Steel site in Nitro, WV, to conduct a site reconnaissance. The following observations were made:

- HNU background readings were 0.2 ppm. There were no readings above background. The radiation mini-alert was set at x1.
- Pit 3 has an area of stressed vegetation.
- There were 5 drums on a concrete slab. Three of the drums had paint filter pads in them.

It was concluded that U.S. EPA should take no further action at this time. Waste was found to be present in the pits; however, there were no receptor targets that would be affected by waste disposal on the site. There is little chance of direct contact, since the waste is covered with 2 to 3 feet of cover material, and a fence surrounds the site. It was also noted that since the site is located in an industrial section of Nitro and it would be difficult to determine if waste from the site entered the environment. It was determined that there are no sampling locations that would provide more information about the waste (NUS Corporation, 1985_2).

1.26 SEYDEL CHEMICAL COMPANY (EARLY 1921 - 1932)

Seydel Chemical Company (Seydel) began operation in Nitro in 1921 (U.S. EPA Region III, START, 2003), and manufactured benzoic acid by oxidation of toluene with nitric acid. This process was a batch reaction with a by-product of trinitrotoluene (TNT). In 1928, the plant ceased operations for several months after the main autoclave exploded, hurling pieces of metal and building materials into the residential section of Nitro (Johnston, 1977).

The facility was later re-opened under new management and began producing pharmaceutical chemicals. The plant closed permanently in January 1932 after a severe fire (U.S. EPA Region III, START, 2003). Fike Chemicals is now located on the site of the old Seydel Plant (Johnston, 1977).

1.27 VIKING LABORATORIES (LATE 1920'S – EARLY 1930'S)

Viking Laboratories was a short-term operation located in the Explosives Plant "C" area in Nitro, WV in the late 1920's and early 1930's. Viking Laboratories was a petroleum cracking plant, which used a large quantity of mercury as a heat transfer agent (Johnston, 1977).

1.28 VIMASCO CORPORATION (1955 -)

Vimasco Corporation has been in operation in Nitro since 1955. The facility manufactures specialized insulation-related coatings and adhesives, fire-retardant cable coating, shipyard-related products, products for nuclear applications, asbestos abatement products, and log home chinkings (Vimasco, 1998).

1.29 WINFIELD LOCKS AND DAM

November 13, 1987
Letter from U.S. EPA Region III to Robert E. Lee, U.S. ACE: Final Environmental Impact Statement Kanawha River Navigation Study Winfield Lock Replacement, Interim Feasibility Report – September 1986

The purpose of this letter was to inform the United States Army Corps of Engineers (U.S. ACE) that U.S. EPA concurred with the selection of Plan A, which is to build a new 110 x 800 foot lock. This lock will be adjacent to the existing lock structure at Winfield.

U.S. EPA stated that they are satisfied that only approximately 12% or 360,000 cubic yards of the estimated 3 million cubic yards of material to be excavated, will be excavated by dredging the River channel. They also expressed concern that approximately 10%, or 36, 000 cubic yards of the dredged material contains dioxins and other toxic materials.

U.S. EPA stated that dioxin has been found in the sediments of the Pocatalico River and Armour Creek in concentrations of ppb, which is considered significantly high for this very toxic substance.

A report entitled "Data Validation of Kanawha Sediment Sample Results for 2,3,7,8-TCDD by High Resolution Gas Chromatography/High Resolution Mass Spectrometry was included with this letter. Attention was drawn to samples 10, 10A, collected from the Pocatalico River, and 16A, collected from Armour Creek. All three of these samples reported concentrations of dioxin in the ppb range.

It was concluded that it is imperative that U.S. ACE coordinated and consulted with U.S. EPA and WV DEP before any of the contaminated dredged material is disposed (Alper, 1987).

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WV DEP, 2003. Letter to Jon W. McKinney, Plant Manager, Flexsys, from Belinda Beller, Permitting Section, WV DEP, Re: Permit Application No. WV0000868 Putnam County, WV.

WV DWR, 1984. Preliminary Assessment, Putnam County Drum Dump.

APPENDIX D

FIELD NOTES

"Rite in the Rain"®

ALL-WEATHER
LEVEL
Notebook No. 311

Book 1 of 1

8602431.001 0201
Kanawha River surface water
Sampling -- Field oversight
October 2004

10/11/04 8602431.001 0201 1 of 2

David Lamadrid

weather: morning - low 40's fog
afternoon - 50s - 60s sunny

High volume surface water sampling

0830 onsite. meet Shelly Gould (CRA) & Tom Pile (Lawendall). Tom will be boat operator

0945 Tony Ethier & Jeanette Bedard from Axys onsite. View boat and check some onsite equipment arrived via Fed Ex

1030 Shelly Gould presented site safety meeting

1200-1300 Lunch

1300 Axys crew begin decon of pump equip. no methanol onsite (to be shipped in) so final decon to wait until shipment arrival

1400 William Huggins (Ecology & Environment) and Dennis Matlock (EPA) onsite

1530 Axys crew picked up pesticide grade methanol locally @ at supplier. Completed decon of equipment, w/ Final flush using DI water (lab provided)

10/11/04 8602431.001 0201 2 of 2

1330 Crew from Normandeau arrived onsite for fish sampling

1615 Health & Safety meeting for crew arriving mid-day or later

1700 Crew from CRA, Exponent, and Axys got on boat to view sampling locations RM46 down to RM31

1920 offsite

D.L.
10/11/04

10/12/04 8602431.001 0201 1 of 7

David Lamadrid
High volume surface water sampling (RM46)
weather: morning - 40's, foggy
afternoon - 60s-70s sunny

0700 onsite. meet Jeff Daniel (CRA) and ~~(Monsanto)~~

0715 Axys crew onsite (Tony E. / Jeanette R.)

Fog expected to lift in about 1-2 hrs.

- Received depth profile infor. from shelly Gould for ~~sta.~~ stations at RM 42 & 46. will start RM 46 today
- Jeff Daniel will need to clarify w/ laboratory exactly how to collect MS/MSD samples.

0930 mob to RM 46 station. ≈ 40' from left bank looking upstream
H_2O depth to mudline = 17 feet
Tube intake depth = 4 meters

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D. Lamadrid / Tony Ethier / Jeanette Bedard

0950 Calibrate Horiba U-20 water quality meter w/ Auto cal solution

pH	3.99	
cond	4.78	mS/cm
temp	1.6 °C	
turb	-2.4	NTU
DO	16.72	mg/L
ORP	+310	mV

1000 new filters installed. start pumping @ ≈ 1.7 l/m. Adjust to ≈ 2 l/m. Column filter ID L7246-1

1015 measure H_2O quality. Probe insert ≈ 1' below water level

pH	~~5.73~~ DL 10/12/04 6.79	
cond	0.158	mS/cm
temp	6.4	°C
DO	17.2	mg/L
redox	342	mV
turb	69.0	NTU

1100 38.39,423 -81.83511 Lat Long

1100 Discussed w/ Jeff Daniel how to collect ~~spill~~ split samples for RM 42 station

10/12/04 8602431.001 0201 3 of 7

D. Lamadrid / T. Ethier / J. Bedard

Dual inline ~~particulate~~ resin DL 10/12/04 filters will be used. ~~Dissolved phase resin~~ Particulate filter will not be duplicated. This method will reduce flow rate by ≈ 1/3, so sampling rate/time to sample will take estimated 11-12 hrs.

After 125 l pumped, raised tube intake to 1 meter depth

1209 Finished first quadrant section @ RM 46. @ 250 l pumped

1220 set up @ 92' ≈ from left bank mudline @ 17.1 feet

Tube intake @ 4 meters

start pumping @ ≈ 2 l/m

1325 raised tubing ~~to~~ intake to 1 meter @ 125 liters pumped (375 l cumulative)

1355 water quality measurement probe placed 1' below water surface.

pH	~~6.89~~ DL 10/12/04 7.11	
cond	0.153	mS/cm
temp	7.3 °C	
DO	18.8	mg/L
redox	+291	mV
turb	54.7	NTU

D. Lamadrid / T. Ethier / J. Bedard

1410 NOTE: Sample bottles for TSS, TOC, & DOC have not yet arrived from STL laboratory. Suppose to collect 3 times a day. Jeff Daniel indicated in lieu of laboratory-provided sample bottles, ok to pour out plastic 12-oz drinking water bottle & sample for TSS.

Sample SW-31884-DL-10/12/04-002
Grab sample by dipping in at top at water surface

18' accuracy
Lat/Long N 38.39385° W 081.83532°

1426 off power 500 l purged. Mob to
~~10~~ 3rd station @ RM 46
1435 start pumping @ ≈ 2 l/min
Depth to mudline = 20.5 feet
sample tubing intake ≈ 5 meters

Lat/Long N 38.39307° 49' accuracy
W 081.83611°

1535 pull up tube intake to 1.25 meters below water level at ~~??~~ 650 liters

D. Lamadrid / T. Ethier / J. Bedard

1600 water quality check
pH 7.24
cond 0.151 mS/cm
temp ~~7.8~~ 7.6 °C DL 10/12/04
DO ~~4~~ 17.9 mg/L
redox +324 mV
turb 48.8 NTU

1640 stop @ 750 liters; move to last station near right bank

Depth to mudline = 18.7 feet (5.7 meters)
Initial intake depth = 4.5 meters
1647 start pumping @ ≈ 2 l/min
Lat Long N 38.39288° 32' accuracy
W 081.83635

1750 raise intake to 1.2' below water surface @ 875 liters
1800 water Quality Measure
pH 7.39 DO 17.7 mg/L
cond 0.150 mS/cm redox +346 mV
temp 7.5 °C turb -5 NTU (?)

10/12/04 8602431.001 0201 6 of 7
D. Lamadrid / T. Ethier / J. Bedard
1810 recheck calibration w/ autocal solution
pH 4.06
cond 4.89 mS/cm
turb 36.4 NTU
DO 15.36 mg/L
temp 8.6 °C
redox + 341 mV

1815 collect SW-31884-DL-10/12/04-003
Grab surface water sample for TSS analysis similar to described earlier this day, used empty 12-oz drinking water bottle since bottles from lab have not arrived onsite
1853 End pumping / sampling @ 1,000 liters. Did not need to change any filters due due stabilized back pressure readings below 7 psi
1855 collect SW-31884-DL-10/12/04-001
wrap particulate filter double foil, methanol rinse on inner foil, in plastic bag
Resin filter in original plastic bag, capped ends, placed in original box

10/12/04 8602431.001 0201 7 of 7
D. Lamadrid / Tony Ethier / J. Bedard
1900 - 1945 Back to dock, unload, decon equipment
① Alconox + tap system flush
② tap water flush
3 ~~②~~ methanol system flush
4 ~~③~~ DI water flush
some individual SS fittings cleaned by same procedure
1945 - 2015 sample documentation (COCs, sample labels). samples placed on ice, taped cooler
Relinquished samples to CRA
Samples stored in CRA trailer

Samples collected this date
SW-31884-DL-10/12/04-001 (1855) RM 46
- particulate filter
- resin filter
SW-31884-DL-10/12/04-002 (1410) RM 46 stage 2
- 12 oz poly bottle (TSS)
SW-31884-DL-10/12/04-003 (1815) RM 46 stage 4

DL 10/12/04

10/13/04 860 2431.001 0201 1 of 6
David Lanadi d / Tony Ethier / Jeanette Bedard
High volume surface water sampling (RM 42)
weather: morning - cloudy 40's
afternoon - ~~few~~ showers 60's
late afternoon - rain 60's; lightening late
0700 onsite Shelly Gould, Jeanette Bedard
Tom (from Lou Wendell

0700-0730 load equip
0750 Arrive @ RM 42 sampling location
Approx 50' from left bank looking upstream
midline @ 16.9' (5.2 meters)
Intake @ 4.1 & 1.0 meters · first @ 4.1 m
N 38.44024 W 081.84666 24' accuracy
0810 Calibrate Horiba U-20 water quality
meter w/ Auto Cal solution

pH	3.98	
cond	4.69	mS/cm
temp	3.0	°C
DO	16.99	mg/L
redox	+338	mV
turb	0.0	

10/13/04
RM42 STAGE 1 8602431.001 0201 2 of 6

pH	6.37	(stabilized ?)
cond	0.188	mS/cm
temp	5.4	°C
DO	17.2	mg/L
redox	+342	mV
turb.	67.7	

0830 start pumping @ stage 1. Dual resin
filter installed for duplicate sample
Intake @ 4.1 meters. 8 stages
across river transect planned, ~~std~~
RM 42 near Flyxis Plant

925 raise intake to 1.0 meter. Prior to
raising, equilized discharge from
dual resin filters @ ≈ 1.5-1.6 l/min
@ max rpm. stabilized @ ≈ 1.4 l/min
1010 move to stage 2 after 125 gal pumped
≈ 150' from left bank
midline = 19.3 ft. (5.9 meters
Intake @ 4.7 and 1.2 meters
Intake @ 4.7 meters initially
N 38.44049° W 081.84680 16' accuracy
1050 Raise Intake to 1.2 meters after
137.5 liters

1140 move to stage 3 @ 250 l pumped
mudline = 20.5 feet (6.8 meters)
Intake @ 5.5 & 1.4 meters
N 38.44062° W 081.84717 32' accuracy
Initial intake @ 5.5 meters

1210 water Quality measure, probe 1' below
water surface
pH 7.50 DO ~~17.9~~ 18.8 mg/L
cond 0.182 mS/cm redox + 360
temp 6.3 °C turb 6.5

1228 Adjust intake to 1.4 meters @ 312.5 l
1245 collect SW-31884-DC-10/13/04-001
1 500 ml poly TSS unpreserved
3 VOA vials TOC sulfuric
3 VOA vials DOC sulfuric

Grab sample, bottles dipped in water surface.

NOTE: Bottles just arrived on boat by
Shelly Gould.
1311 move to stage 4 near midstream @ 375 l
mudline = 21.8 feet (6.6 meters)
Intake @ 5.3 ~~&~~ 1.3 meters
N 38.44077 W 081.84727 21' accuracy

~~stage~~
1320 start @ stage 4, Intake 5.3 meters
1355 raise intake to 1.3' @ 437.5 l
1440 stage 5. move to location @ 500 l
past mid channel
mudline @ 22.9 feet (7.0 meters)
Intake @ 5.6 + 1.4 meters
1445 start pumping, intake @ 5.6 meters
1530 collect SW-31884-DC-10/13/04-002
0000 collect SW-31884-DC-10/13/04-003
(duplicate RM-42 stage 5)
each sample:

500 ml poly; unpreserved; TSS
3 VOA vials; sulfuric; TOC
3 VOA vials; sulfuric; DOC

1535 raised intake to 1.5 meters ~~@ 567 liters~~
1610 stage 6, move to location @ 567 liters
mudline = 21 feet
Intake @ 5.5 and and 1.5 meters
1700 raise intake to 1.5 meters

stage 6 N 38.44109 W 081.84800
15' accuracy

1535 pH 7.55
cond 0.178 mS/cm
temp 6.3 °C
DO 18.5 mg/L
redox +345
turb 2.0 NTU

1737 stage 7 move to location @ 750 liters
mudline 21.5 feet (6.61 liters)
Intake @ 5.2 + 1.3 meters
Initial intake @ 5.2 liters
1743 start pumping
1730 heavy rain / thunder-lightening developing
1800 CRA decide to stop sampling
end @ 77.5 gallons @ stage 7;
decision confirmed w/ Jeff ~~Daniel~~ Daniel
1800-1900 head back + unload
1900 collect SW-31884-DL-10/13/04-004
particulate filter
resin filter
0000 duplicate SW-31884-DL-10/13/04-005
resin filter

1900-2000 decon equipment using
following procedure:
① Alconox + tapwater flush
② tap water flush
3 ~~②~~ methanol flush
4 ~~③~~ DI water flush
some individual ss fittings also
cleaned individually same procedure
2000-2030 Sample prep + storage
on ice in CRA trailer

2030 offsite

NOTE: two samples collected
yesterday in 12 oz water bottles
placed in laboratory provided by
laboratory that arrived today
~~Both~~ Each sample placed in
250 ml poly bottles (unpreserved)
+ 2 40 ml vials (H_2SO_4)
Approved by Jeff Daniel

DZ. 10/13/04

10/14/04 1 of 6

8602431.001 0201

David Lamadrid/Jeanette Ledford (RM33)

High volume surface water sampling

weather: morning - overcast; 40s; light rain

afternoon - overcast; 50s-60's

0700 onsite

0700-0845 Load & travel to RM 32.9.

River mile flag @ 32.9 RM

Stage 1 @ ≈ ~~150~~ 100 ft. from left bank looking upstream. Tried to contact Shelly Gould to find out distances from bank, but not available

N38.54400 W081.88822 36' accuracy

~~mudline~~ = 32.5 feet (9.9 meters)

Intake @ 8 & 2 meters

Initial intake @ 8 meters

0905 Calibrate Horiba U-20 water quality meter w/ Auto Cal solution

pH 3.98 DO 17.57

cond 4.72 mS/cm redox +343

temp 3.1 °C turb -1.6 NTU

10/14/01 8602431.0010201 2 of 6

0920 Install 27248-2 column filter

00141 ID

new particulate filter

0917 start pumping. Adjust to 2 l/min

0935 collect SW-31884-D2-10/14/04-001

grab surface water sample.

1 250 ml poly unpreserved TSS

6 40-ml vials H_2SO_4 TOC/BOC

Fill poly then pour into vials;

0940 measure water quality. Probe

≈ 1 ft below ~~sed~~ water surface

pH 7.69 DO 16.9

cond 0.174 mS/cm redox +392

temp 6.4 °C turb 57.3 NTU

1025 raise intake to 2 meters @ 125 l

1130 end stage 1 @ 250 l

move to stage 2

N38.54379° W081.88638° 18' accuracy

1150 Set up on stage 2 11.9 meters

mudline @ ~~38.5~~ 39.0 ft. (11.7 meters)

Intake @ ~~8.9~~ 9.5 & ~~2.2~~ 2.3 meters

1157 start pumping @ ≈ 2 l/m
1305 raise intake to 2.3 meters @ 375 l

1405 End stage 2 pumping @ 500 l

1410 move to stage 3 just on S. side of mid channel
mudline = 33 ft (10.1 meters)
Intake @ 8.0 and 2.0 meters

start pumping @ ≈ 2 l/min
N 38.54340° W 081.88611 22' accuracy

1430 collect SW-31884-DL-10/14/02-002
2 250-ml poly; unpreserved; TSS
9 40-ml vials; H_2SO_4 TOC/DOC
Extra volume for MS/MSD
grab samples; filled poly bottle from side of boat and filled vials.

1435 water quality measure:
pH 7.78 redox +332
cond 0.193 mS/cm turb 5.5
temp 4.1 °C
DO 18.6 mg/L

1325 Raise intake to 2 meters
1352 switch valve to change particulate filter
NOTE: pressure valve has been reading high all day w/ slowly reduced pumping rate; compensated for by increasing RPM to maintain 2 l/min. Switching to secondary filter did not lower pressure, so problem may be with the column filter, which cannot be change during the sampling

1632 stop pumping @ 750 l; move to stage 4
1637 setup @ stage 4 ≈ 150' from right bank (looking upstream)
mudline 24.5' ft (7.5 meters)
Intake @ 6 + 1.5 meters
initial setting @ 6 meters
1640 start pumping @ ≈ 2 l/min

1745 raise intake to 1.5 meters

10/14/04 8602431.001 0201 5 of 8

1825 water Quality measure; probe inserted
≈ 1 ft below water surface
pH 7.78 DO 18.7
cond 0.197 mS/cm turb, 14.6 NTU
temp 3.8 °C
redox +332

1830 collect SW-31884-DL-10/14/04-003
1 250-ml poly; unpreserved; TSS
6 40-ml vials; H_2SO_4; TOC/DOC

grab surface water sample; dipped
poly bottle in river surface + filled
40-ml vials

1847 end pumping @ 1,000 liters

1900-2000 travel back to dock

2000-2045 unload + take of filters from
high volume pump

2045 collect SW-31884-DL-10/14/04-004
2 particulate filters
1 column resin filter

2045-2130 sample prep + decon equipment

10/14/04 8602431.001 0201 6 of 8

Decon using 3-stage method
1 Alconox + Tap water flush
2 methanol flush
3 DI water flush
some individual SS fittings ~~decon~~
decond same procedure

2130 offsite

DZ
10/14/04

10/15/04 ~~8602431.001 0201~~ 1 of 4

8602431.001 0201

David Lamadrid/Jeanette Bedard RM 31

High volume surface water sampling

weather: morning ~~ovc~~ - overcast, 40's
afternoon

0700 onsite

0700-0810 Load equip + prep

0810-

0915 calibrate Horiba U-20 meter w/
auto cal solution
pH 3.98
cond 4.82 mS/cm
temp -0.72 °C (error?)
DO 18.87 mg/L
redox +348
turb. -2.0 NTU

0945 Set up @ RM 31
stage 1 @ ≈170' from right bank looking upstream. lots of barge traffic this am so starting @ right bank
mud line = 29.5' ~~&~~ (9.0 meters)
Intake @ 7.2 + 1.8 meter depth

10/15/04 8602431.001 0201 2 of 4

new filters installed.

N38.52899 W081.90661 15' accuracy

1025 water quality measure
pH 7.75 DO 19.6 mg/L
cond 0.183 mS/cm redox +387 mV
temp 3.32 °C turb 8.7 NTU

1018 start pumping stage 1; adjust to 2 l/min

1030 Collect SW-31884-DC-10/15/04-001
1 250-ml poly; unpreserved; TSS
6 40-ml vials; H_2SO_4; TOC/DOC

Grab sample; ~~dip~~ poly bottle dipped in water surface + poured into vials

1120 Raise intake to 1.8 meters @ 125 l

NOTE: Heavy wind causing boat to drift. Have to reposition a few times back to original spot

1225 End pumping stage 1 @ 250 l

1235 Setup on stage 2 (from right bank)
mud line = 23 ft (7 meters)
Intake @ 5.6 + 1.4 meters
Initial intake @ 5.6 meters; 2 l/min
N 38.~~52~~971 W 081.90659 16' accuracy

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1350 raised intake to 1.4 meters @

1450 move onto stage 3 ≈ mid channel/
mudline = 22 ft. (6.7 meters) @ 500 l
Intake @ 5.4 + 1.3 meters
initial intake @ 5.4 meters
N38.53012 W081.90660 15' accuracy

1500 start pumping @ 2 l/min
1505 stop for barge
1545 resume pumping. Intake clogged
with silt. stop pumping. Also observe
another barge
change pre-filter
1545 to 1700 standby due to other barges.
Also determine that pump is not
working.
1700-1730 Jeanette B. from Axys attempts
to fix pump but cannot repair. After
communications w/ Axys tech support
determine that motor needs to be
taken apart.

make decision that even if secondary
Grundfos submersible pump is used,

10/15/04 8602431.001 0201 4 of 4

it would be ≈ 1:00 a.m. in morning
when we would get back to dock
+ longer to decon, unload, etc.

call Shelly Gould + she agrees.
She will call Jeff Daniel + update
him.

1735 Head back to dock
1940 Arrive @ dock
2015 unload. Remove filters for
sample SW-31884-DC-101504-002
1 particulate filter
1 resin column filter

2100 ~~204~~ Finish sample prep + cleanup.
Some troubleshooting assessment at
sampler, but will try to fix tomorrow
2100 at site

J.Z.
10/15/04

10/16/04 1 of 1

~~86012~~ 8602431.001 0201

David Lamadrid / Jeanette Bedard

Kanawha River surface water sampling

11:00 onsite @ Lou Wendall marina to fix high volume sampler. Jenette B. from Axys indicated not sure what is wrong but noticed a broken magnet on the motor head (small piece

Backup grundfos submersible pump is working erratically -- sometimes working sometimes not.
will work on equipment tomorrow. If not working or unreliable, will have to rent submersible pump on Monday

1500 offsite [Took 1 hr. for lunch]

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Informed by Jeanette that submersible pump is running fine this date. will start tomorrow @ 0700

10/18/04 1 of 5

8602431.001 0201

David Lamadrid / Jeanette Bedard / Shelly Gould

Kanawha River surface water sampling

RM 68

weather: morning - low 40s / high 30's overcast
afternoon - 40's-50's / light-moderate rain

0700 onsite @ dock in Chesapeake
load boat
0740 leave dock
0810 Arrive RM 68
0815 Calibrate Horiba U-20 water quality meter w/ AutoCal

pH	4.01
cond	5.19 mS/cm
temp	-5.0 (error?)
DO	19.99 mg/L
redox	+359
turb.	0.2 NTU

0825 set up on stage 1 ≈ 150' from left bank looking upstream
mudline = 25.5 ft (7.7 meters)
Intake @ 6.2 + 1.6 meters
initial intake @ 6.2 meters
N 38.24654 W 081.56210

10/18/04 8602431.001 0201 2 of 5

D. Lamadrid

Boat is drifting a lot; have to adjust stage 1. Pump rate 2 l/min

0900 Collect SW-31884-DL-101801-001
4 40-ml vials; H_2SO_4; TOC/DOC
1 250-ml poly; NONE; TSS
Grab surface water sample

0905 water quality measure
pH 8.09 redox +358 mV
cond. 0.168 mS/cm turb ~~X~~ 6.5 NTU
temp 0.39 °C
DO 19.99 (error?) mg/L
Probe @ 1 ft below surface

0915 requested to move due to barges (request by lock master)

1010 reposition and resume pumping
mud line = 23.5' (7.2 meters)
set pump intake @ 5.7 meters
Raise intake to

1129 Requested by lockmaster to move again due to barge. Volume pumped was 232 ~~ga~~ liters, or 18 liters short of target volume of 250 liters. ~~Decide to move to stage 2 when barge is cleared.~~

10/18/04 8602431.001 0201 3 of 5

D. Lamadrid

1210 reposition on stage 1 again & resume pumping

1218 stop pumping @ 250 liters.
move to stage 2 (N38.24636 W081.56227)
mudline @ 26.5 ft (8 meters)
Intake @ 6.4 & 1.6 meters
initial intake @ 6.4 m

1230 start pumping (2 l/min)

1330 Raise Intake to 1.6 meters

1400 stop pumping due to barge traffic

1415 reposition and resume pumping

1450 stop pumping @ 500 liters

1500 set up on stage 3 & start pumping @ 2 l/min
mudline = 29.5 ft (9 meters)
Intake @ 7.2 & 1.8 meters
initial intake @ 6 meters due to tubing length (N38.24598 W081.56254)

1510 collect SW-31884-DL-101804-002
Grab surface water sample
4 40-ml vials; H_2SO_4; TOC/DOC
1 250-ml poly; NONE; TSS
use poly dipped in water to fill vials.

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D. Lamadrid

1515 water quality measure, probe @ 1 ft below water surface
pH 8.06 redox +319 mV
cond 0.163 mS/cm turb. 2.2 NTU
temp 0.64 °C
DO 19.99 (error?) mg/L

1550 Raise intake to 1.8 m
1705 End stage 3 @ 750 liters

1710 ~~Ste~~ Set up @ stage 4 ≈ 130' from left bank. Pump @ 2 l/min
N 38.24604 W 081.56311
mudline = 20 ft (6.1 meters)
Intake @ 4.9 + 1.2 meters
Initial intake @ 4.9 meters
1810 Raise intake to 1.2 meters

1915 ~~OH~~ End pumping
collect SW-31884 DL-10/18/04-003
4 40-ml vials; H_2SO_4; TOC/DOC
1 250-ml poly; unpreserved; TSS
Grab SW sample. Dipped poly bottle in water to fill vials.

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D. Lamadrid

1920 water quality measure. Probe @ 1 ft. below water surface
pH 8.10 redox +326
cond 0.160 mS/cm turb 3.1 NTU
temp 0.80 °C
DO 19.99 mg/L (error?)

1925 Back to dock + unload
2000 leave dock, travel to Lou Wendall marina
2045 Arrive Lou Wendall marina
2100 Collect SW-31883-DL-10/18/04-004
1 particulate filter
1 resin column filter

2100-2200 sample prep + cleanup. Will decon submersible pump tomorrow

2200 offsite

D.L. 10/19/04

10/19/04 1 of 4
8602431.001 0201
David Lamadrid / Jeanette Bedard
Kanawha ~~surf~~ River surface water sampling
Resume RM 31 sample @ midstream
weather: morning - overcast, 50's

0730 onsite. Decon submersible pump
① Alconox + tap water flush
② tap water flush
③ methanol flush
④ DI water flush

0800-0845 prep & load boat head back to RM 31 to resume sampling. Initial sampling on 10/15/04 halted due to equipment failure on stage 3. Jeff Daniel previously indicated can start where we left off. Ended just after stage 2 @ 500 liters
NOTE: Shelly Gould indicated this am. (based on conversation w/ Jeff Daniel) that no trip blank is required for analyses, & rinsate (equipment) blank will be done for both the high volume sampler &

10/19/04 8602431.001 0201 2 of 4
D. Lamadrid
submersible pump since both used.

0950 setup @ stage 3 (≈ midchannel)
@ RM 31
mudline = 22 ft. (6.7 meters)
Intake @ 5.3 & 1.3 meters
initial intake @ 5.3 meters
N 38.53011 , W081.90638 31' accuracy
use new particulate filter.
use existing resin column filter previously used 10/15/04 when RM 31 was first started

0950 start pumping; adjust to 2 l/min
1000 calibrate U-20 water quality meter w/ Auto cal solution

pH	3.97
cond	4.72 mS/cm
temp	~~3~~ 1.65 °C
DO	18.54 mg/L
redox	+349 mV
turb.	-0.9 NTU

1010 collect SW-31884-DL-10/19/04-001
4 40-ml vials; H_2SO_4; TOC/DOC
1 250-ml poly; unpreserved; TSS

Grab surface water sample. Dipped poly bottle @ surface to fill VOA vials
1015 water quality measure. Probe @ 1' below water surface
pH 7.11 redox +339 mV
cond 0.215 mS/cm turb 8.2 NTU
temp -0.25 (error?)
DO 19.47 mg/L

1050 Raise intake to 1.3 meters @ 675 liters
1150 End pumping @ 750 liters
1225 Set up on stage 4 DZ. 10/19/04
mudline = 16 ~~30~~ ft. (4.9 ~~9~~ meters)
Intake @ ~~2.3~~ 4.0 and 1.0 meters
initial intake @ 4.0 meters
N38.53024 W081.90681 20' accuracy

1230 ~~120~~ start pumping @ 2 l/min
1312 Request to move by lockmaster due to barge
1331 Reposition and resume pumping

1350 Raise intake to 1.0 meters
1455 End pumping
1455 collect SW-31884-DL-10/19/04-002
4 40-ml vials; H_2SO_4; TOC/DOC
1 250-ml poly; unpreserved; TSS
Grab surface water sample; dipped poly @ surface to fill VOA vials
1500 water quality measure. probe @ 1 ft. below surface
pH 7.63 redox +362 mV
cond 0.212 mS/cm turb 15.2 NTU
temp -0.03 °C (error?)
DO 19.68 mg/L

1604 Arrive back @ dock
1630 Finish unloading
1645 collect SW-31884-DL-10/19/04-003
1 particulate filter
1 resin column filter (ID 00146)

1730 Finish sample prep & cleanup offsite

DZ. 10/19/04

10/20/04 1 of 2
8602431.001 0201
David Lamedrid / Jeanette Bedard (Axys)
Kanawha River surface water sampling

Collect rinsate sample this date.

0900 onsite. Decon ~~pump as~~ submersible pump (SS grundfos) as follows:
1. tap water + alconox flush
2. tap water flush
3. methanol flush
4. DI water flush

1100 New sample bottles arrive from lab (STL). Ran out of bottles yesterday

1240 ~~Replace~~ use new bucket w/ new DI water to collect rinsate sample. Run pump for ½-hr @ ≈ 2 gal./min. Installed new particulate filter + resin column filter
70 liters pumped

1215 collect SW-31884-DL-10/20/04-001
6 40-ml vials; H_2SO_4; TOC/DOC
1 250-ml poly; unpreserved; TSS

10/20/04 8602431.001 0201 2 of 2
1 particulate filter
1 column resin filter

column Filter IDs

SW-31884-DL-10/12/04-001	# 00140	(RM 46)
10/13/04-004	# 00145	(RM 42)
10/13/04-005	# 00143	(RM 42 dup)
10/14/04-004	# 00141	(RM 33)
10/18/04-004	# 00148	(RM 68)
10/19/04-003	# 00146	(RM 31)
10/20/04-001	# 00144	(rinsate)

1230-~~1430~~ 1630 Demob activities, cleanup, sample preparation

1700 Drop off all samples @ FedEx
Filters to Axys Laboratory in Sidney, B.C.
Grab SW samples to Severn Trent Laboratory (STL) in
Custody of samples signed over to Shelly Gould

D.L. 10/20/04

AXYS ENVIRONMENTAL SYSTEMS FIELD REPORT

Project: 12656	Project Manager: T Ethier
Dates: 12 OCT 04	Field Technician: J. Sedard
Client: Conestoga Rovers Ass. (CRA)	Client Reference: CRA - KANAWHA River
Contact:	

Date	Time	Comments
Oct 12/04	0930	Depart Lou Wendell dome en route to
		STN RM 42. DEPTH 17' → 5.23m
		COLUMN → SPIKED WITH 40ML DX012A-STK/03
		#96 07 OCT 04
		REPACK I.D. L7246-1, 06 OCT 2004
		COLUMN ID 00140
		FILTER → L7246-11 CLEANED 28 SEPT 04
		CLEANING BATCH L6745-25
		FILTER → L7246-11 CLEANED 28 SEPT 04
		CLEANING BATCH L6745-25
		SAMPLE DEPTH 80% = 4m
		SAMPLE DEPTH 20% = 1m
	1000	START SAMPLING N 38° 23.653' } 18' ACCURACY
		W 081° 50.106'
		PRESSURE = 6.5 PSI
		CYLINDER = 2l 20ml IN 1 min
		FLOW METRE = ~2l
	1110	REDUCE DEPTH TO 1m
	1120	FR - 2l/min - Meter ~2000 - PSI - 6 - ~~Total 161~~
	1124	Tot 163 l. 6SF. -168. ~2 in 2 L.
	1215	MAX FLOW RATE 1.6l/30s = 3.2l/min

Sample Parameters: Sample Number (**SN**), Sample Source (**SS**), Sample Media (**SM**), Parameter (**P**), Apparatus (**A**), Start Time/Date (**STD**), End Time/Date (**ETD**), Flow Rate (**FR**), Volume (**V**), Filtration Media (**FM**), Surrogate ID (**SID**)

Signature: [signature] Date: 2 Nov 04

AXYS ENVIRONMENTAL SYSTEMS FIELD REPORT

Project: 12656	Project Manager:
Dates: 12 OCT 04	Field Technician: J. BEDARD
Client: CRA	Client Reference: CRA-KANAWHA R.
Contact:	

Date	Time	Comments
	1215	STOP SAMPLE 250 l. MOVE TO NEXT SUB STN.
	1223	START SAMPLE
		LOCATION N 38.39385° ACCURACY 18'
		W 081.83532°
		PSI = 6, FR = 2.15 l/min TOT = 257 l
	1255	6 PSI, FR = 2.05 l/min TOT = 310 l
	1330	CHANGE INTAKE DEPTH TO 1m BELOW SURFACE
		6 PSI, FR = 2.1 l/min TOT = 383 l
	1400	6 PSI, FR = 2.1 l/min TOT = 438 l
	1430	STOP SAMPLE 500 l - MOVE TO NEXT SUB STATION
	1440	START SAMPLING @ 5m FROM SURFACE
		6 PSI, FR = 2.1 l/min TOT = 504 l
	1505	6 PSI, FR = 2.05 l/min TOT = 555 l
		LOCATION N 38.39307° ACCURACY 49'
		W 081.83611°
	1530	6 PSI, FR = 2.05 l/min TOT = 603 l
	1540	CHANGE INTAKE DEPTH TO 1.25m BELOW SURFACE
		6 PSI, FR = 2.05 l/min TOT = 630 l
	1605	6 PSI, FR = 2.10 l/min TOT = 679 l
	1630	6 PSI, FR = 2.05 l/min TOT = 720 l
	1645	STOP SAMPLE AT 750 l - MOVE TO NEXT SUB STATION

Sample Parameters: Sample Number (**SN**), Sample Source (**SS**), Sample Media (**SM**), Parameter (**P**), Apparatus (**A**), Start Time/Date (**STD**), End Time/Date (**ETD**), Flow Rate (**FR**), Volume (**V**), Filtration Media (**FM**), Surrogate ID (**SID**)

Signature: [signature] Date: 2 NOV 04

AXYS ENVIRONMENTAL SYSTEMS FIELD REPORT

Project:	Project Manager:
Dates: 12 OCT 04 / 13 OCT 04	Field Technician: J BEDARD
Client: CRA	Client Reference: CRA - KANAWHA RIVER
Contact:	

Date	Time	Comments
	1650	START SAMPLING N 38.39288° ACCURACY 32'
		W 081.83635°
		INTAKE DEPTH 4.5 m FROM SURFACE
		~~PS~~ 6 PSI, FR 2.05 l/min, TOT = 755 l
	1720	6 PSI, 2.1 l/min, TOT = 812 l
	1755	INTAKE DEPTH 1.1 m FROM SURFACE
		6 PSI, 2.1 l/min TOT = 880 l
	1820	6 PSI, 2.1 l/min TOT = 930 l
	1855	STOP SAMPLING
13 OCT 04	0805	RIVER MILE 42 39 N 38.44024° ACCURACY 24'
		W 081.84666°
		INTAKE DEPTH 4.1 m FROM SURFACE
		USED FILTER FROM 12 OCT 04
		- COLUMN #1 THRU FLOW METRE 00145
		REPACK ID: L7246-6, 6 OCT 04
		XAD: L6674-18 G.W: L6765-3
		- COLUMN #2 00143
		REPACK ID: L7246-4, 6 OCT 04
		XAD: L6674-18 G.W.: L6765-3

Sample Parameters: Sample Number (**SN**), Sample Source (**SS**), Sample Media (**SM**), Parameter (**P**), Apparatus (**A**), Start Time/Date (**STD**), End Time/Date (**ETD**), Flow Rate (**FR**), Volume (**V**), Filtration Media (**FM**), Surrogate ID (**SID**)

Signature: [signature] Date: 2 NOV 04

AXYS ENVIRONMENTAL SYSTEMS FIELD REPORT

Project: 12656	Project Manager:
Dates: 13 OCT 04	Field Technician: J. BEDARD
Client: CRA	Client Reference: CRA KANAWHA R.
Contact:	

Date	Time	Comments
	0830	BEGIN SAMPLING
		@ 2400 RPM → #1 FR = 900ml/min
		#2 FR = 1.6 l/min
		@ 2600 RPM → #1 FR = 0.98 l/min
		#2 FR = 1.8 l/min
		@ 2600 RPM → #1 FR = 1.10 l/min
		#2 FR = 1.8 l/min → w/ EXTENSION SS TUBE
		#1 FR = 1.18 l/min
		#2 FR = 1.7 l/min → PIPECLAMP RESTRICTING FLOW
	0925	@ 2625 RPM (MAX), 6 PSI, TOT 60
		→ BALANCED FR WITH KINK IN TUBE
	0930	MOVE INTAKE TO 1m BELOW SURFACE TOT 62 l
	0955	6 PSI, 1# FR = 1.32 l/min TOT = 97 l
		#2 FR = 1.58 l/min
	1015	STOP SAMPLING TO MOVE @ TOT 125 l
	1020	START SAMPLING INTAKE @ 4.7m
		POSITION = N 38.44049° ACCURACY 15'
		W 081.84680°
		~~PSI~~ = 6 PSI FR #1 = 1.54 l/min TOT = 132
		FR #2 = 1.32 l/min
	1045	6 PSI, FR# = 1.50 l/min, FR# 2 = 1.34 l/min TOT = 164

Sample Parameters: Sample Number (**SN**), Sample Source (**SS**), Sample Media (**SM**), Parameter (**P**), Apparatus (**A**), Start Time/Date (**STD**), End Time/Date (**ETD**), Flow Rate (**FR**), Volume (**V**), Filtration Media (**FM**), Surrogate ID (**SID**)

Signature: [signature] Date: 2 NOV 04

AXYS ENVIRONMENTAL SYSTEMS FIELD REPORT

Project: 12656	Project Manager:
Dates: 13 OCT 04	Field Technician: J. BEDARD
Client: CRA	Client Reference: CRA KANAWHA R.
Contact:	

Date	Time	Comments
	1100	REDUCED INTAKE DEPTH TO 1.2m
		6 PSI, FR #1 = 1.51 l/min, FR #2 = 1.34 l/min TOT = 195 l
	1125	6 PSI, FR #1 = 1.50 l/min, FR # 2 = 1.34 l/min TOT = 223 l
	1145	SAMPLING STOPPED TOT = 250 l
	1150	START SAMPLING INTAKE A 5.5 m N 38.44062° ACCURACY
		6 PSI, FR #1 = 1.54 l/min W 081.84717 32'
	~~1229~~	FR # 2 = 1.32 l/min TOT = 257 l
	1229	Intake = 1.4 m TOT 312.5
		6.5 PSI, FR #1 = 1.49 l/min
		FR #2 = 1.28 l/min
	1300	6.5 PSI, FR #1 = 1.49 l/min
		FR # 2 = 1.28 l/min TOT = 367 l
	1315	STOPPED PUMPING TO MOVE TOT = 377 l
	1320	START SAMPLING INTAKE AT 5.3m
		N 38.44077° ACCURACY 21'
		W 081.84727°
		6.8 PSI, FR #1 = 1.53 l/min TOT = 385 l
		1.26 l/min
	1345	7 PSI, FR #1 = 1.52 l/min TOT = 420
		1.28 l/min

Sample Parameters: Sample Number (**SN**), Sample Source (**SS**), Sample Media (**SM**), Parameter (**P**), Apparatus (**A**), Start Time/Date (**STD**), End Time/Date (**ETD**), Flow Rate (**FR**), Volume (**V**), Filtration Media (**FM**), Surrogate ID (**SID**)

Signature: [signature] Date: 2 NOV 04

AXYS ENVIRONMENTAL SYSTEMS FIELD REPORT

Project: 12656	Project Manager:
Dates: 13 OCT 04	Field Technician: J. BEDARD
Client: CRA	Client Reference: CRA KANAWHA R.
Contact:	

Date	Time	Comments
	1400	RAISED INTAKE TO 1.3 m
		7 PSI FR#1 = 1.51 l/min, FR#2 = 1.26 l/min TOT = 443 l
	1425	7 PSI FR#1 = 1.49 l/min, FR#2 = 1.24 l/min TOT = 478 l
	1445	STOPPED PUMPING TO MOVE TOT = 500 l
	1450	START SAMPLING INTAKE AT 5.5 m
		N 38.44101° ACCURACY 25'
		W 081.84750°
		7.1 PSI. FR#1 = 1.54 l/min, FR#2 = 1.24 l/min TOT = 506 l
	1515	7.5 PSI FR#1 = 1.56 l/min; FR#2 = 1.26 l/min TOT = 547 l
	1535	RAISED INTAKE TO 1.5 m ~~ABOV~~ BELOW SURFACE TOT 567 l
		7.8 PSI FR#1 = 1.48 l/min, FR#2 = 1.28 l/min TOT = 580 l
	1600	8 PSI FR#1 = 1.48 l/min, FR#2 = 1.26 l/min TOT = 610 l
	1610	STOPPED PUMPING TO MOVE TOT 625 l
	1615	21' DEPTH PUMP AT ~~5m~~ 5.5m START SAMPLING
		8 PSI FR#1 = 1.54 l/min, FR#2 = 1.24 l/min TOT = 630 l
		N 38.44109° ACCURACY 15'
		W 081.84800°
	1640	8.1 PSI FR#1 = 1.52 l/min, FR#2 = 1.28 l/min, TOT = 654 l
	1700	RAISED INTAKE TO 1.5 m BELOW SURFACE TOT = 692 l
		8.5 PSI FR#1 = 1.46 l/min, FR#2 = 1.30 l/min TOT = 697 l
	1725	8.9 PSI FR#1 = 1.48 l/min, FR#2 = 1.24 l/min TOT = 731 l

Sample Parameters: Sample Number (**SN**), Sample Source (**SS**), Sample Media (**SM**), Parameter (**P**), Apparatus (**A**), Start Time/Date (**STD**), End Time/Date (**ETD**), Flow Rate (**FR**), Volume (**V**), Filtration Media (**FM**), Surrogate ID (**SID**)

Signature: [signature] Date: 2 NOV 04

AXYS ENVIRONMENTAL SYSTEMS FIELD REPORT

Project: 12656	Project Manager:
Dates: 13 OCT 04 / 14 OCT 04	Field Technician: J BEDARD
Client: CRA	Client Reference: CRA KANAWHA R
Contact:	

Date	Time	Comments
	1740	SAMPLE STOPED TO MOVE TOT = 750 l
	1745	START SAMPLING @ 5.2 m N 38.44125° ACCURACY 27'
		W 081.84829°
		9 PSI, FR# 1 = 1.46 l/min, FR# 2 = 1.28 l/min TOT = 756 l
	1805	STOP SAMPLING DUE TO LIGHTNING TOT = 775 l
14 OCT	0905	RIVER MILE 32.9 N 38.54400° ACCURACY 36'
		W 081.88622°
		FILTER L7246-11 28 SEP 04
		CLEANING BATCH L6745-25
		COLUMN 00141 REPACK ID: L7246-2 6 OCT 04
		XAD: L6674-18 G.W.: L6765-3
	0920	START SAMPLE INTAKE AT 8 m FROM SURFACE
		8.5 PSI FR = 1.96 l/min TOT = 6 l
	0945	9.1 PSI FR = 1.96 l/min TOT = 48 l
	1010	10 PSI FR = 1.99 l/min TOT = 95 l
	1025	RAISED INTAKE TO 2 m BELOW SURFACE
		10.8 PSI FR = 2.0 l/min TOT = 128 l
	1050	11 PSI FR = 1.98 l/min TOT = 170 l
	1130	STOPPED SAMPLING

Sample Parameters: Sample Number (**SN**), Sample Source (**SS**), Sample Media (**SM**), Parameter (**P**), Apparatus (**A**), Start Time/Date (**STD**), End Time/Date (**ETD**), Flow Rate (**FR**), Volume (**V**), Filtration Media (**FM**), Surrogate ID (**SID**)

Signature: [signature] Date: 2 NOV 04

AXYS ENVIRONMENTAL SYSTEMS FIELD REPORT

Project: 12656	Project Manager:
Dates: 14 OCT 04	Field Technician: J BGDARD
Client: CRA	Client Reference: CRA KANAWHA R
Contact:	

Date	Time	Comments
	1200	NEW POSITION N 38.54379° ACCURACY 18'
		W 081.88638°
		START SAMPLING @ 9.5m FROM SURFACE
		11 PSI, FR = 2.0 l/min, TOT = 253 l
	1225	11.5 PSI, FR = 1.99 l/min, TOT = 293 l
	1250	12 PSI, FR = 1.98 l/min, TOT = 343 l
	1305	RAISED INTAKE TO 2.2m BELOW SURFACE
		12.5 PSI, FR = 2.0 l/min, TOT = 379 l
	1335	13 PSI, FR = 1.96 l/min, TOT = 431 l
	1400	13.5 PSI, FR = 1.98 l/min, TOT = 480 l
	1410	STOPPED SAMPLING TO MOVE TOT = 500 l
	1415	NEW POSITION N 38.54340° ACCURACY 22'
		W 081.88611°
		START SAMPLING @ 8m FROM SURFACE
		13.5 PSI, FR = 2.02 l/min TOT = 503
	1420	STOPPED SAMPLING → BOAT DRIFTED DUE TO WIND
	1422	RESUMED SAMPLING
	1445	14 PSI, FR = 2 l/min, TOT = 550
	1455	STOPPED SAMPLING → BOAT DRIFTED
	1458	RESUMED SAMPLING
	1510	13.5 PSI, ~~FR =~~ STOPPED SAMPLING → BOAT DRIFTED

Sample Parameters: Sample Number (**SN**), Sample Source (**SS**), Sample Media (**SM**), Parameter (**P**), Apparatus (**A**), Start Time/Date (**STD**), End Time/Date (**ETD**), Flow Rate (**FR**), Volume (**V**), Filtration Media (**FM**), Surrogate ID (**SID**)

Signature: [signature] Date: 2 NOV 04

AXYS ENVIRONMENTAL SYSTEMS FIELD REPORT

Project: 12656	Project Manager:
Dates: 14 OCT 04	Field Technician: J BEDARD
Client: CRA	Client Reference: CRA KANAWHAR
Contact:	

Date	Time	Comments
	1511	RESUMED SAMPLING
		13.5 PSI, FR = 2.0 l/min, TOT = 590 l
	1530	RAISED INTAKE TO 2m BELOW SURFACE TOT = 625 l
		14 PSI, FR = 1.98 l/min, TOT = 628 l
	1555	15 PSI, FR = 2 l/min, TOT = 669 l
		SWITCHED FILTER
	1605	14 PSI, FR = 1.99 l/min, TOT = 695 l
	1625	15 PSI, FR = 1.98 l/min, TOT = 730 l
	1635	STOPPED SAMPLING TO MOVE TOT = 750 l
	1640	NEW POSITION N 38.54284° ACCURACY 23'
		W 081.88624°
	1645	START SAMPLING INTAKE AT 6m BELOW SURFACE
		15 PSI, FR = 2 l/min, TOT = 753 l
	1715	15.5 PSI, FR = 1.9 l/min, TOT = 810 l
	1740	17 PSI, FR = 2.2 l/min, TOT = 863 l
	1750	RAISED INTAKE TO 1.5m FROM SURFACE
		17.5 PSI, FR = 2.2 l/min, TOT = 878 l
	1815	17 PSI, FR = 2.3 l/min, TOT = 930 l
	1850	STOPPED SAMPLING @ 1000 l

Sample Parameters: Sample Number (**SN**), Sample Source (**SS**), Sample Media (**SM**), Parameter (**P**), Apparatus (**A**), Start Time/Date (**STD**), End Time/Date (**ETD**), Flow Rate (**FR**), Volume (**V**), Filtration Media (**FM**), Surrogate ID (**SID**)

Signature: [signature] Date: 2 NOV 04

AXYS ENVIRONMENTAL SYSTEMS FIELD REPORT

Project: 12656	Project Manager:
Dates: 15 OCT 04	Field Technician: J. BEDARD
Client: CRA	Client Reference: CRA KANAWHA R.
Contact:	

Date	Time	Comments
15 OCT	1010	COLUMN ID 00146
		REPACK ID L7246-7, 6 OCT 04
		XAD: L6674-18, G.W.: L6765-3
		FILTER L7246-12, 29 SEP 04
		CLEANING BATCH L6745-26
	1020	START SAMPLING INTAKE A 5.5 m BELOW SURFACE
		6.5 PSI, 1.94 l/min, TOT = 6 l
		POSITION N 38.52899° ACCURACY 15'
		W 081.90661°
	1045	6.8 PSI, 2.4 l/min, TOT = 54 l
	1105	STOPPED SAMPLING → BOAT DRIFTING
	1106	RESUMED SAMPLING
	1115	7 PSI, 2.2 l/min, TOT = 103 l
	1125	RAISED INTAKE TO 1.8m BELOW SURFACE
		7.3 PSI, 2.2 l/min, TOT = 130 l
	1150	7.5 PSI, 9.8 l/min, TOT = 176 l
	1230	STOPPED SAMPLING TO MOVE → WIND MAKING IT TOT = 250 l
		DIFFICULT TO KEEP STATION
	1245	STARTED SAMPLING, INTAKE AT 5.5 m BELOW SURFACE
		POSITION N 38.52971° ACCURACY 16'
		W 081.90659°

Sample Parameters: Sample Number (**SN**), Sample Source (**SS**), Sample Media (**SM**), Parameter (**P**), Apparatus (**A**), Start Time/Date (**STD**), End Time/Date (**ETD**), Flow Rate (**FR**), Volume (**V**), Filtration Media (**FM**), Surrogate ID (**SID**)

Signature: [signature] Date: 2 NOV 04

AXYS ENVIRONMENTAL SYSTEMS FIELD REPORT

Project: 12656	Project Manager:
Dates: 15 OCT 04	Field Technician: J BEDARD
Client: CRA	Client Reference: CRA KANAWHA
Contact:	

Date	Time	Comments
	1245	7.6 PSI, 2 l/min, 259 l
	1310	8 PSI, 2 l/min, 303 l
	1335	8.9 PSI, 2 l/min, 352 l
	1350	RAISED DEPTH TO 1.4 m BELOW SURFACE
		9 PSI, 2.3 l/min, 384 l
	1420	9.8 PSI, 2.1 l/min, 440 l
	1450	PUMPING STOPPED TO MOVE TOT = 500 l
	1500	NEW POSITION N 38.53012° ACCURACY 15'
		W 081.90660°
		START PUMPING INTAKE A 5.4 m
		10 PSI, 2.4 l/min, 503 l
	1505	STOPPED SAMPLING & MOVED TO LET BARGE PASS
	1545	RESUMED SAMPLING, INTAKE CLOGGED w/ MUD
	1555	STOPPED SAMPLING & MOVED TO LET BARGE PASS
	1600	CHANGED 160 M FILTER

Sample Parameters: Sample Number (**SN**), Sample Source (**SS**), Sample Media (**SM**), Parameter (**P**), Apparatus (**A**), Start Time/Date (**STD**), End Time/Date (**ETD**), Flow Rate (**FR**), Volume (**V**), Filtration Media (**FM**), Surrogate ID (**SID**)

Signature: [signature] Date: 2 Nov 04

AXYS ENVIRONMENTAL SYSTEMS FIELD REPORT

Project: 12656	Project Manager:
Dates: 18 OCT 04	Field Technician: J BEDARD
Client: CRA	Client Reference: CRA KANAWHA R.
Contact:	

Date	Time	Comments
18 OCT		COLUMN 00148, REPACK ID: L7246-9, 6 OCT 04
		XAD: L6674-18, G.W.: L6765-3
		FILTER L7246-11, CLEANED 28 SEP 04
		CLEANING BATCH L6745-25
	0830	RM 68, N 38.24654° ACCURACY 20'
		W 081.56210°
	0845	START SAMPLING W/ SUBMERSABLE PUMP, 5.8m BELOW SURFACE
		6 PSI, FR = 1.9 l/min, TOT = 10 l
	~~10~~ 0915	6.5 PSI, FR = 2 l/min, TOT = 65 l
	~~10~~ 0920	STOPPED SAMPLING TO LET BARGE PASS
	1015	RESUMED PUMPING
		6.5 PSI, FR = 1.84 l/min, TOT = 74 l
	1040	RAISED INTAKE TO 1.5m BELOW SURFACE
		7 PSI, FR = 2 l/min, TOT = 131 l
	1105	7 PSI, FR = 1.94 l/min, TOT = 184 l
	1130	STOPPED SAMPLING TO MOVE TOT = 230 l
	1215	RESUMED PUMPING
		7.5 PSI, FR = 1.96 l/min, TOT = 236 l
	1220	STOPPED TO MOVE STATIONS, TOT = 250 l
	1235	START SAMPLING, INTAKE DEPTH 6m BELOW SURFACE
		N 38.24636°, W 081.56227° ACCURACY 25'

Sample Parameters: Sample Number (**SN**), Sample Source (**SS**), Sample Media (**SM**), Parameter (**P**), Apparatus (**A**), Start Time/Date (**STD**), End Time/Date (**ETD**), Flow Rate (**FR**), Volume (**V**), Filtration Media (**FM**), Surrogate ID (**SID**)

Signature: [signature] Date: 2 NOV 04

AXYS ENVIRONMENTAL SYSTEMS FIELD REPORT

Project: 12656	Project Manager:
Dates: 18 OCT 04	Field Technician: J. BEDARD
Client: CRA	Client Reference: CRA KANAWHA R
Contact:	

Date	Time	Comments
	1235	7PSI, 2 l/min, TOT = 258 l
	1305	7PSI, 1.92 l/min, TOT = 311 l
	1325	8PSI, 2.1 l/min, TOT = 355 l
	1335	RAISED INTAKE TO 1.6m BELOW SURFACE
		8.5PSI, FR = 2.1 l/min, TOT = 379 l
	1405	9PSI, FR = 1.96 l/min, TOT = 435 l
		STOPPED SAMPLING TO GET OUT OF WAY OF BARGE
	1420	RESUMED SAMPLING
		9 PSI, FR = 2.3 l/min, TOT = 440 l
	1445	9.5PSI, FR = 2.1 l/min, TOT = 487 l
	1450	STOPPED SAMPLING TO MOVE TO NEXT LOCATION TOT = 500 l
		N 38.24598° W/081.56254° ACCURACY 20'
	1500	RESUMED SAMPLING INTAKE AT 6m BELOW SURFACE
		9 PSI, FR = 2.1 l/min, TOT = 508 l
	1525	9.5 PSI, FR = 2 l/min, TOT = 552 l
	1550	RAISED INTAKE TO 1.8m BELOW SURFACE
		10 PSI, FR = 1.98 l/min, TOT = 600 l
	1620	11 PSI, FR = 2 l/min, TOT = 667 l
	1705	STOPPED SAMPLING TO MOVE TO NEXT LOCATION TOT = 750
	1710	STARTED SAMPLING INTAKE AT 5m FROM SURFACE
		N 38.24604° W081.56311° ACCURACY 22'

Sample Parameters: Sample Number (**SN**), Sample Source (**SS**), Sample Media (**SM**), Parameter (**P**), Apparatus (**A**), Start Time/Date (**STD**), End Time/Date (**ETD**), Flow Rate (**FR**), Volume (**V**), Filtration Media (**FM**), Surrogate ID (**SID**)

Signature: [signature] Date: 2 NOV 04

AXYS ENVIRONMENTAL SYSTEMS FIELD REPORT

Project: 12656	Project Manager:
Dates: 18 OCT 04 - 19 OCT 04	Field Technician: J BEDARD
Client: CRA	Client Reference: CRA KANAWHA R
Contact:	

Date	Time	Comments
	1713	10.5 PSI, FR = 1.94 l/min, TOT = 762 l
	1735	11 PSI, FR = 1.98 l/min, TOT = 808 l
	1803	11.2 PSI, FR = 1.98 l/min, TOT = 867 l
	1815	Raise intake to 1.2 m, TOT = 894 l
	1850	12 PSI, FR = 1.90 l/min, TOT = 952 l
	1915	STOPPED SAMPLING TOT = 1000 l
19 OCT		RETURN TO RM 31, COLUMN 00146
		N 38.53011, W 081.90638' ACCURACY 31'
	1000	START SAMPLING, INTAKE AT 5.3m BELOW SURFACE
		10 PSI, FR = 2.06 l/min, TOT = 6 l
	1025	10 PSI, FR = 2.06 l/min, TOT = 64 l
	1055	RAISED INTAKE TO 1.3m BELOW SURFACE
		10 PSI, FR = 2.0 l/min, TOT = 128 l
	1120	10 PSI, FR = 2.0 l/min, TOT = 182 l
	1155	STOPPED SAMPLING TOT = 250 l
	1235	STARTED SAMPLING INTAKE AT 4m BELOW SURFACE
		N 38.53024° W 081.90681' ACCURACY 20'
		10 PSI, FR = 2.0 l/min, TOT = 250 l
	1300	10 PSI, FR = 1.99 l/min, TOT = 303 l
	1315	STOPPED SAMPLING TO GET OUT OF THE WAY OF A COAL BARGE

Sample Parameters: Sample Number (**SN**), Sample Source (**SS**), Sample Media (**SM**), Parameter (**P**), Apparatus (**A**), Start Time/Date (**STD**), End Time/Date (**ETD**), Flow Rate (**FR**), Volume (**V**), Filtration Media (**FM**), Surrogate ID (**SID**)

Signature: [signature] Date: 2 NOV 04

AXYS ENVIRONMENTAL SYSTEMS FIELD REPORT

Project: 12656	Project Manager:
Dates: 19 OCT 04 – 20 OCT 04	Field Technician: J. BEDARD
Client: CRA	Client Reference: CRA KANAWHA R.
Contact:	

Date	Time	Comments
	1335	RESUMED SAMPLING
		10 PSI, FR = 1.96 l/min, TOT = 339 l
	1355	RAISE INTAKE TO 1 m BELOW SURFACE
		11 PSI, FR = 2.02 l/min TOT = 378 l
	1420	11 PSI, FR = 1.98 l/min TOT = 431 l
	1455	STOPPED SAMPLING TOT = 500 l
20 OCT 04	1140	STARTED SAMPLING FOR EQUIPMENT BLANK
		ON ULTRA PURE WATER ~ 2 l/min
		TOT = 70 l

Sample Parameters: Sample Number (**SN**), Sample Source (**SS**), Sample Media (**SM**), Parameter (**P**), Apparatus (**A**), Start Time/Date (**STD**), End Time/Date (**ETD**), Flow Rate (**FR**), Volume (**V**), Filtration Media (**FM**), Surrogate ID (**SID**)

Signature: [signature] Date: 2 NOV 04

#038144 11-27-07 (1)

CRA - Blechner
Exponent - K Cerreto
Normandeau - Rich, Andrew, Mike

0800 - meet exponent + Normandeau on site at Lou Werdell Marina
- Normandeau sets up barge + John Boat + Equipment storage area
- CRA sets up sampling area + picks up supplies
- still awaiting on cooler arrival
- will start 1st am 11-28-07
- All off site 13:00
- 1300 - coolers arrive at hotel
- prep + review for sampling next day

[illegible signature]

AR100891

6 #031884 11-28-07 (2)

CRA - P. Peitre
Exponent - K Certo
Normandeau - Rich, Mike, + Drew
Task - surface sediment sample using van veen sampler; decon between each location
H+S - level D
07:00 - review Normandeau + CRA HASPs, H+S tailgate meeting
- all equipment decon'd using alconox wash, tap rinse; DI rinse after each sample location
- all samples placed in ice-chilled cooler as collected
- all parameters are 2,3,7,8-TCDD; total solids, grain size, and TOC unless otherwise noted; (1-4oz jar + 1-16oz jar)

08:10 - set up at SSD-29
08:20 - collect "SE-031884-112807-DD-001"
- see field form for details
- N 510975.150 E 1726959.353
- decon equipment
09:05 - set up at SSD-28
09:10 - collect "SE-031884-112807-DD-002"
- N 513996.?? E 1725704.006
- see field form for details

031884 11-28-07 (3)

decon equipment
0940 - move to location SSD-27
09:50 - collect "SE-031884-112807-DD-003"
collect additional parameters as pesticide, svoc, metals, PCB/TCP
N 520223.789 E 1724957.805
- see field form for details
- decon equipment
10:25 - move to location SSD-26
10:30 - collect "SE-031884-112807-DD-004"
1035 - dupe sample "SE-031884-112807-DD-005"
N 521131.841 E 1724850.097
decon equipment
10:55 - move to location COR-43
N 521944.481 E 1724854.908
11:00 - collect "SE-31884-112807-DD-006"
- not in exact proposed position due to Barges docked
- see field form for details
12:39 - move to location COR-42
N 523004.140 E 1724245.197
12:45 - collect "SE-31884-112807-DD-007"
- added volume for MS/MSD for dioxin analysis only
see field form
- decon equipment

AR100892

031884 11-28-07 (4)

1300 - move to location $\boxed{SSD-25}$
N523165.462 E 1724303.697
~~13:30~~ 13:25 collect "SE-031884-112807-DD-008"
00 11/28/07
used new location N523194.654 E 1724312.831
due to poor sediment recovery
- see field form -
- decon equipment
* - added volume for Pest, PCB, TCDD/TCDF
+ select metals parameters

1340 - move to location $\boxed{COR-41}$
N522972.291 E 1725032.224
1350 - collect "SE-031884-112807-DD-009"
- See field form
- decon equipment
14:10 - move to location $\boxed{COR-40}$
N523688.951 E 1725254.851
14:15 - collect "SE-031884-112807-DD-010"
- see field form
- decon equipment
1428 - move to location $\boxed{COR-39}$
N524274.529 E 1725397.751
1435 - collect "SE-031884-112807-DD-011"
- see field form
- decon equipment

031884 11-28-07 (5)

1445 - move to location $\boxed{COR-38}$
- N524781.605 E 1725624.228
1450 collect "SE-031884-112807-DD-012"
- see field form
- decon equipment
15:10 - move to location $\boxed{SSD-24}$
N524969.985 E 1724912.695
1520 - collect "SE-031884-112807-DD-013"
- see field form
- decon equipment
1530 - move to location $\boxed{SSD-27}$
1540 - collect "SE-031884-112807-DD-014"
N525682.336 E 1725288.684
- see field form for details
- decon equipment
1600 - set up on $\boxed{COR\ 37}$
N525318.210 E 1725661.812
1605 - collect "SE-031884-112807-DD-015"
- see field form for details
- decon equipment
1620 - end sample collection for day; return to shore
1645 - Repack coolers, complete COC
1700 - Normandeau off site
1730 - CH2M - Exponent off site, take samples to FED-EX

11-28-07 031884 (6)

Sample Summary

Sample ID Time Location depth QA/Qa

SE-031884-112807-DD-001

SE

Sample ID	Time	Location	depth	Param.	QA/QC
SE-031884-112807-DD-001	820	SSD-29	0-2	1	–
-002	910	SSD-28	0-2	1	–
-003	950	SSD-27	0-2	1 and 2	–
-004	1020	SSD-26	0-3.5	1	–
-005	1035	SSD-26	0-3.5	1	dup of 004
-006	1100	COR-43	0-3	1	–
-007	1245	COR-42	0-3.5	1	MS/MSD
-008	1330	SSD-25	0-4	1+2	–
-009	1350	COR-41	0-2.5	1	–
-010	1415	COR-40	NA	1	–
-011	1435	COR-39	0-3	1	–
-012	1450	COR-38	0-3	1	–
-013	1520	SSD-24	0-2	1	–
-014	1545	SSD-23	0-1	1	–
SE-031884-112807-DD-015	1605	COR-37 ~~SSD~~	0-3	1	–

Parameters

1. 2,3,7,8-TCDD, TOC, total solids, grainsize
2. TCL SVOC, TCL PCBs, TCL Pesticides, TCDD/TCDF, site specific metals

11-29-07 031884 (7)

CRA - D Reimer

Exponent - K Cereto

Normandeau - Mike, Rich, Drew

Task - Sediment sampling using Van Veen and/or Ponar Sampler

Method - decon sampler, SS bowl, SS spoon prior to sampling; homogenize top 4" of sample in SS bowl

Parameters - 2,3,7,8-TCDD, Total solids, Grainsize, TOC unless otherwise noted

H+S - level D

weather - partly cloudy, windy, chance showers, 45°F

07:15 - H+S tailgate meeting; see field form

07:20-07:50 - adjust equipment + rearrange boat

07:50 - move to location COR 36

N 526314.211 E 1725621.895

water = 1' deep; total sed collected = 0"-4"

08:30 collect "SE-031884-112907-DD-016"

- see field form for details
- decon equipment
- offset original location due to co-ordinates located on shore

11-29-07 #031884 (8)

Sample Key

Sample ID	Time	Depth	Location	Param	QA-QC
SE-031884-112907-DD-016	0830	0"-4"	COR-36	1	—
SE-031884-112907-DD-017	08:45	0"-1"	COR-35	1	—
SE -018	09:10	0"-4"	COR-34	1	—
SE -019	09:35	0"-3"	COR-33	1	—
SE -020	10:05	0"-4"	SSD-22	1	—
SE -021	10:30	0"-4"	COR-32	1	—
SE -022	10:55	0"-1"	SSD-21	1	—
SE -023	11:15	0"-4"	COR-31	1	—
SE -024	11:35	0"-1.5"	COR-30	1	—
SE -025	12:50	0"-3"	COR-29	1	—
SE -026	13:05	0"-4"	SSD-20	1, 2	MS/MSD 7 jars total
SE -027	13:50	0"-1"	COR-28	1	—
SE -028	1415	0"-3"	COR-27	1	—
SE -029	14:35	0"-1"	SSD-19	1	—
SE -030	15:05	0"-3.5"	COR-26	1	—
SE -031	15:20	0"-3"	COR-25	1	—
SE-031884-112907-DD-032	15:30	0"-3"	COR-25	1	dupe of 031

Parameters

* 1 = Grainsize; 2,3,7,8-TCDD; Total Solids, TOC

* 2 = TCDD/TCDF; TCL SVOC, TCL PCB, TCL Pesticide, Site Specific Metals

11-29-07 #031884 (9)

0835 move to $\boxed{\text{COR-35}}$

N 526203.831 E 1726529.974

water depth = 17'; sediment collected = 0"-1"

08:45 - collect "SE-031884-112907-DD-017"

- see field form for details
- decon equipment

09:03 - move to $\boxed{\text{COR-34}}$

N 526682.229 E 1726738.950

water depth = 24' sediment depth collected = 0" to 4"

09:10 - collect "SE-031884-112907-DD-018"

- see field form for details
- decon equipment

09:22 - move to $\boxed{\text{COR-33}}$

N 527137.718 E 1726471.539

water depth = 28' ; depth of sediment collected = 0" to 3"

09:35 - collect "SE-031884-112907-DD-019"

- see field form for details
- decon equipment

09:53 move to location $\boxed{\text{SSD-22}}$

N 527776.066 E 1728722.026

water depth = 18' sediment depth collected = 0" to 4"

1005 - collect "SE-031884-112907-DD-020"

- see field form for details
- decon equipment

11-29-07 #031884 (10)

10:14 - move to location [COR 32]
N 528174.214 E 1728887.369
Depth to Water = 33' sediment Depth - 0"-4"
10:30 - collect "SE-031884-112907-DD-021
- see field form for details
- decon equipment
10:42 - move to location [SSD-21]
N 528968.935 E 1730804.226
Depth to water = 17' ; sediment collected depth = 0"-1"
- see field form for details
- decon equipment
10:55 - collect "SE-031884-112907-DD-022
1:06 - move to location [COR-31]
N 528429.188 E 1729351.571
Depth to water = 28' Sediment depth - 0"-4"
11:15 - collect "SE-031884-112907-DD-023"
- see field form for details
- decon equipment
11:26 - move to location [COR-30]
N 529625.963 E 1731576.839 (changed to below)
Depth to water = 18' Sediment depth = 0"-1.5"
11:35 - collect "SE-031884-112907-DD-024
- see field form for details
- decon equipment
* N 529522.487 E 1731506.211 - after 12 attempts,
- depth to water

11-29-07 #031884 (11)

12:35 - move to location [COR-29]
N 530067.191 E 1731467.569
Depth to water = 28' ; collected sediment 0" to 3"
1250 - collect "SE-031884-112907-DD-025"
- see field form for details
- decon equipment
12:54 - move to location [SSD-20]
N 529658.992 E 1732583.054
Depth to water = 6' ; collected sediment sample 0"-4"
13:05 - collect "SE-031884-112907-DD-026"
* added volume for TCL SVOC, TCL PCB, TCL Pesticides; site specific Metals; TCDD/TCDF
* - added volume for all parameters except grainsize; see field form for details; decon equipment
- total 7 jars (3-32oz; 3-4oz; 1-16oz)
13:30 - move to location [COR-28]
N 530703.681 E 1732586.614
13:50 - collect "SE-031884-112907-DD-027"
water depth = 20' ; sediment sample collected = 0"-1"
- see field form for details
- decon equipment
13:55 - move to location [COR-27]
N 531418.909 E 1730619.447
1415 - collect "SE-031884-112907-DD-028"
- depth to water = 25 sediment collection interval = 0"-3"
- see field form for details; decon equipment

AR100896

031884

11-29-07 # ~~012968~~ 13968 (12)

14:25 - move to location SSD-19

N 531908.090 E 1733450.325

depth ~~to~~ of water = 29' ; sediment sample interval 0"-1'

14:35 - collect "SE-~~012968~~-112907-DD-029"

- see field form for details

- decon equipment

14:50 - move to location COR-26

N 532577.187 E 1733547.829

depth of water = 30' ; collected sediment interval 0"-3.5'

1505 - collect "SE-031884-112907-DD-030"

- see field form for details

- decon equipment

15:12 - move to location COR-25

N 533380.761 E 1734332.823

depth OF water = 21' ; collected sediment interval 0"-3'

1520 - collect "SE-031884-112907-DD-031"

- see field forms for details

- decon equipment

15:30 - collected "SE-031884-112907-DD-032"

(dupe of # 031)

15:40 - end sample collection; start to return to Marina

- pack samples

- take samples to FEDEX

11/30/07 031884 (13)

CRA - D Deithe

Exponent - K Carpoto

Normandeau - Rich, Mike, + Drew

Task - Surface sediment sampling using van veen and/or Ponar sampler

Method - Decon sampler + stainless steel bowl and stainless steel spoon; samples composited in SS bowl

HS - level D

07:00 - meet at Raymond area public boat launch

- HS tailgate meeting; see field form

Parameters: 2,3,7-8 TCDD, Total Solids, Grainsize, TOC unless otherwise noted

weather: clear; 30-45°F

07:15-07:50 - prepare equipment + sample bottles

07:55 - move to location SSD-18

N 534747.771 E 1735082.702

depth to water ~ 5' ; sediment sample interval 0"-4"

08:15 - collect "SE-031884-113007-DD-033"

- see field form for details

- decon equipment

Sample Key

Sample ID	Time	Depth	Location	Param	QA/QC
~~SE-031884-113007-DD-033~~	~~Time~~	~~Dept~~ dd 11-30-07			
SE-031884-113007-DD-033	08:15	0"-4"	SSD-18	1 + 2	—
SE- -034	08:45	0"-3"	SSD-17	1	—
SE- -035	09:55	0"-4"	SSD-16	1	—
SE- -036	10:15	0"-2"	SSD-15	1	—
SE- -037	11:00	0"-4"	COR-24	1	—
SE- -038	11:15	0"-3"	SSD-14	1	—
SE- -039	1200	0"-2.5"	COR-23	1	—
SE- -040	1325	0"-4"	COR-22	1	—
SE- -041	13:45	0"-2"	COR-21	1	—
SE- -042	14:05	0"-4"	COR-20	1+2	—
SE- -043	14:10	0"-4"	COR-20	1+2 no G.S.	dupe of 042
SE- -044	14:25	0"-4"	COR-19	1	—
SE- -045	1445	0"-4"	SSD-13	1	—
SE- -046	15:10	0"-3"	SSD-12	1	—
SE- -047	15:40	0"-4"	SSD-11	1	—
SE-031884-113007-DD-048	16:00	0"-4"	SSD-10	1	-

* end sample collection at 16:00

Parameters: 1 - 2,3,7,8-TCDD, TOC, Total Solids, Grain Size
2 - TCL SVOC, TCL PCB, TCL Pesticide, Site Specific Metals, TCDD/TCDF

08:35 - move to location $\boxed{SSD-17}$
N 535152.828 E 1734955.127
water depth = 20'; sediment sample interval = 0"-3"
08:45 - collect "SE-031884-113007-DD-034"
- see field form for details
- decon equipment
09:05 - return to shore to purchase supplies to reduce ice on boat deck
09:50 - move to location $\boxed{SSD-16}$
N 536903.993 E 1734382.480
water depth = 17; sediment sample interval: 0"-4"
09:55 - collect "SE-031884-113007-DD-035"
- see field form for details
- decon equipment
10:09 - move to location $\boxed{SSD-15}$
N 537423.505 E 1734966.885
water depth = 26'; sediment interval = 0"-2"
10:15 - collect "SE-031884-113007-DD-036"
- see field ~~box~~ form for details
- decon equipment
1045 - move to location $\boxed{COR-24}$
N 538502.616 E 1734061.138
water depth = ~~25~~ dd-mm; collected sediment interval = 0"-4"
1100 - collect "SE-031884-113007-DD-037"
- see field form for details; decon equipment

11-30-07 #031884 (16)

11:07 - move to location $\boxed{SSD-14}$
N 540164.034 E 1733279.131 (old)
water depth ~25'; sediment interval collected = 0"-3"

11:15 - collect "SE-031884-113007-DD-038"
- see field form for details
- decon equipment
- 35+ attempts to retrieve sample
- offset location due to no return/recovery
2' water - new location for $\boxed{SSD-14}$ → N 539874.121 E 1733644.233

11:56 - move to location $\boxed{COR-23}$
11 attempts to retrieve sample
N 540720.879 E 1732572.025
water depth = 24'; sediment interval collected = 0"-25"

1200 - collect "SE-031884-113007-DD-039"
- see field form for details
- decon equipment

1318 - move to location $\boxed{COR-22}$
N 541276.568 E 1731669.256 (old)
water depth = 26'; sediment interval collected = 0"-4"

1325 - collect "SE-031884-113007-DD-040"
- see field form for details
- decon equipment
- offset due to no recovery at COR-2 (sample)
N 541288.687 E 1731744.237

11-30-07 #031884 (17)

13:37 - move to $\boxed{COR-21}$
N 542078.493 E 1731061.284
water depth - 6' sediment interval collected = 0"-2"

1345 - collect "SE-031884-113007-DD-041"
- see field form for details
- decon equipment

13:52 - move to $\boxed{COR-20}$
N 542790.000 E 1730499.085
water depth = NR; collected sediment interval = 0"-4"

1405 - collect "SE-031884-113007-DD-042"
- see field form for details
- decon equipment
- full parameters (TCL SVOC, TCL PCB, TCL Pest, TCDD/TCDF, site specific metals)

1410 - collect "SE-031884 113007-DD-043"
duplicate of #042; no grain size analysis

14:20 - move to $\boxed{COR-19}$
N 543822.587 E 1729867.879
water depth = 18'; collected sediment interval = 0"-4"

14:25 - collect "SE-031884-113007-DD-044"
- see field forms for details
- decon equipment

11-30-07 #031884 (18)

14:37 - move to location $\boxed{\text{SSD-13}}$
N544413.604 E 1729502.161
water depth ~ 21'; collected sediment interval = 0"-4"

1445 - collect "SE-031884-113007-DD-045"
- see field form for details
- decon equipment

1500 - move to location $\boxed{\text{SSD-12}}$
N545994.375 E 1728712.195
water depth = 23'; collected sediment interval 0"-3"

15:10 - collect "SE-031884-113007-DD-046"
- see field forms for details
- decon equipment

15:20 - move to location $\boxed{\text{SSD-11}}$
N546277.253 E 1729116.843
water depth = 3'; collected sediment interval 0"-4"

15:40 collect "SE-031884-113007-DD-047"
- see field forms for details
- decon equipment

15:47 - move to location $\boxed{\text{SSD-10}}$
N547567.204 E 1727159.993
water depth = 8'; collected sediment interval = 0"-4"

1600 - collect "SE-031884-113007-DD-048"
- see field forms for details
- decon equipment

11-30-07 #031884 (19)

16:11 - start heading back to boat launch
- prepare coolers for shipment
- off site; take samples to FED-EX

11-30-07

CRA - DDeitner
Exponent - K Cerreto
Normandeau - Rich, Andrew, Mike
Task - Sediment sampling (surface) using VanVeen Sampler and/or Ponar
Method - composite sample interval in stainless steel bowl with stainless steel spoon; sample + s steel equipment precleaned prior to use at each sample location using alconox wash, DI rinse
weather 30-45°F, clear
HTS - level D
07:00 HTS tailgate meeting; see field form
- meet at public boat launch
07:30 - move to COR-18
N 550370.023 E 1727159.179
water depth = 32'; collected sediment interval = 0"-2"
08:00 - collected "SE-031884-120107-DD-049"
- see field forms for details
- decon equipment
08:17 - move to SSD-09
N 552121.377 E 1726947.265
water depth = 2'; collected sediment interval = 0"-2"
08:20 - collect "SE-031884-120107-DD-050"
- see field form for details; decon equipment
- location offset - [illegible] on land?

Sample Key

Sample ID	Time	Depth	Location	Params	QA/QC
SE-031884-120107-DD-049	08:00	0"-2"	COR-18	1	—
SE- -050	08:30	0"-2"	SSD-09	1	—
SE- -051	0855	0"-3"	COR-17	1	—
SE- -052	0925	0"-2"	COR-16	1	—
SE- -053	0945	0"-6"	COR-15	1	MS/MSD extra GS
SE- -054	1005	0"-2"	COR-14	1	—
SE- -055	10:30	0"-4"	COR-13	1+2	—
SE- -056	10:55	0"-5"	COR-12	1	—
SE- -057	11:15	0"-5"	COR-11	1	—
SE- -058	11:30	0"-4"	COR-10	1	—
SE-031884-120107-DD-059	11:45	0"-4"	COR-9	1	—
— NO ACCESS —			SSD-8		—
SE-031884-120107-DD-060	1255	0"-3"	SSD-7	1	—
SE- -061	1310	0"-5"	COR-8	1	—
SE- -062	1330	0"-2"	COR-6	1	—
SE- -063	1340	0"-5"	COR-07	1+2	—
SE- -064	1400	0"-6"	SSD-06	1	
SE- -065	1415	0"-4"	COR-05	1	—
SE -066	1425	0"-4"	COR-05	1	dup of 065 no GS
SE-031884-120107-DD-067	1455	0"-4"	COR-04	1	—

Parameters: (1) 2,3,7,8-TCDD; TOC, Total Solids; Grainsize
(2) TCL SVOC; TCL PCB, TCL Pesticide; TCDD/TCDF; site Specific Metals

12/01/07 #031884 (22)

08:39 - move to location COR-17
N 554383.678 E 1724896.805
water depth = 36'; collected sediment interval = 0"-3"
0855 - collect "SE-031884-120107-DD-051"
- see field forms for details
- decon equipment
09:05 - move to location COR-16
N 554805.452 E 1724952.833
water depth = 22'; collected sediment interval 0"-2"
09:25 - collect "SE-031884-120107-DD-052"
- see field forms for details
- decon equipment
09:35 move to location COR-15
N 555109.208 E 1723814.271
water depth = 26'; collected sediment interval = 0"-6"
0945 - collected "SE-031884-120107-DD-053"
- see field forms for details; * MS/MSD all but grainsize *
- decon equipment
09:55 - move to location COR-14
N 556751.039 E 1723149.640
water depth = 30'; collected sediment interval = 0"-2"
10:05 - collect "SE-031884-120107-DD-054"
- see field forms for details
- decon equipment

12/01/07 #031884 (23)

10:15 - move to location COR-13
N 557096.444 E 1722462.494
depth of water = 32'; collected sediment interval = 0"-4"
10:30 - collect SE-031884-120107-DD-055"
- see field form for details
- decon equipment
* - grab extra parameters "TCL SVOC, TCL PCB, TCL Pesticide, TCDD/TCDF, site specific metals"
10:37 - move to location COR-12
N 558404.986 E 1720993.534
depth of water = 30'; collected sediment interval = 0"-5"
1045 - collect "SE-031884-120107-DD-056"
- see field form for details
- decon equipment
11:04 - move to location COR-11
N 559487.960 E 1720952.404
depth of water = 24'; collected sediment interval = 0"-5"
11:15 - collect "SE-031884-120107-DD-057"
- see field form for details
- decon equipment
11:22 - move to location COR-10
N 560988.913 E 1719458.457
depth of water = 36'; collected sediment interval = 0"-4"
11:30 - collect "SE-031884-120107-DD-058"
- see field form for details; decon equipment

AR100902

12/01/07 #031884 24

11:37 - move to location COR-07
N 561425.534 E 1719592.689
water depth = 20'; collected sediment material = 0"-4"
11:45 - collect "SE-031884-120107-DD-059"
- see field form for details
- decon equipment
11:48 - move to SSD-8
* Eliminate Location SSD-8 - could not access due to low water level; 800'+ away from little grass creek
12:42 - move to location SSD-07
N 562425.934 E 1717677.660
water depth = 35'; collected sediment material 0"-3"
1255 - collect "SE-031884-120107-DD-060"
- see field form for details
- decon equipment
13:03 - move to COR-08
N 562409.832 E 1717137.450
water depth = 18'; collected sediment material = 0"-5"
1310 - collect "SE-031884-120107-DD-061"
- see field form for details
- decon equipment
13:18 - move to COR-06
N 563773.704 E 1715781.459
water depth = 35'; collected sediment material = 0"-2"
1330 - collect "SE-031884-120107-DD-062"
- see field form for details; decon equipment

12/01/07 #031884 25

13:35 - move to location COR-07
N 563513.888 E 1715757.471
water depth = 26'; collected sediment material = 0"-5"
1340 - collect "SE-031884-120107-DD-063"
- see field form for details
- decon equipment
* - collected extra parameters; TCL SVOC, TCL PCB, TCL Pesticide; site specific Metals; TCDD/TCDF
1355 - move to location SSD-06
N 563781.505 E 1716036.679
water depth = 4'; collected sediment material = 0"-6"
1400 - collect "SE-031884-120107-DD-064"
- see field form for details
- decon equipment
14:08 - move to location COR-05
N 563022.593 E 1714913.196
water depth = 44'; collected sediment material = 0"- "
1415 - collected "SE-031884-120107-DD-065"
- see field form for details
- decon equipment
14:25 - collect "SE-031884-120107-DD-066" - duplicate of #065

AR100903

12-01-07 #031884 (26)

14:39 - move location [COR-04]

N 961847.685 E 1713562.333

water depth ~ 1'; collected sediment interval = 0"-4"

1455 - collect "SE-031884-120107-DD-067"

- see field forms for details

- decon equipment

* sample "067 - " ~~bott~~ all DD 12-01-07 samples DD 12-01-07

in 16 oz jars"

- end sample collection for day at COR-04

12-02-07 #031884 (27)

CRA - D Dostne

Exponent - K Cerreto

Normandeau - Rich, Mike, Andrew

Task - sediment sampling using van veen sampler and/or PONAR sampler

Method - composite sample in precleaned stainless steel bowl using stainless steel spoon; sampler also precleaned prior to use

- all cleaned using alconox wash; DI rinse

weather - overcast; chance showers + periods of rain in PM; 40-55°F

H&S - level D

07:00 - meet at Poca Area boat launch; H&S tailgate meeting; see field form

07:40 - move to location [COR-03]

N 961018.481 E 1712999.825

water depth = 1'; collected sediment interval = 0"-4"

0810 - collect "SE-031884-120207-DD-068"

- see field form for details

- decon equipment

- offset location - due to shore line

· collect extra volume for parameters TCL SVOC, TCL PCB, TCL Pesticide, PCDD/PCDF site specific metals

* samples collected for: 2,3,7,8-TCDD, TOC, total solids + Grainsize at all locations unless otherwise noted

sample Key

Sample ID	Time	Depth	Location	Param	QA/QC
SE-031884-120207-PP-068	08:10	0"-4"	COR-03	①+②	–
SE- -069	08:25	0"-4"	SSD-05	①	MS/MSD
SE- -070	0900	0"-3"	COR-02	①	–
SE- -071	0915	0"-6"	COR-01	①	–
SE- -072	09:30	0"-4"	SSD-4	①	–
SE- -073	09:50	0"-4	SSD-3	①	–
SE- -074	10:05	0"-3"	SSD-2	①	–
SE-031884-120207-PP-075	10:20	0"-2'	SSD-1	①	–

end surface sediment samples

W-031884-120207-PP-076 13:00 – Rinseblank ①② –

13:00 – collected rinse blank from stainless steel bowl; param: 2,3,7,8-TCDD; TCDD/TCDF, TOC, TCL SVOC, TCL PCB, TCL Pesticides, site specific metals

Parameters: ① 2,3,7,8-TCDD; TOC, Total Solids, Grainsize
② TCL SVOC, TCL PCB, TCL Pesticide, TCDD/TCDF, Site Specific Metals

08:20 – move to location SSD-05
N 560887.391 E 1713251.364
water depth 2'; collected sediment interval = 0"-4"
– collect "SE-031884-120207-PP-069"
– added volume for MS/MSD all parameters
08:25 – collected except grainsize
– see field forms for details
– decon equipment
– not in exact original location due to shallow water.
0845 – move to location COR-02
N 559745.125 E 1710952.92C
water depth: 34'; collected sediment interval 0"-3"
0900 – collect "SE-031884-120207-PP-070"
– see field form for details
– decon equipment
09:06 – move to location COR-01
N 558931.634 E 1710131.123
water depth = 33'; collected sediment interval: 0"-6"
0915 – collect "SE-031884-120207-PP-072
– see field form for details
– decon equipment

09:24 - move to locat ~~SSD-04~~ SSD-04
N 559335.253 E 1709734.676
0930 - collect SE-031884-120207-DD-072
dep of water = 12 collected sediment = 0"-4"
- see field form for details
- decon equipment
09:42 - move to location ~~eo~~ SSD-03
N 559143.065 E 1709419.76
0950 - collect "SE-031884-120207-DD-073"
- depth of water = 17'; collected sediment 0"-4"
- see field form for details
- decon equipment
1000 - move to Location SSD-8
N 558937.103 E 1709035.561
depth of water = 8'; collected sediment interval 0"-3"
1005 - collect "SE-031884-120207-DD-074"
- see field form for details
- decon equipment
1015 - move to location SSD-01
N 558306.687 E 1709296.992
depth of water = 33'; collected sediment interval = 0"-2"
1020 - collect "SE-031884-120207-DD-075"
- see field forms for details
- decon equipment

1300 - repack samples; collect [illegible]
15:30 - ERA + Expert off site
16:30 - [illegible] off site

12-02-07

12-03-07 #031884 (32)

CRA - D Repfree
Expanent - K Cerreto
Andrac - D Guillias
Normandeau - Rich, Mike, Andrew
07:00 - H+S tailgate meeting
07:00-08:35 prepare equipment & supplies

09:30 - start to setup at location $\boxed{\text{COR-43}}$
- try 2 locations
< N 521784.978 E 1724877.045
2nd attempt = 2' recovery;
refusal at rabble
- ~~N522994.852 E1724251062~~
- 522996.305 E 1724261.60

SE-031884-120307-DD-077" at 0'-2' at
15:20 ; 2,3,7,8-TCDD; TOC, total solids,
Grain size From COR-43

SE-031884-120307-DD-078 at 0'-2'
at 15:30 ; parameters #1
from COR-42

SE-~~120307~~

12-03-07 #031884 (33)

① Sample Key

Sample ID	Time	Location	Depth	Param	QA/QC
SE-031884-120307-DD-077	1520	COR-43	0'-2'	①	-
SE-031884-120307-DD-078	1530	COR-42	0'-2'	①	-

Parameters : ① - 2,3,7,8-TCDD; TOC, Total solids, Grain size
-17:00 - all off site
- take samples to FEDEX

12-3-07 Exit

AR100907

12-04-07 #031884 1 (34)

CRA - D DeNike
Exponent - K Cerreto
Anchor - D Guilter
Normandeau - Rich, Andrew, Mike
Weather - partly cloudy; 30-45°F
H+S - level D
Task - sediment coring

07:00 - H+S tailgate meeting (see sign in form)

07:00 - 08:20 - prepare for coring & get additional supplies

08:00 - process COR-40 (cored previous day)
- see sample Key (page 35) for details
- see field form for description

11:30 - EPA representative Bill Huggins + John on site

12-04-07 #031884 (35)

Sample Key

Sample ID	Time	Location	Depth	Param	QA/QC
SE-031884-120407-DD-079	0820	COR-40	0'-2'	1	—
SE- -080	0845	COR-40	2'-3.3'	1	—
SE -081	12:30	COR-41	0'-1.7'	1	—
SE -082	12:40	COR-41	1.7'-3.5'	1	—
SE- -083	14:20	COR-39	0-17"	1 2	EPA split
SE- -084	14:30	COR-39	17"-33"	1 2	
SE-031884-120407-DD-085	1615	COR-38	0'-2'	1	MS/MSD

Parameters: 1 2,3,7,8-TCDD; TOC; Total Solids; grainsize
2 - TCL SVOC, TCL Pesticide; TCL PCB; Site specific Metals
TCDD/TCDF

12-04-07 #031884 (36)

- spoke to Jeff Daniel (CRA) and (Anchor) about changing intervals for NRC core - we will add sample
- and process next day
1230 - receive COR-41 and NRC-8
- do not process NRC core ; process COR-41
- see field form for description and sample Key for details (page 35)
1400 - Normandeau brings COR-39 to shore
- added parameters at both intervals due to hydrocarbon-like odor
- process core
- see sample key (page 35) for details
- see field form for description
- split sample with ERM 0'-1.7'
15:50 - Normandeau returns with COR-38
- see field form for description
- see sample Key (page 35) for details
- processed core
- extra volume for MS/MSD

12-05-07 #031884 (37)

CRA - DiBeibe
Exponent - K Cerreto
Anchor - DGHillingham
Normandeau - Rich, Mike, Matt, Andrew
Weather - overcast, snow showers potential rain showers AM; 29-40°F
Task - sediment coring; sample processing
H+S - level D

07:00 - H+S tailgate meeting - see sign in form
- review HASP with new Normandeau (Matt)
07:15 - 08:15 - prepare for coring
08:15 - Normandeau crew off to next location
- CRA + Exponent move drums to fenced in area at front of Bldg (soil, water, PPE)
- all sample parameters 2,3,7,8-TCDD, TOC, total solids, and grainsize unless otherwise noted
- additional parameters - TCL SVOC, TCL pesticides, site specific metals, TCDD/TCDF, and TCL PCBs are other parameters
- all samples for COR - locations

AR100909

12-05-07 #031884 (38)

homogonized in stainless steel bowl
each interval
- all equipment decoNed between interval
- all samples placed in ice-chilled cooler
as collected
~~1040~~ 08:45 Normandeau to come to shore - too slippery to work in canoe
10:45 - Normandeau returns to base to
resume work weather clears
- EPA on site 10 minutes
08:45 - start to process COR-35
- see sample key for sample details
on page 39
- see field form for soil description
11:00 - start to process NRC-8 ~~and~~ following
new procedures - 2.5 cm interval top
50 cm then 5 cm intervals; do
not have to composite it is to be
completed at lab (see page 40-41 for details
- Normandeau made 5 attempts at COR-37
16:10 - Normandeau at shore with
COR-36 - see field form for details &
description + sample key (page 39) for sample collected
- made 5 attempts at COR-37,
could not penetrate - went up and
downstream of original location
see archive notes

12-05-07 # 031884 (39)

Sample Key

Sample ID	Time	Location	Depth	Param	QA/QC
SE-031884-120507-~~DD~~086	0850	COR-35	0-24"	1	–
SE- -087	0900	COR-35	0-24"	1	dupe of 086
SE- -088	0910	COR-35	24"-48"	1	–
SE- -089	0920	COR-35	48-72"	1	–
SE- ~~-090~~ -123	1630	COR-36	0-24	1	
SE- -124	1640	COR-36	24-48	3 2	
SE- -125	1650	COR-36	48-72	3 2	
SE- -126	1700	COR-36	72-96	Hold 2 Jars	–
SE-031884-120507-127	1710	COR-36	96-~~108~~ 108	Hold 2 Jars	–

On Ice

Parameters: ① 2,3,7,8-TCDD; TOC; Total solids; Grainsize
② TCL SVOC; TCL PCB; TCL Pesticides; TCDD/TCDF; Site Specific Metals
③ Be-7; Cs-137; Total solids
Hold jars = archive samples

AR100910

12-05-07 #031884 (40)

Sample ID	Time	Location	cm Depth	Para	QA/QC
SE-031884-120507-NN-090	1200	NCR-08	0-2.5	3	—
-091	1205		2.5-5		
-092	1210		5-7.5		
-093	1215		7.5-10		
-094	1220		10-12.5		
-095	1225		12.5-15		
096	1230		15-17.5		
097	1235		17.5-20		
098	1240		20-22.5		
099	1245		22.5-25		
100	1250		25-27.5		
101	1255		27.5-30		
102	1300		30-32.5		
103	1305		32.5-35		
104	1310		35-37.5		
105	1315		37.5-40		
106	1320		40-42.5		
107	1325		42.5-45		
108	1330		45-47.5		
109	1335		47.5-50		
110	1340		50-55		
111	1345		55-60		
112	1350		60-65		
SE-031884-120507-NN-113	1355		65-70		

12-05-07 #031884 (41)

Sample ID		Time	Location	cm depth	Para	QA/QC
SE-031884-120507-NN-	~~090~~ 114	1400	NCR-08	70-75	3	—
	-115	1405		75-80		
	-116	1410		80-85		
	-117	1415		85-90		
	-118	1420		90-95		
	-119	1425		95-100		
	-120	1430		100-105		
	-121	1435		105-110		
SE-031884-120507-NN	-122	1440		110-115		

Parameters (3): Be-7; Cs-137; total solids; potential Pb-210
- hold all samples

- complete packing codes
Nav mandery off site 1715, EPA off site
- cert / Expert / Andar off site 1815
Take sample to FED-EX

[illegible signature]

AR100911

12-06-07 #031884 42

CRA - V Reitner
Exponent - K Cerreto
Anchor - D Gillingham
Normandeau - Rich, Mike, Andrew, Matt
Weather - clear to partly cloudy; 19-35°F
H&S - level D
Task - sediment coring + processing
Method - new 10' ~~battery~~ butt/vibracore each location
③ - Cs-137, Be-7, total solids, potential Pb-210
samples - every 2.5cm first 50 cm; then every 5cm ~~to~~ until 6' depth max;
lab to composite
- use pre cleaned SS knife + spoons to fill jars
① 2,3,7,8-TCDD; total solids, TOC, grainsize composited in SS bowl with SS spoon over interval
② TCL (S)VOC, TCL PCB, TCL Pesticide; TCDD/TCDF site specific metals - combined with #1 method above at select locations
- all samples placed in ice chilled cooler as collected
0700 - H&S tailgate meeting - see sign in form
0915 - John Elgan on site (from START)
0800 - pick up additional supplies + complete decon from previous day

12-06-07 #031884 43

1145 - got $\boxed{COR-33}$ from Normandeau
- see field form for description
- see sample key (page 44) for details of samples
1200 - start to process ~~COR-4~~ NRC-?
- see field form for details / description
- see sample key page 44-45 for sample information
1540 - no penetration at COR-31 and COR-32
- speak to ~~Jeff~~ Daniel about no penetration
- all samples placed in ice-chilled cooler as collected
1930 - off site, take sample to Fed-Ex

OC
on
Cal

AR100912

12-06-07 #031884

Sample Key

Sample ID	Time	Location	Depth	Param	QA/QC
SE-031884-120607-DD-128	1205	COR-33	0-21"	1 (2)	EPA Split
-129	1225	NRC-07	0-2.5 cm	3	—
-130	1230		2.5-5		—
-131	1235		5-7.5		—
-132	1240		7.5-10		—
-133	1242		10-12.5		—
-134	1244		12.5-15		—
-135	1246		15-17.5		—
-136	1248		17.5-20		—
-137	1250		20-22.5		—
-138	1252		22.5-25		—
-139	1254		25-27.5		—
-140	1256		27.5-30		—
-141	1258		30-32.5		—
-142	1300		32.5-35		—
-143	1302		35-37.5		—
-144	1304		37.5-40		—
-145	1306		40-42.5		—
-146	1308		42.5-45		—
-147	1310		45-47.5		—
-148	1312		47.5-50		—
-149	1314		50-55		—
-150	1316		55-60		—
SE-031884-120607-DD-151	1318		60-65 cm	3	—

12-06-07 #031884

Sample ID	Time	Location	Depth	Param	QA/QC
SE-031884-120607-DD-152	1320	NRC-07	65-70 cm	3	—
-153	1322		70-75		—
-154	1324		75-80		—
-155	1326		80-85		—
-156	1328		85-90		—
-157	1330		90-95		—
-158	1332		95-100		—
-159	1334		100-105		—
-160	1336		105-110		—
-161	1338		110-115		—
-162	1340		115-120		—
-163	1342		120-125		—
-164	1344		125-130		—
-165	1346		130-135		—
-166	1348		135-140		—
-167	1350		140-145		—
-168	1352		145-150		—
-169	1354		150-155		—
-170	1356		155-160		—
-171	1358		160-165		—
-172	1400		165-170		—
SE-031884-120607-DD-173	1405	NRC-07	170-175	3	—
~~-174~~					
~~-175~~					
~~-176~~					

DD 12-06-07

12-07-07 #031884 (46)

CRA - D Reitner

Exponent - K Cereto

Anchor - D Gillighan

Normandeau - Mike, Matt, Andrew

Weather - overcast, 45°F, chance showers

HTS - level D

Task - sediment coring + processing

Method - same as previous day

0700 - HTS tailgate meeting

Parameters -

① ~~FC~~ 2,3,7,8-TCDD; TOC, total solids, grain size

② TCL SVOC, TCL PCBs, TCL Pesticide, TCDD/TCDF

③ Be-7; Cs-137; total solids; potential Pb-210 (all Hold)

0800 - 1100 - onboard observing coring

- D Gillighan taking notes (Anchor)
- all samples placed in ice chilled cooler as collected
- did not take samples to Fed-Ex due to limited number + samples

- No penetration NRC ~~NER~~-06

12-07-07 #031884 (47)

Sample ID	Time	Location	Depth	Param	Obs/
SE-031884-120707-DD-174	1200	COR-30	0-24"	①	–
SE-031884-120707-DS-175	1215	COR-30	24"-30	①	–

No penetration COR-29 and COR-27 - 5 attempts at each location

able to collect core sample from COR-28

- end day

12-08-08 #031884 48

CRA Meeting
EXPonent - K Cereto
Anchor - D Guillaume
Normandeau - Mike, Matt, Andrew
weather overcast, 40°F
HAS - level D
Task - sediment coring / processing
Method - same as previous day
0700 - HAS tailgate meeting
800 - launch john boat
0830 - 0900 - return to hotel to pick
up sampling jars & coolers
Parameters
① - 2,3,7,8-TCDD; TOC, total solids, Grainsize
② TCL SVOC, TCL PCB, TCL Pest/ach, TCDD/TCDF;
site select metals
processed sample COR-28; added
extra sample due to odor (metallic?)

1050 - collect Rinse blank from new Sampler
sediment tube for all parameters
"W-031884-120808-NA-176" total
in containers

- could not get a sample from COR-26
(no penetration after 5 attempts)

12-08-08 #031884 49

Sample Key	Location	Depth	Time	Param	QA/QC
SE-031884-120808-NA-176	COR-28	0"-24	1010	②+①	EPA split
W-031884-120808-NA-177	sampler line	—	1050	①/②	rinse blank
SE-031884-120808-NA-178	COR-25	0"-14"	1415	①	EPA split
SE 031884-120808-NA-179	COR-23	0"-24"	1610	①	—

1400 - start to process Core-25
1600 - start to process COR-23
- no recovery at COR-24
- all samples placed in cooler with
ice; will be shipped on Monday
Dec 10/07

[illegible signature]

AR100915

CRA - D Deifner, P Mackoe

Exponent - K Cerreto

Anchor - D Gillingham

Normandeau - Matt, Mike, Andrew

Task - sediment coring + processing

weather - cloudy, showers, 50°F

HTS - level D

07:00 - HTS tailgate meeting

Sample Method - same as previous day

Parameters: (1) - 2,3,7,8-TCDD; TOC; Total Solids; Grainsize

(2) TCL SVOC; TCL PCB; TCL Pesticide; TCDD/TCDF; Site specific Metals

(3) Be-7; Cs-137; Total Solids

- all samples placed in ice-chilled cooler as collected

- see sample Key for all sample info

10:45 Normandeau on shore with ~~COR~~ - 22

1100 started processing COR-22

from N541256.095 E1731755.933

depth of water 5.7'

11:~~20~~ 10 Collected sediment interval 0-2'

Sample ID: SE-031884-121007-DD-180

11:20 Collected sediment interval 24"-~~44~~ 48"

Sample ID: SE-031884-121007-DD-181

See Field form for details

12/10/07 DD

→ 52

Sample Key

Sample ID	Time	Location	Depth	Param	QA/QC
SE-031884-121007-DD-180	1110	COR-22 0-2	0-2	1	
SE-031884-121007-DD-181	1120	COR22	24"-48"	2	
" -182	1330	NRC05	0-2.5cm	3	
-183	1335	NRC05	2.5-5		-
-184	1340	NRC05	5-7.5		-
-185	1345		7.5-10		-
-186	1350		10-12.5		-
-187	1355		12.5-15		-
-188	1400		15-17.5		-
-189	1405		17.5-20		-
-190	1410		20-22.5		-
-191	1415		22.5-25		-
-192	1420		25-27.5		-
-193	1425		27.5-30		-
-194	1430		30-32.5		-
-195	1435		32.5-35		-
-196	1440		35-37.5		-
-197	1445		37.5-40		-
-198	1450		40-42.5		-
-199	1455		42.5-45		-
-200	1500		45-47.5		-
-201	1505		47.5-50		-
-202	1510		50-52.5		-

→ 53

12/10/07 031884 52

12:50 Normandeau on shore with NRC-05 & COR-21
13:15 Start to process NRC-05
(see field form for details)
Collected samples at 2.5cm intervals from 0cm - 50cm
see sample key page 51 and 53
Collected samples at 5cm intervals from 50cm - 110cm
see sample key page 51 and 53.
Depth of water - 8.2'
Length of core - 6'
16:10 Start to process COR-21
(see field form for details)
Location N54 2074.456 E1731075.641
Depth of water 3.0'
Length of core 10'
16:25 Collected sample from sediment interval 0-2'
Sample ID: SE-031884-121007-DD-213
SE-031884-121007-DD-214 is A Duplicate of 213
Sample # 213 is an EPA split.
16:35 Collected sample from sediment interval 2'-4' Sample ID: SE-031884-121007-DD-215
16:40 Collected sample from sediment interval 4'-6'
Sample ID: SE-031884-121007-DD-216.
16:45 Collected sample from interval 72"-78" (Archived)
ID: SE-031884-121007-DD-217 FOR ARCHIVE

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SAMPLE KEY

SAMPLE ID	TIME	LOCATION	DEPTH	PAR	QA/QC
SE-031884-121007-DD-203	1515	NRC05	55-60cm	5	-
" -204	1520		60-65cm		-
-205	1525		65-70		-
-206	1530		70-75		-
-207	1535		75-80		-
-208	1540		80-85		-
-209	1545		85-90		-
-210	1550		90-95		-
-211	1555		95-100		-
-212	1600		100-105		-
~~-213~~	~~1605~~		~~105-110~~		-

12.10.07

SAMPLE ID	TIME	LOCATION	DEPTH	PAR	QA/QC
SE-031884-121007-DD-213	1625	COR21	0-2	1	EPA SPLIT
" -214	1630		0-2		DUP
-215	1635		2-4		-
-216	1640		4-6		-
-217	1645		72"-78"		-

Samples sent to Fed EX

12.10.07

12-11-07 #031884 54

CRA - D Deither; F MacKie
Exponent - K Cerreto
Anchor - D Gillingham
Normandeau - Matt, Andrew, Mike
Task - sample processing + coring
Weather partly cloudy; chance showers; 50-28F
H+S - level D
07:00 - H+S tailgate meeting
Sample method - same as previous day
Parameters: ① - 2,3,7,8-TCDD; TOC; total solids; grain size
② TCL SVOC, TCL PCB; TCL Pesticides; TCDD/TCDF; site specific metals
③ Be-7; Cs-137; Total solids
- see sample Key for all sample information
8:00 Started to process $\boxed{\text{COR-20}}$ extracted 12.10.07
(see field log for details)
Location: N542793.221 E1730507.804
Water Depth: 19.1'
Core Length: 31.5"
8:30 Collected sample from sediment interval 0-2' Sample ID # SE-031884-121107-DD-218
Sample #218 is a MS/MSD.
8:35 Collected sample from sediment interval 24" - 31.5" Sample ID # SE-031884-121107-DD-219
Sample #219 is archived.

56 →

12-11-07 #031884 55

SAMPLE KEY

Sample ID	Time	Location	Depth	Param	QA/QC
SE-031884-121107-DD-218	8:30	COR-20	0-2'	①	MS/MSD
SE-031884-121107-DD219	8:35	↓	24"-31.5"	Archive	
" -220	9:00	COR-19	0-7"	~~Archive~~ 12.11.07	
-DD221	13:05	COR-18	0-2'	①	

*12:00 W.V DEP ~~U.S. EPA~~ 12.11.07 Tom Bass
U.S EPA John Nelson on site.

12.11.07

8:40 Started to process $\boxed{\text{COR-19}}$
Extracted 12.10.07 by Normandeau
9:00 Collect sample from sediment interval 0-7".
Sample ID# SE-031884-121107-DD-220
~~Sample Archived.~~ KMC Sample will be submitted, although overlap w/ surficial penetration sample (4") may make the core sample redundant.
12:25 Started to process $\boxed{\text{COR-18}}$
extracted by Normandeau 12-11.07.
(see field log for details)
* current caused core to enter at an angle.
Location:
Water Depth:
Core Length: 27"
13:05 Collect sample from sediment interval 0-2' Sample ID: SE-031884-121107-DD-221

12-11-07

CRA - D Reitmer, F Mackie
Exponent - K Cerato
Anchor - D Gillingham
Normandeau - Matt, Andrew, Mike
Task - sample coring + processing
Weather - cloudy, showers, 55°F
H+S - level D
0700 - H+S tailgate meeting - see sign in form
sample method - same as previous ~~sp~~ 12-12-07
Parameters ① 2,3,7,8-TCDD; TOC; total solids, grain size
② TCDD/TCDF; site select metals; TCL SVOC; TCL Pesticides, TCL PCB
③ Be-7; Cs-137; Total Solids
* U.S. EPA John Nelson on site
10:30 Start to process $\boxed{\text{COR-04}}$
extracted by Normandeau 12-12-07
(see field log for details)
Location: N561853.890 E 413575.506 12-12-07
Water Depth: 0.9'
Core Length: 8'2"
Average Compaction: 82%
11:00 Collected sample from sediment interval 0-~~1.7~~ 2' *(actual interval 0-1'7") based on 82% compaction 12-12-07
~~Sample ID# SE~~
Sample ID: SE-031884-121207-DD-269

→ (60)

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SAMPLE KEY

Sample ID	Time	Location	Depth	Par	QA/QC
SE-031884-121207-DD-222	14:00	NRC02	0-2.5cm	3	
" 223	14:02	"	2.5-5		-
224	14:04		5-7.5		-
225	14:06		7.5-10		-
226	14:08		10-12.5		-
227	14:10		12.5-15		-
228	14:12		15-17.5		-
229	14:14		17.5-20		-
230	14:16		20-22.5		-
231	14:18		22.5-25		-
232	14:20		25-27.5		-
233	14:22		27.5-30		-
234	14:24		30-32.5		-
235	14:26		32.5-35		-
236	14:28		35-37.5		-
237	14:30		37.5-40		-
238	14:32		40-42.5		-
239	14:34		42.5-45		-
240	14:36		45-47.5		-
241	14:38		47.5-50		-
242	14:40		50-55		-
243	14:42		55-60		-
244	14:44		60-65		-

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SAMPLE KEY

Sample ID	Time	Location	Depth	Par	QA/QC
SE-031884-121207-DD 245	14:46	NRC-02	65-70cm	3	
246	14:48		70-75		-
247	14:50		75-80		-
248	14:52		80-85		-
249	14:54		85-90		-
250	14:56		90-95		-
251	14:58		95-100		-
252	15:00		100-105		-
253	15:02		105-110		-
254	15:04		110-115		-
255	15:06		115-120		-
256	15:08		120-125		-
257	15:10		125-130		-
258	15:12		130-135		-
259	15:14		135-140		-
260	15:16		140-145		-
261	15:18		145-150		-
262	15:20		150-155		-
263	15:22		155-160		-
264	15:24		160-165		-
265	15:26		165-170		-
266	15:28		170-175		-
267	15:30		175-180		-
268	15:32		180-185		

(60) 031884 12.12.07

~~1030 Started to process~~ ~~COR-4~~

~~See field log for details~~

~~Location~~ 0.4', 12.12.07

~~Depth of water 0.4'~~

~~Length of core 10'~~ 12.12.07

~~Recovery 8'2"~~

~~(See page~~

11:05 Collected sample from sediment interval 2'-4' (1'7" - 3'2') based on 82% compaction

Sample ID: SE-031884-121207-DD-270

11:10 Collected sample from sediment interval 4'-6' ~~(3'2"-4'9")~~ ~~based on 82% compaction~~ 12.12.07

Sample ID: SE-031884-121207-DD-271

11:15 Collected sample from sediment interval 6'-8' ~~(4'9" - 6'4")~~ ~~based on 82% compaction~~ 12.12.07

Sample ID: SE-031884-121207-DD-272

Sample sent for archiving

11:20 Collected sample from sediment interval 8-10' ~~(6'4" - 7'11")~~ ~~based on 82% compaction~~ 12.12.07

Sample ID: SE-031884-121207-DD-273

→ (62)

12.12.07 031884 (61)

Sample ID	Time	location	Depth	Para	QA/QC
SE-031884-121207-DD-~~270~~ 269	1100	COR4	0-2	(1)	
SE-031884-121207-DD-270	1105	COR-4	2-4	(1)	
SE-031884-121207-DD-271	1110	COR-4	4-6	(1)	
SE-031884-121207-DD-272	1115	↓	6-8	Archive	
↓ -273	1120	↓	8-10	Archive	

12.12.07

12.12.07 031884 (62)

13:30 Start to process $\boxed{\text{NRC-02}}$
retrieved by Normandeau 12.12.07
(See field log for details)
Location ID: N561885.940 E1713596.929
Water Depth: 1.2'
Core Length: 7'8"
Collected samples ~~from~~ at 0-25cm 12.12.07
from 0-50cm.
See sample key page (58) & (59)
for sample ID and details
collected samples at 0-5cm from
50cm-185cm.
See sample key page (58) & (59) for
sample ID and details

Samples sent to Fed Ex

12.12.07

12.13.07 031884 (63)

CRA: D. Deitner, F. Machie
Exponent: K. Cerreto
Anchor: D. Gillenham
Normandeau: Matt, Andrew, ~~Matt~~ Mike 12.13.07
Task: Sample coring and processing
Weather: Overcast, 50°F, Heavy Rain
H&S: Modified level D.

8:00Am Arrive on Site, Health and Safety Meeting 12.13.07
CRA representative and Normandeau
representative meeting with Army Corps of
Engineers.
9:00 Start to process $\boxed{\text{COR-03}}$
extracted by Normandeau 12.12.07
(See field log for details)
Location: N561024.731
E1713104.241
Water Depth: 0.8'
Core Length: 8'11"
Cored Length: 10' (89% recovery)
9:25 Collected sample from
interval 0-2'
Sample ID: SE-031884-121307-DD-274
12.13.07 ~~(64)~~ →
(65)

12.13.07 031884 64

Sample Key

ID	Time	Location	Depth	QA/QC
SE-031884-121307-DD-274	9:25	COR-03	0'-2'	①
" -275	9:30	↓	2'-4'	↓
-276	9:35		4'-6'	↓
-277	9:40		6'-8'	Archive
-278	9:45	↓	8'-8'11"	Archive
-279	10:30	COR-08	0'-2'	~~①~~ ① ②
-280	10:35	↓	2'-4'	①②
W-031884-121307-DD-281	11:00	—	—	Rinse Blank

12.13.07

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9:30 Collected sample from interval 2-4'
Sample ID: SE-031884-121307-DD-275
9:35 Collected sample from interval 4-6' Sample ID: SE-031884-121307-DD-276
9:40 Collected sample from interval 6-8' Sample ID: SE-031884-121307-DD-277
9:45 Collected sample from interval 8'-8'11" Sample ID: SE-031884-121307-DD-278
10:00 Begin to process COR-08 extracted by Normandeau 12.12.07 (see Field log for details)
Location: E1717129.45 N 562411.269
Water Depth: 20.8'
Core Length: 4'
Cored Length: 4'
10:30 Collected sample from interval 0-2'.
Sample ID: SE-031884-121307-DD-279
~~10:35~~ Collected sample from interval
10:35 2'-4'. ID: SE-031884-121307-DD-280
Sample sent for analysis of additional parameters ① and ② (see endnote)

66 →

12·13·07 031884 (66)

11:00 Collect Equipment Blank
W-031884-121307-DD-281

* Note: Parameter Analysis
① 2,3,7,8,-TCDD, TOC, Grain Size, Total Solids.
② 2,3,7,8-TCDD, TCDD/TCDF, Total Solids, TOC, TCL SVOC, TCL Pesticides, TCL PCB, Site Specific Metals, Grain Size
③ Be-7, Cs-137, Total Solids
-See Sample Key for Sample information
* Samples sent to Fed-Ex.

12/13/07
CD

12·14·07 031884 (67)

CRA: D. Deitner, F. Mackie
Exponent: K. Cerreto
Anchor: D. Gillenhan
Normandeau: Matt, Andrew, Mike
Task: Sample, Coring, and Processing
Weather: Overcast, 45°F
H&S: Modified Level D.

7:00 ~~AM~~ 12·14·07 H&S Tailgate Meeting
7:15 Boat launch, sample method same as previous.
Parameters sampled for:
① 2,3,7,8-TCDD; TOC, Total Solids; Grain Size
② TCL SVOC; TCL PCB; TCL Pesticides, TCDD/TCDF; Site Specific Metals
③ Be-7; Cs-137; Total Solids
* See sample key for sample information
10:00 Begin to process $\boxed{\text{COR-07}}$ extracted by Normandeau 12·14·07 (See field log for details)
Location: N 563513.888 E 1715757.471
Water Depth: 29'
Cored Length: 3'

(68) →

12·14·07 031884 (68)

Core Recovery: 35.5" (2' 11.5")
10:30 Collect sample from interval 0-2'
Sample ID: SE-031884-121407-DD-282
10:35 Collect sample from interval 24"-35.5"
Sample ID: SE-031884-121407-DD-283
12:30 Begin to process NRC-02
extracted by Normandeau, 12·14·07
(See field log for details)
Location ID: N561468.412 E1719638.696
Water Depth:
Cored Length: 10 Core Length: 9' 8"
Collected samples at 0-2.5cm intervals
from 0-50cm.
see page (69) & (70) for sample key information
Collected samples at 5cm intervals from
50-175cm.
see page (69) and (70) for sample key information
Samples sent to Fed Ex

12·14·07

12·19·07 031884 (69)

Sample Key

ID	Time	Location	Depth	Par	QA/QC
SE-031884-121407-DD-282	10:30	COR-07	0-2'	1	
"-283	10:35	↓	24"-35.5"	↓	
-284	13:00	NRC02	0-2.5cm		-
-285	13:02		2.5-5.0		-
-286	13:04		5.0-7.5		-
-287	13:06		7.5-10.0		-
-288	13:08		10.0-12.5		-
-289	13:10		12.5-15.0		-
-290	13:12		15.0-17.5		-
-291	13:14		17.5-20		-
-292	13:16		20-22.5		-
-293	13:18		22.5-25		-
-294	13:20		25-27.5		-
-295	13:22		27.5-30		-
-296	13:24		30-32.5		-
-297	13:26		32.5-35		-
-298	13:28		35-37.5		-
-299	13:30		37.5-40		-
-300	13:32		40-42.5		-
-301	13:34		42.5-45		-
-302	13:36		45-47.5		-
-303	13:38		47.5-50		-
-304	13:40	↓	50-55		-

(70) →

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Sample Key

ID	Time	Location	Depth	Par	QA/QC
SE-031884-121407-DD-305	13:42	NRC02	55-60 cm	3	-
-306	13:44		60-65	"	-
-307	13:46		65-70		-
-308	13:48		70-75		-
-309	13:50		75-80		-
-310	13:52		80-85		-
-311	13:54		85-90		-
-312	13:56		90-95		-
-313	13:58		95-100		-
-314	14:00		100-105		-
-315	14:02		105-110		-
-316	14:04		110-115		-
-317	14:06		115-120		-
-318	14:08		120-125		-
-319	14:10		125-130		-
-320	14:12		130-135		-
-321	14:14		135-140		-
~~-320~~ 322 12.14.07	14:16		140-145		-
-323	14:18		145-150		-
-324	14:20		150-155		-
-325	14:22		155-160		-
-326	14:24		160-165		-
-327	14:26		165-170		-

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Sample Key

ID	Time	Location	Depth	Par	QA/QC
SE-031884-121407-DD-328	14:28	NRC02	170-175 cm	3	-
-329	14:30		175-180 cm		-
-330	14:32		180-185		-

12.14.07

AR100926

12·15·07 031884 (72)

CRA: D. Deitner, F. Mackie
Exponent: K. Cerreto
Normandeau: Matt, Andrew, Mike
Task: Sample, Coring and Processing
Weather: Cloudy, 35°F
H&S: Modified Level D

7:00 H&S Meeting
7:15 Boat launch. Sampling method same as previous.
* Parameters sampled for:
(1) 2,3,7,8 - TCDD; TOC; Total Solids; Grain Size
(2) TCL SVOC; TCL PCB; TCL Pesticides; TCDD/TCDF; Site Specific Metals;
(3) Be-7; Cs-137; Total Solids
* see sample Key for sample information
8:40 ~~8:00~~ 12:50 Begin to process $\boxed{\text{COR-09}}$
Extracted by Normandeau 12·14·07
Location ID: N561434.631 E17195.526
Water Depth: 17'
Cored Length: 3.3'
Core Recovery: 34"

(74) →

12·15·07 031884 (73)

Sample Key

ID	Time	Location	Depth	Par	QA/QC
SE-031884-121507-DD-331	8:20	COR 11	0-2'	1	
" -332	9:00	COR-09	24"-34"	1	
-333	9:05	COR-09	2'-3.4'	1	EPA Split
-334	1320	COR-12	0-2'	1	EPA Split

12.15.07 031884 (74)

9:00 Collect sample from interval 0-2'
ID: SE-031884-121507-DD-332
9:05 Collect sample from interval 24"-34"
Sample ID: SE-031884-121507-DD-333
* Sample #333 is an EPA Split.

12.15.07
[illegible]

8:00 Begin to process COR-11
Extracted by Normandeau 12.14.07.
Location ID: N559483.089 E1720959.137
Water Depth: 24.5'
Cored Length: 30"
Core Length: 24" (60% Recovery)
8:20 Collect sample from interval 0-2'
ID: SE-031884-121507-DD-331
13:00 Begin to process COR-12
Extracted by Normandeau 12.15.07
Location ID: N558406.269 E1720991.866
Water Depth: 29.5'
Cored Length: 30"
Core Length: 22"
13:20 Collect sample from interval
Sample ID: SE-031884-121507-DD-334

(75) →

12.17.07 031884 (75)

CRA - B Deiter, F Mackie
Exponent - K Cereto
Anchor - AMY
Normandeau - Matt, Mike, Andrew
Task - Sample coring and processing
H&S - level D
weather - partly cloudy; windy; 26-31°F
07:00 - H+S tailgate meeting
07:20 - take boat to barge
SAMPLING Method - same as previous
Parameters: ① 2,3,7,8-TCDD; TOC; Total Solids; Grain size
② TCL SVOC; TCL PCB; TCL Pesticide; TCDD/TCDF; site specific metals
③ Be-7; Cs-137; total solids

No samples collected due to flow conditions

[illegible]

02.20.08 031884 (77)

CRA - D Meitha
Expanet - K Cerreto
Anchor - D Gillmighty
ERA oversight - Gene Napa
weather: overcast, 29-33°F, snow flurries
H+S - level D
Task - sediment coring + processing
07:10 - H+S tailgate meeting
- River flow approx 12000 cfs
07:20 - Normandeau prepares to set up at NRC-04
- Expanet & CRA set up at sample processing area
Sample method - follow sample plan
0845 - start to process $\boxed{\text{NRC-05}}$
- see sample key for details
- sample "335 to 354" in 2.5cm intervals
- sample "355 to 374" in 5cm intervals
All samples collected placed on hold until further instruction; test parameters Be-7; Cs-137; total solids
1057 - end sample collection; place in cooler with ice
1220 - start to process ~~Ca~~ NRC-04, see sample key for details; all samples submitted for RC analysis
- place samples in ice chilled cooler

AR100929

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Sample Key

ID	Time	Location	Depth	Param	QA/QC
SE-031884-022008-00-335	900	NRC-05	0-2.5cm	3	none
336	903		2.5-5		
337	906		5-7.5		
338	909		7.5-10		
339	912		10-12.5		
340	915		12.5-15		
341	918		15-17.5		
342	921		17.5-20		
343	924		20-22.5		
344	927		22.5-25		
345	930		25-27.5		
346	933		27.5-30		
347	936		30-32.5		
348	939		32.5-35		
349	942		35-37.5		
350	945		37.5-40		
351	948		40-42.5		
352	951		42.5-45		
353	954		45-47.5		
354	957		47.5-50		
SE-031884-022008-00-355	1000		50-55		

Parameters: ① 2,3,7,8-TCDD, Grainsize, TOC
② SVOC, PCB, site specific Metals, TCL Pesticide, PCDD/PCDF
③ Be-7, Cs-137, total solids

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Sample Key

ID	Time	Location	Depth	Param	QA/QC
SE-031884-022008-00-356	1003	NRC-05	55-60	3	none
357	1006		60-65		
358	1009		65-70		
359	1012		70-75		
360	1015		75-80		
361	1018		80-85		
362	1021		85-90		
363	1024		90-95		
364	1027		95-100		
365	1030		100-105		
366	1033		105-110		
367	1036		110-115		
368	1039		115-120		
369	1042		120-125		
370	1045		125-130		
371	1048		130-135		
372	1051		135-140		
373	1054		140-145		
SE-031884-022008-00-374	1057		145-150		
SE-031884-022008-00-375	1220	NRC-04	0-2.5 cm		
376	1223		2.5-5		
377	1226		5-7.5		
SE-031884-022008-00-378	1229		7.5-10		

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Sample Key

ID	Time	Location	Depth	Param	QA/QC
SE-031884-022008-MD-379	~~1220~~	NRC-04	10-12.5cm	3	none
-380	~~1223~~ 1232		12.5-15		
-381	~~1226~~ 1235		15-17.5		
-382	~~1229~~ 1238		17.5-20		
-383	~~1232~~ 1241		20-22.5		
-384	~~1235~~ 1244		22.5-25		
-385	~~1238~~ 1247		25-27.5		
-386	~~1241~~ 1250		27.5-30		
-387	~~1244~~ 1253		30-32.5		
-388	1256		32.5-35		
-389	1259		35-37.5		
-390	1302		37.5-40		
-391	1305		40-42.5		
-392	1308		42.5-45		
-393	1311		45-47.5		
-394	1314		47.5-50		
-395	1317		50-55		
-396	1320		55-60		
-397	1323		60-65		
-398	1326		65-70		
-399	1329		70-75		
-400	1332		75-80		
SE-031884-022008-MD-401	1335	NRC-04	80-85	3	none
	1338				

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Sample Key

Sample ID	Time	Depth	Location	Param	QA/QC
SE-031884-022008-MD-402	~~1338~~	85-90cm	NRC-04	3	none
-403	1341	90-95			
-404	1344	95-100			
SE-031884-022008-MD-405	1347	100-105	NRC-04	3	none
	1350				

- Normandeau made 5 attempts at coring each of the following locations: NRC-01, COR-01, COR-02; all attempts resulted in refusal
- wrap coolers + take to Fed-EX
- 1630 arrive back at Hotel, fax COCs, update sample key, update summary table

JA 2/20/08

031884 (82)

SE

SE

02/22/08 031884 (83)

CRA - Dkerke - cancelled work day due to freezing rain till 10AM followed by rain

02/23/08 031884 84

CRA - D Deitra
Expanent - K Cerreto
Anchor - D Gillingham
Normandeau - Andrew, Mike, Matt
H&S - level D
Weather - overcast, light snow/rain mix
35°F
Task - sediment coring & processing
07:00 - H&S tailgate meeting
07:30 - launch boat, move to COR-14
- complete locations COR-14, 15, 16, 17
- see Anchor field notes for details
1330 - start to process samples
1345 - start to process $\boxed{\text{COR-15}}$
- see sample key
- parameters - 2,3,7,8-TCDD, TOC, total solids, grainsize

SE

SE

02/23/08 031884 85

sample key

sample ID	Time	Location	Depth	Param	Q
S-031884-022308-DK 406	1355	COR-15	0-19"	1	-
S-031884-022308-DK-407	1425	COR-16	0-16"	1	-

Parameters: 1 2,3,7,8-TCDD, TOC, total solids, grainsize

AR100933

CRA - DMcGuire
Exponent - K Cerreto
Anchor - D Gillingham
Normandeau - Mike, Matt, Andrew
Task - Demob Normandeau barge; core processing
carbon black sample collection
H+S - level D
Weather - overcast, 35°F
07:00 - H+S tailgate meeting
07:15 - Normandeau demobs barge;
CRA, Exponent, Anchor start to Process
NRC-08 ; For RC analysis; see
sample Key for details
10:00 - Launch Boat for Black Carbon
Analysis
10:30 - set up at BC COR-10
1100 - collect BC-COR-10A (coal sample) (455)
1110 - off set and BC-COR-10B (no coal) (456)
1115 - set (reduced coal) up at BC-COR-13A
- 1120 collect "457" coal sample
- 1145: collect "458" no coal
1150 - move to BC-COR-37
1210 - collect "459" (coal sample) BC-COR-37A
1225 - collect "460" (no coal) BC-COR-37B

Sample Key

Sample ID	Time	Location	(cm) Depth	Param.	QA/[illegible]
S-031884-022408-DD-408	730	NRC-08	0-2.5	2	none
-409	733		2.5-5		
-410	736		5-7.5		
-411	739		7.5-10		
-412	742		10-12.5		
-413	745		12.5-15		
-414	748		15-17.5		
-415	751		17.5-20		
-416	754		20-22.5		
-417	757		22.5-25		
-418	800		25-27.5		
-419	803		27.5-30		
-420	806		30-32.5		
-421	809		32.5-35		
-422	812		35-37.5		
-423	815		37.5-40		
-424	818		40-42.5		
-425	821		42.5-45		
-426	824		45-47.5		
-427	827		47.5-50		
-428	830		50-55		
-429	833		55-60		
S-031884-022408-DD-~~431~~ 430	836		60-65		

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Sample Key

SE

Sample ID	Time	Location	Depth (cm)	Pardy	QA/QC
S-031884-022408-MM-431	839	NRC-08	65-70	3	none
-432	842		70-75		
-433	845		75-80		
-434	848		80-85		
-435	851		85-90		
-436	854		90-95		
-437	857		95-100		
-438	900		100-105		
-439	903		105-110		
-440	906		110-115		
-441	909		115-120		
-442	912		120-125		
-443	915		125-130		
-444	918		130-135		
-445	921		135-140		
-446	924		140-145		
-447	927		145-150		
-448	930		150-155		
-449	933		155-160		
-450	936		160-165		
-451	939		165-170		
-452	942		170-175		
-453	945		175-180		
S-031884-022408-MM-454	948		180-185		

SE

02/24/08 031884 89

Sample ID	Location	Time	Depth	[illegible]	[illegible]
S-031884-022408-MM-455	BC-COR-10A	1100	0-6"	4	-
-456	BC-COR-10B	1110	0-2"	4	-
-457	BC-COR-13A	1120	0-2"	4	-
-458	BC-COR-13B	1145	0-2"	4	-
-459	BC-COR-37A	1210	0-3"	4	-
-460	BC-COR-37B	1235	0-2"	4	-
-461	BC-SSO-26	1300	0-3"	4	-
S-031884-022408-MM-462	BC-SSO-26	1320	0-2"	4	-
S-031884-022408-MM-463	sediment waste drum	1500	-	5	-
W-031884-022408-MM-464	waste water drum	1530	-	5	-

1°

1245 - move to $\boxed{\text{SSO-26}}$

1300 - collected "461" BC-~~[illegible]~~ SSO-26A" coal sample

1320 - collected "462" BC-SSO-26B" no or reduced coal sample

031884
Kanawha River
West Virginia

KARA
COMPANY INC.
FIELD BOOK
49-0000N

CONTENTS

PAGE NO.	REFERENCE	DATE

CRA: S. Gould, R. Bentley
Normandeau: R. Kling, Andrew, Helen
PPE: Level D + PFD, tyvek
0700: Meet Normandeau at LWMS launch
Normandeau sets up sediment sampling vessel and support boat at the St Albans public launch
CRA sets up sample processing area at the marina.
1000: Health and Safety meeting, Normandeau goes over their HASP and plan of the day.
Normandeau plans to collect 3 core locations today.
Randy Cooper, Monsanto and Bill Huggins (Start), Bryan McKinnon (Start) and Suddha Graves (Start) also on-site
1100: Normandeau leaves to setup at 1st location
1230: Dennis Matlock (EPA on site)
1300: Normandeau setup at COR 42 and collect sediment sample
1400: Dennis Matlock off-site

12-9-08 031884-00

Weather: 60's clear and mild

Sample ID	Time	Loc	Depth	Par	QA/QC
SE-031884-120908-SG-001	~~13:40~~ 14:55 15:00	COR42	0-2	①	EPA split
SE-031884-120908-SG-002	15:00	COR42	0-2	①	dup of 001
SE-031884-120908-SG-003	16:10	COR-40	0-2	①	—
SE-031884-120908-SG-004	16:20	COR-40	2-4	①	—
SE-031884-120908-SG-005	16:30	COR-40	4-6	①	MS/MSD

① 2,3,7,8-TCDD, TOC, Total Solids, Grain Size

12/9/08 SY

12-9-08 031884-00

1400: R Kling call to say sample at COR 42 only 0-2 ft

- Called J Daniel - most locations only 4-6' recovery last year, so if only 2' recoverable, that's all we can collect.
- Process sample from $\boxed{\text{COR-42}}$ extracted by Normandeau 12-9-08 (see Field log for details)

Location: 522999.994' N
1724248.898' E

Water Depth: 3'3"

Penetration Depth: 17"

Core Recovery: 16.5"

1500: Collect sample from 0-2'

Sample ID: SE-031884-120908-SG-001

Collect duplicate SE-031884-120908-SG-002 (dup of -001)

1500: Normandeau move to $\boxed{\text{COR-40}}$ extracted by Normandeau 12-9-08 (see Field log for details)

Location: COR-40 523704.638 N' 1725257.736

Water Depth: 5'9"

Penetration Depth: 72"

Core Recovery: 66"

12-9-08

031884-00

1610: Collect Sample from 0-2'

S Sample ID: SE-031884-120908-SG-003

S Collect Sample from 2-4'

Sample ID: SE-031884-120908-SG-004

S Collect Sample from ~~4~~-6'

S Sample ID: SE-031884-120908-SG-005

S - Normandeau move to location $\boxed{36A}$

S 1700: Normandeau attempt at 36A, however core broke off

Done sampling for today

- CRA clean up sample prep. area for the night

1830: CRA, Normandeau off-site

EPA off-site

CRA take samples -001 → -004 to FedEx Airbill # 8620 0190 7256

Note: All samples collected today were split with EPA - they are collecting 1 4oz jar for 2,3,7,8-TCDD only.

[signature] 12/9/08

12-10-08

31884-00

CRA: S. Gould, R. Bentley

Normandeau: Rich, Helen, Andrew

EPA oversight: Bill Huggins, Bryan McKinnon

PPE: Level D with PFD, tyvek

Weather: 50's, heavy rain, fog in a.m.

0700: CRA, Normandeau on-site

H&S Meeting - inclement weather (see field form)

- Normandeau prep. sediment sampling boat and CRA prep. sample prep. area

0730: Bill Huggins and Bryan McKinnon on-site, H&S meeting - inclement weather, boating safety

0745: Normandeau move to $\boxed{\text{COR 36A}}$

1020: CRA collect equipment blank

Sample ID: ~~EB-031884-121008-SG-001~~ 12/10/08

W-031884-121008-SG-001

collected 2- 40ml VOA for TOC

2- 1L Amber for dioxin

1045: Call from Rich King - collected a 0-2' sample at 36A

12-10-08

31884

Sample ID		Time	Loc	Depth	Par	S/NR
S	SE-031884-121008-SG-006	12:40	36A	0-2	1	S
S	SE-031884-121008-SG-007	13:00	36	0-2		—
	SE-031884-121008-SG-008	13:10		2-4		—
S	SE-031884-121008-SE-009	13:20		~~4-6~~ 2-4 12/10/08	dup of -008	
S	SE-031884-121008-SG-010	13:30		~~6-8~~ 4-6 12/10/08		—
S	SE-031884-121008-SG-011	13:40		~~8-10~~ 6-8 12/10/08		—
S	SE-031884-121008-SG-012	13:50		8-10 12/10/08		—
	W-031884-121008-SG-001	10:20	—	—	2	—
	SE-031884-121008-SG-013	17:20	~~36B~~ 12/11/08	0-2	1	—
	SE-031884-121008-SE-014	17:35	36C	0-2		—
	SE-031884-121008-SE-015	17:50	36C	2-4		—

1 2,3,7,8-TCDD, TOC, Grain size, Total Solids
2 TOC, Dioxin

- All samples except equipment blank split with EPA.

12/10/08

SJ[illegible]

12-10-08 31884

4

- Process Sample from $\boxed{\text{COR-36A}}$ extracted by Normandeau 12/10/08 (see field log for details)

location: 525953.061 N, 1725482.782 E

Water depth: 18'

Penetration depth: 12"

Core Recovery: 10.5"

12:40 Collect sample from 0-2'

Sample ID: SE-031884-121008-SG-006

~~Collect sample for~~ 12/10/08 SJ

- Process Sample from $\boxed{\text{COR-36}}$ extracted by Normandeau 12/10/08 (see field log for details)

location: 526313.650 N, 1725685.143E

Water depth: 4'

Penetration depth: 10'

Core Recovery: 9'

13:00 Collect sample from 0-2'

Sample ID: SE-031884-121008-~~SG~~-007

~~- Process~~ 12/10/08 SJ

13:10 Collect sample from 2-4' and a duplicate

Sample ID: SE-031884-121008-SG-008

SE-031884-121008-SG-009

dup. collected at 13:20

12/10/08 31884-00

13:30 Collect sample from 4-6'
Sample ID: SE-031884-121008-SG-010
13:40 Collect sample from ~~8~~-8' 12/10/08 sg
Sample ID: SE-031884-121008-SG-011
13:50 Collect sample from 8-10'
sample ID. SE-031884-121008-SG-012

-Process sample from $\boxed{\text{COR-}\cancel{32}\text{ 36 -B}}$ 12/11/08 sg
extracted by Normandeau 12/10/08
(see field log for details)
location: ~~5249173.875 N~~ 12/10/08 sg ~~1729846.029'E~~ 12/10/08 sg
526781.794 N
1726044.552E
water depth: ~~13' 7"~~ 12/10/08 sg 25' 2"
Penetration depth: ~~9'~~ 12/10/08 14"
Core Recovery: ~~7' 8"~~ 12/10/08 12"
17:20 Collect sample from 0-2'
Sample ID: SE-031884-121008-SG-013

-Process sample from $\boxed{\text{COR-36C}}$
extracted by Normandeau 12/10/08
(see field log for details)
location: 526956.636' N, 1726186.614'E
water depth: 24' 1"
Penetration depth: 48"
Core Recovery: 40"

12/10/08 31884-00

17:35 Collect sample from 0-2'
Sample ID: SE-031884-121008-SG-014
17:50 Collect sample from 2-4'
Sample ID: SE-031884-121008-SG-015

18:00 Normandeau, EPA, CRA discuss plan for tomorrow. Bill Huggins would like us to re-do the COR-32A location as he believes they were not on location. Normandeau attempted 5X and had no recovery, only small pebbles. Bill Huggins will mark the locations with a buoy tomorrow. Normandeau will record the new coordinates.
-All samples collected today were split with EPA. EPA is sampling for full dioxin analysis.
18:15 Normandeau, EPA off-site
-CRA prepare samples for FedEx and cleanup work area
18:30 CRA off-site

12/10/08 sg

12/11/08 31884

CRA: S. Gould, R. Bentley
Normandeau: R. Kling, Andrew, Helen
EPA: B Huggins, B. MacKinnon
PPE: Level D, plus PFD
Weather: 30s, rainy, fog in a.m.
steady rain
0700: CRA, Normandeau on-site
H&S Meeting - slips, trips, and
falls, weather safety
0730: EPA on-site, re-do H&S
Meeting for EPA.
Plan of the day is to continue
to collect sediment cores
at 32-B, 28-A, 31, and to redo
loc. 32-A where refusal was
met yesterday.
0830: Call to Jeff Daniel to let
him know we are re-doing
loc COR32A. as per EPA.
0845: Call to Paul Wiseman to
confirm waste analysis
requirements
- will collect 5 amber 1L
bottles for water and
2 16oz jars and 1 4oz jar
for soil

12/11/08 31884 6

- Paul to call back to confirm
analytical.
0900: CRA setup sample prep.
area
- Process sample from $\boxed{32\text{-}B}$
extracted by Normandeau 12/11/08
(see field log for details)
location: 529173.875' N
1729846.029' E
water depth: 13'2"
Penetration depth: 9'
Core Recovery: 7'8"
11:10 Collect sample from 0-2'
sample ID: SE-031884-121108-SG-016
11:20 Collect sample from 2-4'
sample ID: SE-031884-121108-SG-017
and ~~dupl~~ extra volume for ms/msd
12/11/08 [initials]
11:35 Collect sample from 4-6'
sample ID: SE-031884-121108-SG-018
11:40 Collect sample from 6-8'
sample ID: SE-031884-121108-SG-019
1240: Call to Rich Kling
Attempted five tries at $\boxed{COR\text{-}31}$
met refusal (see field log for details)

AR100942

12/11/08 31884

Sample ID	Time	Loc	Depth	Par	QA/QC
SE-031884-121108-SG-016	11:10	32B	0-2'	1	—
SE-031884-121108-SG-017	11:20		2-4'		MS/MSD
SE-031884-121108-SG-018	11:35		4-6'		—
SE-031884-121108-SG-019	11:40		6-8'		—
W-031884-121108-SG-002	14:45	—	—	2	—
SE-031884-121108-SG-020	16:10	28A	0-2'	1	—
SE-031884-121108-SG-021	16:25	32A	0-2'	1	—
WW-031884-121108-SG-001	17:00	—	—	3	—
WS-031884-121108-SG-001	17:06	—	—	3	—

① 2,3,7,8 - TCDD, TOC, Grain Size, Total Solids

② TOC, Dioxin

③ TCL VOC, PCDD/PCDF, TCL SVOC, TCL Pest., TCL PCB, Target Metals

- All samples except equip. blank and waste characterization split with EPA

12/11/08
SJoudel

12/11/08 31884 7

- Normandeau moving to COR-28A next

1445: Collect equipment blank
Sample ID: W-031884-121108-SG-002

- CRA Pack coolers for FedEx

- call from Rich Kline. Refusal at location 28-A. They were able to obtain ~~appx~~ 12/11/08 SJ approx 6" of sediment to be sampled. possibly (clay).

- Normandeau Move to COR-32A to attempt a sixth ~~of~~ 12/11/08 SJ try.

- Process sample from $\boxed{28A}$ extracted by Normandeau 12/11/08 (see field log for details)

location: 530361.864 'N
1732307.659 'E

water depth: 15' 10"

penetration depth: ~~10"~~ 8" 12/11/08 SJ (28A-2)

core recovery: 6"

16:10 collect sample from 0-2'

sample ID: SE-031884-121108-SG-020

12/11/08 31884-00

- process sample from $\boxed{32A}$ extracted by Normandeau 12/11/08 (see field log for details)
location: 528076.747'N
1727874.335'E
water depth: 9'6"
penetration depth: 22"
Core recovery: 18.5"
16:25 Collect sample from 0-2'
Sample ID: SE-031884-121108-SG-021

17:00 CRA collect waste characterization samples from drums. Collected 7 1L amber bottles and 3 VOAs for decon water.
Collected 2 16oz and 1 4oz jars for soil cuttings.
Sample ID:
WW-031884-121108-SG-001
WS-031884-121108-SG-001
17:00: EPA off-site
✓ CRA, Normandeau cleanup work area, decon sample equipment.
✓ CRA prepare samples for FedEx

12/11/08 031884 8

- Normandeau will return in a.m. to demob sediment sampling boat.
✓ All samples in entire program split with EPA.
1830: CRA off-site, take coolers to FedEx

Note:
- Waste charc. samples were not split with EPA.

[signature] 12/11/08

AR100944

12/12/08 #31884-06

CRA: S. Gould, R. Bentley
Normandeau: Rich, Andrew, Helen
Weather: 30's, snow, sleet
PPE: level D, plus PFD

0800: CRA on-site, Normandeau on-site, H&S meeting
- CRA, Normandeau de-mob. CRA process waste samples for FedEx and site cleanup
- Normandeau decon and cleanup of sediment boat.
- Helen is leaving today to drive the sediment boat back to Stowe. Andrew and Rich to start electrofishing

12:00 CRA off-site
- called Bill Huggins to advise that fishing may begin this afternoon. Bill H. to contact Rich directly. Provided Bill with Don Knort's contact info.

SGould 12/12/08

12/14/2008

Exton to Charleston
C. Potts
D. Kuow

45°F clear
windy

River very high
& turbid
flood stage on
Saturday -
electrofishing was
poor due to high
flows and
poor visibility of
water

Kathy Petnade USFWS
304-234-0238

D. Kuow
C. Potts

12/15/2008 Monday

Normandeau
Rich King
Andrew 610.716-~~6719~~ 6419
Mike Fiske
Mettler 412-728-2936

TechLaw
Gene Nance
Wheeling cell (304) 830-1442
Bill Huggins - office 704-867-0968
PM TechLaw -

Met w. above, went over
plans -

cold, windy, cloudy,
light rain 37°F

Rain changed to snow
around 6PM
foggy -

set trot lines at RM 42

AR100946

12/16/2008 Tues
32° F
light ~~rain~~ rain
snow last night
River - high
-turbid-

Processed
Gizzard Shad

25 samples of 2
gizzard shad
each -
will be shipped via
dry ice today -

- Spotted + LMB -

- C Catfish -

RM 42
Gizzard Shad
003 - 007
RM42
Bass
001
002
008

Shipped 2 coolers w.
gizzard shad to
AXYES LAB FED EX

Giz Shad RM 33 } whole
Giz Shd RM 42 } fish

all wrapped 2 fish per
subsample then 5 packs
= 10 fish per composite
5 Composites = 50 fish
per composite -

Multi size ranges -

RM33
Bass 16 need 9

Catfish

15 + 6 = 21 = 4

RM33
Gizzard shad - 55 - 0 - done

Wednesday
12-17-2008
D. Crow
C. Potts

Heavy rain 32°-44°F, cloudcover 90%
Finished sampling RM33

Prepared samples sent

7 coolers to AXYS -

RM-33
5 Comp. Bass
21 Spotted
3 LMB
1 SMB
25

12/17
shipped
whole
fish

RM-33-45
5 Comp. Catfish
15 Channel Cats
10 Saugers

shipped
12/17

C. Cat head removed
Sauger sent whole

AR100948

RM 42
Bass Comp.
20 Spotted
2 LMB
3 SMB

25

sent whole fish
to Lab 12/17/2008

DFK

John } from Normandeau
Jammy } will be back to site
on 12th

Previously
Shipped

1/8/2009

Shipped ups. 9 1/2 shad
samples to AXYS
TISS031884-122208-DFK-033AB C, D
this makes a complete

composite -

also shipped 2
TISS031884-010809-DFK-038
Channel catfish

Making this composite

to date 10 Sauger &
2 C catfish

(13 more C Cats needed)

07-27-09 031884-Kapucha River ①

CRA- DRoctner

Normandeau- Mike Mettle

Sea Engineering- Frank Spada

Task- sed Flume core collection

HHS- level D

weather - clear, 75°F

0730-0900 - utility clearances with Mike Mettle (Normandeau)

0900-1130 - get supplies with Mike Mettle

1030-1130 get supplies + load up boat with Mike Mettle + Frank Spada

1300- launch boat

- HHS tailgate meeting - review HASP- hospital route, muster point, Boat safety,

1315- move to location KRSD-28

continued next page

07-27-09 031884 Kapucha River ②

1330 - set up at KRSD 28

approximate ~~water~~ = 7' water depth

7-27-09 @ 14:16

38 23 48.3 GPS mark 03

81 50 31.0

- one attempt

- 20" penetration 20" recovery, acceptable - sand overlie silt

1430 move to KRSD 25

1448 - set up at KRSD-25

water depth = ~~25'~~ 9' lost 1st attempt due to boat drift

1520 - collect sample 7-27-09

thin sand layer 3-4" thick over silt

16" penetration 16" recovery

38 24 43.2
81 50 52.4 GPS mark 004

1530 move to KRSD-24

1540 - set up on KRSD-24 - 0

water depth = 2'

1610- collect KRSD 24

38 25 14.1 GPS Mark 005

81 51 06.1

sandy mud

attempt 1 - Refit

2 Refit

3 18" pen 18" recovery

07-28-09 031884- Kanawha River (3)

CRA - Dredne

Normandeau - Mike Moffle

Sea Engineering - Frank Spada

Task - Sed Flume core collection

H&S - level D

Weather - clear to partly cloudy; 75-88°F

0800 - Go to Marine to pick up supplies

0900 - arrive at Poka Boat Launch

0905 - H&S tailgate meeting

0900 EPA - Bill Hagenst + Brian

0910 - move to location COR-42

0945 - set up at COR-42

actual GPS location: N 38 26 00.5 W 81 51 10.2 GPS 006

measured water depth: 3'

10:02 - collect sample at COR-42

16" penetration 16" Recovery

mud with clay: location may be off here GPS ...

1012 - start to move to location COR-40

1022 - Set up at COR-40

1039 - collect sample - muddy sand

water depth - 2', 18" Pen 18" Recd

N 38 26 06.2 W 81 50 57.5 GPS 007

GPS accuracy was low due poor sat reception (trees)

1045 - move to COR-39

1050 - other consultant at this location collecting

water sample for FMC site; Move to

KRSD-20

07-28-09 031884 - Kanawha River (4)

1100 - set up at KRSD-20

#5 → water depth = 15' 16" Pen 16" Rec

11:39 - collect sample - mud w/ organic debris

Attempt (1) Disturbed sample

(2) NR

(3) over vegetation

(4) Disturbed

N 38 26 22.5 W 81 50 49.2 GPS 008

GPS working

- mud ledge on sample; surface undisturbed

1144 - move to COR 39

1155 - 20 m D/S from location due to PZ sampling; set on location COR 39 (down stream)

water depth = ~~4~~ 5'

12:14 - collect sample @ 21" Pen 21" Rec

N 38 26 12.4 W 81 50 54.7 GPS #009

"sand"

12:45 - move to COR-35

1255 water depth = 5' 20" PER 20" Rec

N 38 26 31.0 W 81 50 41.4 GPS 010

1121 collect sample - sandy silt

1300 - from state on site

1316 - move to COR 36

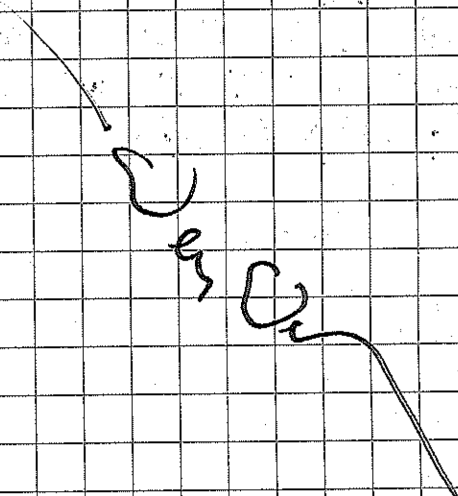
AR100951

(5) 031884 Kanawha River 07-28-09

1320 - set up at COR-36
water depth 3' 20" PEN 20" Rec
N 1343 - collect sample - sand
N 38 26 32.2 W 81 50 52.2 GPS 011
1349 - move to location COR-32B
1358 - set up on COR-32B
water depth = 8'
- no sample recovered
- 5 attempts; there was a layer of
dense cohesive clay under ~~sever~~ several
inches of sand. the pieces kept
pulling through the top (breaking seal)
broke 1 core box, attempted 12" core
depth; spoke to Jeff Daynolds
+ Lindsay Little to advise. Will
continue to core next location location adjacent to gravel mine
Approx. 1 hour at this location
1505 - move to COR-30
water depth - 6'
15:47 - collect sample - silt with mud layer
N 38 27 04.4 W 81 49 39.3 GPS 012
Attempt 1 coarse gravel 1"-2" gravel
2 broken core box
3 - stern - NR - went deeper for more attempts
~~4~~ able to get 12" Rec on final attempt
14 ~~5~~ 4 - sample 12" Pen 12" Rec
location downstream of gravel mine

07-28-09 031884 Kanawha River (6)

1543 - move to ~~KRSD-14~~ KRSD-14
1558 - set up on KRSD-14
16:26 - collect sample - 20" pen 20" Rec
N 38 27 14.8 W 81 44 40.8 - GPS 013
water depth = 6'
silt - mud
1623 - move to COR-25
1645 - set up on COR-25
water depth = 22'
- 5 attempts very loose sand in 22' water
probably overlying gravel. Broke
core box



(7) 031884-Kanawha River 07-29-09

CRA-[illegible]

Normandeau- Mike Mettle

Sea Engineering - Frank Spada

Task- Sed flume core collection

H+S - level D

Weather - rain/showers - chance t-storms, 81° F

0790- at Marina to load/unload supplies

0815 - speak to Jeff Daniel - do not need to redo COR-25 - sandy/gravels

0900 - Go to POCA Boat Launch; EPA Bill + [illegible]

1000 - H+S tailgate meeting

1021 - set up on KRSD-48 - 3' ft water

1045- start to push core

1056- collect sample 16" PEN 16" Rec

N 382835.4 W 814900.9 GPS 014

1 attempt; soft silty mud;

1105 - move to KRSD 10

1115 - set up on KRSD 10 - 5' water

11:36 - collect sample 16" PEN 16" Rec

N 3828432 W 814921.9 GPS 015

1 attempt soft silty mud

1142 move to COR-20

1157 - set up on COR-20 - water ≥ 20'

12:24 - collect sample 20" PEN 20" Recov

N 3829157.8 W 814953.5 GPS 016

silty mud

7-29-09 031884 (8)

1252 -> back to boat launch - rain

9 031884-Kanawha River 07-30-09

CRA-D Reehe
Normandeau- Mike Mettle
Sea Engineering- Frank Spada
Task- sed flume core collection
H+S-level D
weather- overcast, partly sunny, 80°F
0800-launch boat
0805- H+S tailgate meeting
0807- move to location KRSD 1
0830- set up on KRSD-1
0915- collect sample- silty mud
N 383140.6 W 8154247
Attempt (1) 18' deep water soft loose silt w/o consolidation
(2) " " " branch + rock debris
not accepted (3) 15' " " approx 8" recov
(4) 15" " " 1-4 attempt
(5)-sampled - 20" PEN 20" Recovery
-move in shore after 4 attempts of poor recovery; 8' water depth
-silty mud; almost hard past collection to 20"
0922- move to COR-7
0940 set up on COR-7
10:15- collect sample at attempt #6
N383239.5 W8153015
16" PEN 16" Recovery silty mud 20' water

07-30-09 031884 10

COR-07 (continued)
Features (1) ~~broke~~ underlay by clay, sucked pressure flow
(2) slight slope to surface
(3) lost ½ of sample
(4) lost ½ of sample
(5) No Recovery
took shallower sample at 2-6
attempt #6- move ahead 5'
1028- move to KRSD-4
1040- set up at KRSD-4
1055 - collect sample 20" PEN 20" Recov.
N 383137.4 W 8151433.2 GPS 019
1st attempt 6' water
silty mud
1106 - move to KRSD-05
1111 - set up on KRSD-05
1132- collect sample; 3rd attempt.
N 3830~~09~~53.1 W 8150455
(1) attempt - cracked tube
(2) attempt- broke seal - reject sample
(3) -collect sample 10' water 20" PEN 20" Rec.
silty mud + clay sand lenses
hammock & Strat ; petroleum type odor
1156 - move locations
outside River mouth
1215- return to boat launch
1215- 1330 - pack equipment + Samples

AR100954

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number: **Project Title:**

DATE (mm/dd/yy) 7-30 INITIALS FWS AREA-STATION ID KRSD01

ON STATION (time) 8:50 WATER DEPTH 8 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38°31'40.6" Longitude or Easting 81°54'24.7"

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ______) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* silty mud	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number	1	2	3	4	
Attempt Start/End Time	/	/	/	/	/ 9:20
Apparent Penetration Depth (ft or cm)	8"	6"	2"	6"	20"
Recovery (ft or cm)					20"
Accepted (yes/no)					Yes
Rejection Code	DB	DB	DB	DB	

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at ______ cm Photographed ? No Yes	KRSD 01

Comments GPS Mark 017 WAAS Enabled
4 attempts made @ 18ft depth. lots of Rock or wood debris, soft silty sediment overlaying gravel. Only ~8" of penetration. move in toward shore ~~eas~~ about 15 ft. Easy 20" silty mud core. (almost full hand push)

Reviewed by ________________ Date ________

AR100955

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number: **Project Title:**

DATE (mm/dd/yy) 7-30 INITIALS FWS AREA-STATION ID COR07

ON STATION (time) 9:50 WATER DEPTH 20 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38°32'39.5" Longitude or Easting 81°53'01.5"

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ______) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* silty mud	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number	1	2	3	4	5	6
Attempt Start/End Time	/	/	/	/	/	/ 10:20
Apparent Penetration Depth (ft or cm)	Plunger pulled	disturbed ~~S~~				16"
Recovery (ft or cm)	through	surface				16"
Accepted (yes/no)						yes
Rejection Code	DS	DS	NR	NR	NR	

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at ______ cm	COR07
Photographed ? No Yes	

Comments GPS Mark 018 WAAS Enabled
6 attempts. 1st attempt, plunger pulled through.
2nd attempt, surface seemed disturbed. 3rd – 5th slurry. possibly
sampling same spot. moved boat forward 10 ft.
6th attempt. good sample. this was out side ~~a~~ lagoon

Reviewed by ____________________ Date __________

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number: **Project Title:**

DATE (mm/dd/yy) 7-30 INITIALS FWS AREA-STATION ID KRSD04

ON STATION (time) 10:30 WATER DEPTH 6 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38°31'37.4" Longitude or Easting 81°51'43.2"

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ______) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* silty mud	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number	1				
Attempt Start/End Time	/ 10:55	/	/	/	/
Apparent Penetration Depth (ft or cm)	20"				
Recovery (ft or cm)	20"				
Accepted (yes/no)	yes				
Rejection Code					

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at ______ cm	KRSD04
Photographed ? No Yes	

Comments GPS Mark 019 WAAS Enabled

* small crack at bottom of core barrel. ReinForced with 2 strips of duct tape.

Reviewed by ____________ Date ________

AR100957

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number: Project Title:

DATE (mm/dd/yy) 7-30 INITIALS FWS AREA-STATION ID KRSD05

ON STATION (time) 11:15 WATER DEPTH 10 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38°30'53.1" Longitude or Easting 81°50'45.5"

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ______) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* silty mud clay	30 cm (1 ft)

* Core must have undisturbed surface and no visible fractures in core.

Attempt Number	1	2	3		
Attempt Start/End Time	/	/	/ 11:56	/	/
Apparent Penetration Depth (ft or cm)			20"		
Recovery (ft or cm)			20"		
Accepted (yes/no)	DS	DS	yes		
Rejection Code	Bad O'ring	Bad O'ring			

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at _____ cm Photographed ? No Yes	KRSD05

Comments GPS Mark ~~05~~ 020 WAAS Enabled

hummocky surface outside river mouth. some deformation on surface of 1st & 2nd samples. outside river mouth. Strong smell of Hydrocarbons.

Reviewed by ________________ Date __________

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number: **Project Title:**

DATE (mm/dd/yy) 7-29 INITIALS FWS AREA-STATION ID COR20

ON STATION (time) 12:10 WATER DEPTH 20 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38°29′15.7″ Longitude or Easting 81°49′53.6″

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ____) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* Silty mud	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number	1				
Attempt Start/End Time	/	/	/	/	/
Apparent Penetration Depth (ft or cm)	20″				
Recovery (ft or cm)	20″				
Accepted (yes/no)	yes				
Rejection Code					

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at ____ cm	COR20
Photographed ? No Yes	

Comments GPS Mark 016 WAAS Enabled

very nice. ~~Boo~~ Heavy Rain

Reviewed by ________________ Date ________

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number: **Project Title:**

DATE (mm/dd/yy) 7-29 INITIALS FWS AREA-STATION ID KRSD10

ON STATION (time) 11:10 WATER DEPTH 5 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38°28'43.2" Longitude or Easting 81°49'21.9"

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ______) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* soft silty mud	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number	1				
Attempt Start/End Time	/ 11:40	/	/	/	/
Apparent Penetration Depth (ft or cm)	16"				
Recovery (ft or cm)	16"				
Accepted (yes/no)	yes				
Rejection Code					

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample: Visible color change near surface? No Yes at ______cm Photographed ? No Yes	Attach Unique Sample ID here KRSD 10

Comments GPS Mark 015 WAAS Enabled

Heavy Rain.

Reviewed by ________________ Date __________

AR100960

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number:
Project Title: Kanawha

DATE (mm/dd/yy) 7-29 INITIALS FWS AREA-STATION ID KRSD 48

ON STATION (time) 10:30 WATER DEPTH 3 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38° 28′ 35.4″ Longitude or Easting 81° 49′ 00.9″

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ____) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* Soft silty mud	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number	1				
Attempt Start/End Time	/10:56	/	/	/	/
Apparent Penetration Depth (ft or cm)	16″				
Recovery (ft or cm)	16″				
Accepted (yes/no)	yes				
Rejection Code					

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:

Visible color change near surface?

No Yes at ____ cm

Photographed ?

No Yes

Attach Unique Sample ID here

KRSD 48

Comments GPS Mark 014 WAAS Enabled

Reviewed by ______________ Date ________

AR100961

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number: **Project Title:**

DATE (mm/dd/yy) 7-28 INITIALS FWS AREA-STATION ID COR25

ON STATION (time) 16:35 WATER DEPTH 22 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing ______ Longitude or Easting ______

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ____) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* loose Sand	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number					
Attempt Start/End Time	/	/	/	/	/
Apparent Penetration Depth (ft or cm)					
Recovery (ft or cm)					
Accepted (yes/no)					
Rejection Code	NR	NR	NR	NR	NR

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at ____ cm Photographed ? No Yes	COR25

Comments 5 attempts very loose sand in 22 Ft of water. Probably over ~~laying~~ gravel. Broke core box
coarse loose sand providing no suction for core recovery. probably overlaying gravel & rock place core barrel was cracked up the middle

Spoke to Jeff Daniels he said our efforts were sufficient and to take notes on why sample was unrecoverable.

Reviewed by ________________ Date __________

AR100962

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number: **Project Title:** Kanawha

DATE (mm/dd/yy) 7-28 INITIALS FWS AREA-STATION ID KRSD 14

ON STATION (time) 16:00 WATER DEPTH 6 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38°27'14.8" Longitude or Easting 81°49'40.8"

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ______) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* silt-mud	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number	1				
Attempt Start/End Time	16:15/16:26	/	/	/	/
Apparent Penetration Depth (ft or cm)	20"				
Recovery (ft or cm)	20"				
Accepted (yes/no)	yes				
Rejection Code					

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at ______ cm Photographed ? No / Yes	KRSD 14

Comments GPS mark 013 WAAS Enabled

Reviewed by ____________ Date ________

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number: **Project Title:** Kanawha

DATE (mm/dd/yy) 7-28 INITIALS FWS AREA-STATION ID COR 30

ON STATION (time) 15:06 WATER DEPTH 6 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38° 27′ 04.4″ Longitude or Easting 81 49 39.3

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ______) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* Red Mud & Sand	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number	1	2	3	~~3~~	~~4~~
Attempt Start/End Time	/	/	/	/	/
Apparent Penetration Depth (ft or cm)	Rocks	Broken core	stern		12″
Recovery (ft or cm)		box			12″
Accepted (yes/no)					yes
Rejection Code	NR DB	NR DB	NR		

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at ______cm Photographed ? No Yes	COR 30

Comments GPS Mark 012 WAAS Enabled
1st & 2nd attemp 1"-2" rocks in sample, broken core box. Went deeper for more attempts was able to collect a good 12" sample on final attempt.

across River down stream of Gravel mine.

Reviewed by ________________ Date ________

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number:
Project Title: Kanawha

DATE (mm/dd/yy) 7-28 INITIALS FWS AREA-STATION ID COR32B

ON STATION (time) 13:54 WATER DEPTH 3 to 8 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing ______ Longitude or Easting ______

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ____) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume*	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number					
Attempt Start/End Time	/	/	/	/	/
Apparent Penetration Depth (ft or cm)					
Recovery (ft or cm)					
Accepted (yes/no)					
Rejection Code	NR	NR	NR	NR	NR

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at ____ cm	COR 32B
Photographed ? No Yes	

Comments GPS Mork /// No Sample recovered. 5 attempts. There was a layer of dense orange clay under several inces of sand. The plunger kept pulling through. Broke 1 core box. Attempted 12" of core depth. Called Lindsay Little & Jeff Danials for advise. Said to skip this site since we've had 9 successful cores to this point.

1 hour at location

* Just downstream of Gravel mine.

Reviewed by ______ Date ______

AR100965

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number:

Project Title: Kanawha

DATE (mm/dd/yy) 7-28 INITIALS FWS AREA-STATION ID COR35

ON STATION (time) 12:55 WATER DEPTH 5 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38°26'31.0" Longitude or Easting 81°50'41.4"

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ____) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* Sandy-Silty	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number	1				
Attempt Start/End Time	/ 13:11	/	/	/	/
Apparent Penetration Depth (ft or cm)	20"				
Recovery (ft or cm)	20"				
Accepted (yes/no)	yes				
Rejection Code					

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at ____ cm	COR35
Photographed ? No Yes	

Comments GPS Mark 010 WAAS Enabled

Reviewed by ________________ Date __________

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number: **Project Title:**

DATE (mm/dd/yy) 7-28 INITIALS FWS AREA-STATION ID COR36

ON STATION (time) 13:20 WATER DEPTH 3 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38°26'32.2" Longitude or Easting 81°50'52.2"

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ______) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* Sand	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number	1				
Attempt Start/End Time	/ 13:43	/	/	/	/
Apparent Penetration Depth (ft or cm)	20"				
Recovery (ft or cm)	20"				
Accepted (yes/no)	yes				
Rejection Code					

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at _____ cm Photographed ? No Yes	COR36

Comments GPS Mark 011 WAAS Enabled

Reviewed by ________________ Date __________

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number: **Project Title:**

DATE (mm/dd/yy) 7-28 INITIALS FWS AREA-STATION ID KRSD20

ON STATION (time) 11:00 WATER DEPTH 15 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38°26'22.5" Longitude or Easting 81°50'49.2"

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ______) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* Mud + organic Debris	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number	1	2	3	4	5
Attempt Start/End Time	/	/	/	/	/ 11:35
Apparent Penetration Depth (ft or cm)	—	—	—	—	16"
Recovery (ft or cm)					16"
Accepted (yes/no)					Yes
Rejection Code	DS	NR	OP	DS	

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at ____ cm	KRSD20
Photographed ? No Yes	

Comments GPS mark 008

large mud/Algae mound on surface of Sample. Although, surface was undisturbed. Keeping sample due to difficulty of recovery.

Reviewed by ________________ Date __________

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number:

Project Title: Kanawha

DATE (mm/dd/yy) 7-28 INITIALS FWJ AREA-STATION ID COR39

ON STATION (time) 11:55 WATER DEPTH 5 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38°26′12.4″ Longitude or Easting 81°50′54.7″

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ______) Van Veen Grab Other:

Sampling Area	Sample Type		Minimum Acceptable Recovery
	Sedflume*	Sandy	30 cm (1 ft)

* Core must have undisturbed surface and no visible fractures in core.

Attempt Number	1				
Attempt Start/End Time	12:00/12:14	/	/	/	/
Apparent Penetration Depth (ft or cm)	21″				
Recovery (ft or cm)	21″				
Accepted (yes/no)	yes				
Rejection Code					

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at ______ cm	COR39
Photographed ? No Yes	

Comments GPS mask 009 WAAS Enabled

moved downstream 20m to avoid PISCO sampling boat.

Reviewed by ________________ Date ________

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number: **Project Title:** Kanawha

DATE (mm/dd/yy) 07-28 INITIALS FWS AREA-STATION ID COR 40

ON STATION (time) 10:20 WATER DEPTH 2 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38°26' 06.2" Longitude or Easting 81°50'57.5"

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ____) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* Muddy sand	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number	1				
Attempt Start/End Time	/ 10:39	/	/	/	/
Apparent Penetration Depth (ft or cm)	18"				
Recovery (ft or cm)	18"				
Accepted (yes/no)	yes				
Rejection Code					

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at ____ cm	COR 40
Photographed ? No Yes	

Comments GPS Mark 007 WAAS Enabled

GPS accuracy was low due to poor sattelite reception. Tree cover

Reviewed by ____________ Date ________

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number: **Project Title:** Kanawha

DATE (mm/dd/yy) 7-28-09 INITIALS FWS AREA-STATION ID COR42

ON STATION (time) 9:45 WATER DEPTH 3. Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38°26'00.5" Longitude or Easting ~~81~~ 81°51'10.2"

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ____) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* Mud w/ clay	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number	1				
Attempt Start/End Time	9:50 / 10:02	/	/	/	/
Apparent Penetration Depth (ft or cm)	16"				
Recovery (ft or cm)	16"				
Accepted (yes/no)	yes				
Rejection Code	—				

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at ____ cm Photographed ? No Yes	COR42

Comments GPS Mark 006 WAAS Enabled

Reviewed by ____________ Date ________

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number: **Project Title:** Kanawha

DATE (mm/dd/yy) 7-27 INITIALS FWS AREA-STATION ID KRSD 24

ON STATION (time) 15:46 WATER DEPTH 2 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38°25′14.1″ Longitude or Easting 81°51′06.1″

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ______) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* Sandy mud	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number	1	2	3		
Attempt Start/End Time	/	/	/ 16:10	/	/
Apparent Penetration Depth (ft or cm)	—	—	18″		
Recovery (ft or cm)	—	—	18″		
Accepted (yes/no)			yes		
Rejection Code	Drift	DB			

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at ______cm Photographed ? No Yes	KRSD24

Comments GPS Mark 005 WAAS Enabled

Reviewed by ____________________ Date __________

AR100972

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number:

Project Title: Kanawha

DATE (mm/dd/yy) 7-27-04 INITIALS FWS AREA-STATION ID KRSD 25

ON STATION (time) 14:48 WATER DEPTH 9 Ft M Fm

STATION POSITION (NAD 83) Latitude or Northing 38° 24' 43.2" Longitude or Easting 81° 50' 52.4"

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ____) Van Veen Grab Other:

Sampling Area	Sample Type	Minimum Acceptable Recovery
	Sedflume* Sandy mud w debris	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.		

Attempt Number	1	2			
Attempt Start/End Time	15:10 / 15:12	15:~~15~~ / 15:20	/	/	/
Apparent Penetration Depth (ft or cm)		16"			
Recovery (ft or cm)	~~16~~	16"			
Accepted (yes/no)	~~yes~~ NO	yes			
Rejection Code	Boat drift				

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at ____ cm Photographed ? No Yes	KRSD 25

Comments GPS Mark 004 WAAS Enabled

Reviewed by ______________ Date ________

SEDFLUME SAMPLING DATA SHEET

Sea Engineering, Inc.
Project Number: **Project Title:** CRA Kanawha

DATE (mm/dd/yy) 7-27-09 INITIALS FWS AREA-STATION ID KRSD28

ON STATION (time) ______ WATER DEPTH 5 (Ft) M Fm

STATION POSITION (NAD 83) Latitude or Northing 38° 23' 45.3" Longitude or Easting 81° 50' 31.0"

SAMPLER USED (circle one) Vibracorer Gravity Corer Push Corer (size ______) Van Veen Grab Other:

Sampling Area	Sample Type		Minimum Acceptable Recovery
	Sedflume*	Sand w/ mud	30 cm (1 ft)
* Core must have undisturbed surface and no visible fractures in core.			

Attempt Number	1				
Attempt Start/End Time	14:00/14:16	/	/	/	/
Apparent Penetration Depth (ft or cm)	20"				
Recovery (ft or cm)	20"				
Accepted (yes/no)	yes				
Rejection Code					

Rejection Codes

OP	Overpenetrated	DB	Debris interference	NS	No sediment in sampler
NR	Insufficient Recovery	DS	Disturbed surface	FR	Core has visible fracture in sediments

For Acceptable Sample:	Attach Unique Sample ID here
Visible color change near surface? No Yes at ____ cm Photographed ? No (Yes)	KRSD28

Comments GPS Mark 003 WAAS Enabled

Sand 16" mud bottom layer.

Reviewed by ____________ Date ________

AR100974

APPENDIX E

PHOTOGRAPHIC LOG

PHOTO 01: FISH OBTAINED FOR SAMPLING AND ANALYSIS. OCTOBER 2004.

PHOTO 02: PREPARATION OF FISH TISSUE FILLET SAMPLE. OCTOBER 2004.

PHOTOGRAPHIC LOG
EOC INVESTIGATION FIELD ACTIVITIES
EE/CA REPORT
Kanawha River, West Virginia

CRA

PHOTO 03: VAN VEEN GRAB SAMPLER USED TO COLLECT SURFACE SEDIMENT SAMPLES. NOVEMBER 2007.

PHOTO 04: HIGH FLOW CONDITIONS IN THE KANAWHA RIVER. DECEMBER 2007.

PHOTOGRAPHIC LOG
EOC INVESTIGATION FIELD ACTIVITIES
EE/CA REPORT
Kanawha River, West Virginia

CRA

PHOTO 05: SURFACE SEDIMENT SAMPLING ACTIVITIES. NOVEMBER 2007.

PHOTO 06: SURFACE SEDIMENT SAMPLE COLLECTED AT SSD-17 (STUDY AREA 3). NOVEMBER 2007.

PHOTOGRAPHIC LOG
EOC INVESTIGATION FIELD ACTIVITIES
EE/CA REPORT
Kanawha River, West Virginia

PHOTO 07: SURFACE SEDIMENT SAMPLE COLLECTED AT COR-39 (STUDY AREA 2). DECEMBER 2007.

PHOTO 08: SURFACE SEDIMENT SAMPLE COLLECTED AT COR-33 (STUDY AREA 2). NOVEMBER 2007.

PHOTOGRAPHIC LOG
EOC INVESTIGATION FIELD ACTIVITIES
EE/CA REPORT
Kanawha River, West Virginia

PHOTO 09: SURFACE SEDIMENT SAMPLE COLLECTED AT COR-35 (STUDY AREA 2). NOVEMBER 2007.

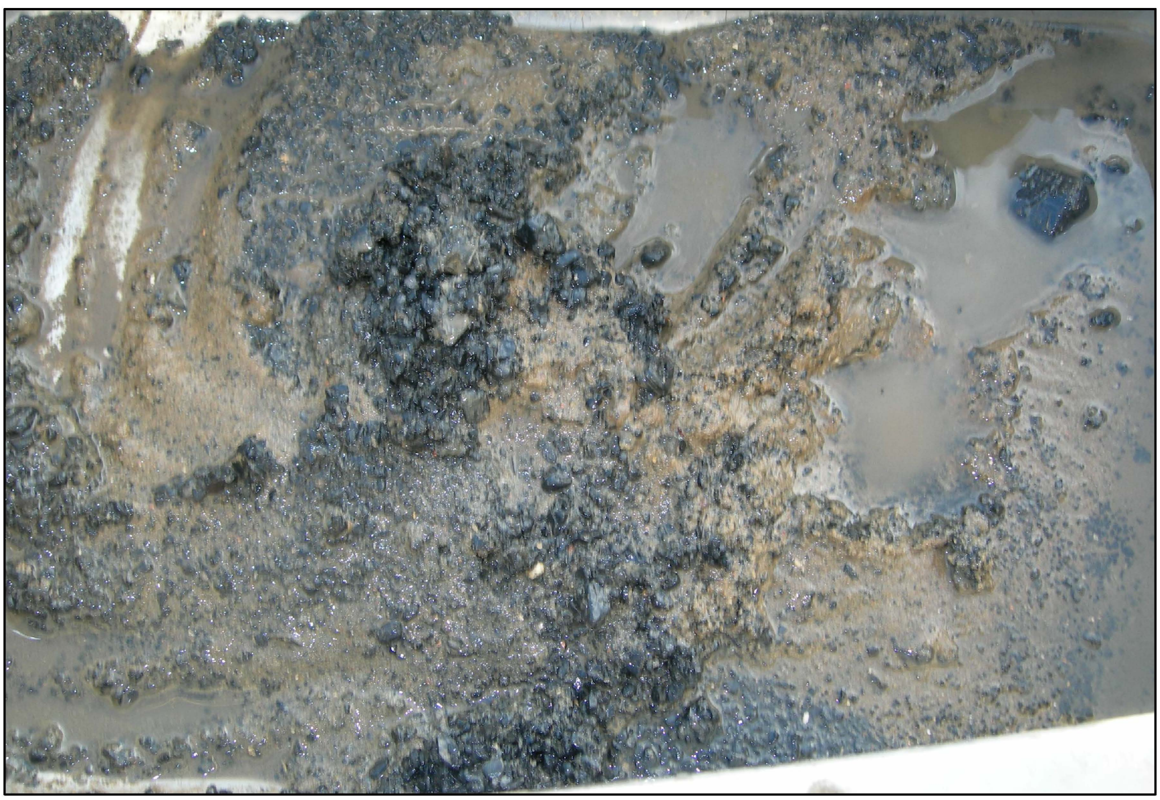


PHOTO 10: SURFACE SEDIMENT SAMPLE COLLECTED AT COR-37 (STUDY AREA 2). NOVEMBER 2007.

PHOTOGRAPHIC LOG
EOC INVESTIGATION FIELD ACTIVITIES
EE/CA REPORT
Kanawha River, West Virginia

CRA

PHOTO 11: SEDIMENT CORE COLLECTED AT COR-28 (STUDY AREA 3) FOR SUBSURFACE SAMPLING. NOVEMBER 2007.

PHOTO 12: 0" TO 15" SUBSECTION OF COR-28 (STUDY AREA 3). DECEMBER 2007.

PHOTOGRAPHIC LOG
EOC INVESTIGATION FIELD ACTIVITIES
EE/CA REPORT
Kanawha River, West Virginia

CRA

31884-00(051)GN-WA013 OCT 27/2009

PHOTO 13: 11" TO 24" SUBSECTION OF COR-28 (STUDY AREA 3). DECEMBER 2007.

PHOTO 14: 0 TO 12" SUBSECTION OF COR-39 (STUDY AREA 2). DECEMBER 2007.

PHOTOGRAPHIC LOG
EOC INVESTIGATION FIELD ACTIVITIES
EE/CA REPORT
Kanawha River, West Virginia

PHOTO 15: 9 TO 22" SUBSECTION OF COR-39 (STUDY AREA 2). DECEMBER 2007.

PHOTO 16: 23" TO 35" SUBSECTION OF COR-39 (STUDY AREA 2). DECEMBER 2007.

PHOTOGRAPHIC LOG
EOC INVESTIGATION FIELD ACTIVITIES
EE/CA REPORT
Kanawha River, West Virginia

CRA

PHOTO 17: SURFACE SEDIMENT SAMPLE COLLECTED AT SSD-20 (STUDY AREA 3) FOR ANALYSIS OF ADDITIONAL PARAMETERS. DECEMBER 2007.

PHOTO 18: SAMPLE PREPARATION OF SEDIMENT CORE COLLECTED AT NRC-07 (STUDY AREA 2) FOR RADIOISOTOPE ANALYSIS. DECEMBER 2007.

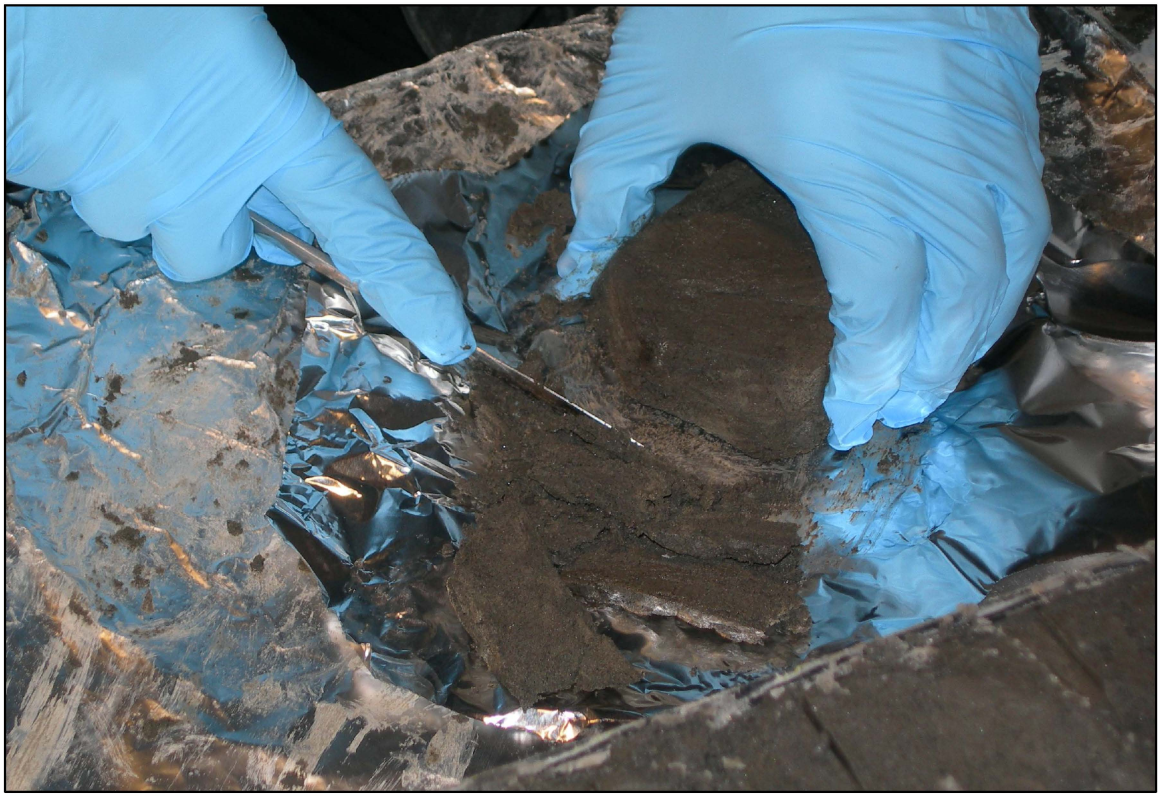


PHOTO 19: SECTION OF SEDIMENT CORE COLLECTED AT NRC-07 (STUDY AREA 2) FOR RADIOISOTOPE ANALYSIS. DECEMBER 2007.

PHOTO 20: PREPARATION OF SAMPLES FROM SEDIMENT CORE COLLECTED AT NRC-08 (STUDY AREA 2) FOR RADIOISOTOPE ANALYSIS. FEBRUARY 2008.

PHOTOGRAPHIC LOG
EOC INVESTIGATION FIELD ACTIVITIES
EE/CA REPORT
Kanawha River, West Virginia

PHOTO 21: PREPARATION OF SURFACE SEDIMENT SAMPLE COLLECTED AT BC-SSD-26A (STUDY AREA 1) FOR BLACK CARBON ANALYSIS. FEBRUARY 2008.

PHOTOGRAPHIC LOG
EOC INVESTIGATION FIELD ACTIVITIES
EE/CA REPORT
Kanawha River, West Virginia

PHOTO 22: ADDITIONAL SEDIMENT CORE COLLECTED AT COR-36
(STUDY AREA 2) FOR RE-SAMPLING. DECEMBER 2008.

PHOTO 23: ADDITIONAL SEDIMENT CORE COLLECTED AT COR-36C
(STUDY AREA 2). DECEMBER 2008.

PHOTOGRAPHIC LOG
EOC INVESTIGATION FIELD ACTIVITIES
EE/CA REPORT
Kanawha River, West Virginia

CRA

PHOTO 24: WATER DEPTH MEASUREMENT BEFORE COLLECTION OF CORE FOR SEDFLUME TESTING. JULY 2009.

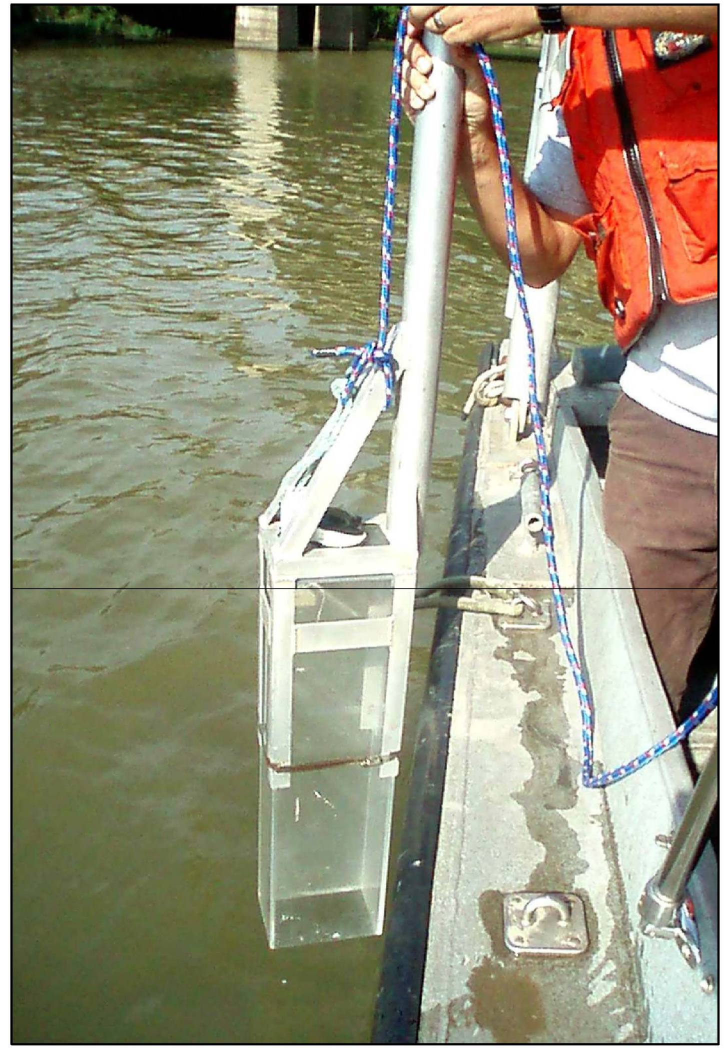


PHOTO 25: SPECIALIZED CORING EQUIPMENT USED TO COLLECT SEDIMENT CORES FOR SEDFLUME TESTS. JULY 2009.

PHOTOGRAPHIC LOG
EOC INVESTIGATION FIELD ACTIVITIES
EE/CA REPORT
Kanawha River, West Virginia

PHOTO 26: RETRIEVAL OF SEDIMENT CORE FOR SEDFLUME TESTING.
JULY 2009.

PHOTO 27: RETRIEVED SEDIMENT CORE AT KRSD-25 (STUDY AREA 1)
FOR SEDFLUME TESTING . JULY 2009.

PHOTOGRAPHIC LOG
EOC INVESTIGATION FIELD ACTIVITIES
EE/CA REPORT
Kanawha River, West Virginia

CRA

PHOTO 28: RETRIEVED SEDIMENT CORE AT KRSD-20 (STUDY AREA 2)
FOR SEDFLUME TESTING. JULY 2009.

PHOTO 29: RETRIEVED SEDIMENT CORE AT COR-30 (STUDY AREA 3)
FOR SEDFLUME TESTING. JULY 2009.

PHOTOGRAPHIC LOG
EOC INVESTIGATION FIELD ACTIVITIES
EE/CA REPORT
Kanawha River, West Virginia

PHOTO 30: RETRIEVED SEDIMENT CORE AT COR-07 (STUDY AREA 4)
FOR SEDFLUME TESTING. JULY 2009.

PHOTOGRAPHIC LOG
EOC INVESTIGATION FIELD ACTIVITIES
EE/CA REPORT
Kanawha River, West Virginia

APPENDIX F

GIS DATABASE OF ANALYTICAL RESULTS (ON COMPACT DISC)

APPENDIX G

ANALYTICAL DATA REPORTS (ON COMPACT DISC)

APPENDIX G.1

2004 ANALYTICAL DATA REPORTS

APPENDIX G.2

2005 ANALYTICAL DATA REPORTS

APPENDIX G.3

2007 ANALYTICAL DATA REPORTS

APPENDIX G.4

2008 ANALYTICAL DATA REPORTS

APPENDIX H

FISH TISSUE SAMPLE PREPARATION FIELD NOTES

Kanawha Fish Samples		October 2004		CRA				
RM	**Species**	**Replicate 1**	**Replicate 2**	**Replicate 3**	**Replicate 4**	**Replicate 5**	**DUP**	**MSDS**
75-95	C. Catfish	5	5	5	5	0	0	0
Sample No. *		-046	-047	-048	-049	-050		
68	Bass	5	5	5	5	5	0	0
Sample No.		-041	-042	-043	-044	-045		
68	Forage	15	15	15	15	15	6**	0
Sample No.		-036	-037	-038	-051	-052	-039	
42	Bass	5	5	5	5	5	0	0
Sample No.		-001	-011	-012	-033	-034		
42	Forage	15	15	15	15	15	0	0
Sample No.		-003	-004	-005	-006	-007		
33-45	C. Catfish	5	5	5	5	5	0	0
Sample No.		-002	-008	-009	-010	-035		
33	Bass	5	5	5	5	5	0	0
Sample No.		-023	-024	-025	-026	-027		
33	Forage	15	15	15	15	15	75	50
Sample No.		-013	-014	-015	-016	-017	-018/-022	-028/-032

* Sample No. TISS03188410XX04DFK-0XX
** 6 large gizzard shad
*** Sample not obtained
All forage fish are gizzard shad

10/12/04
1200

Live Sample	Prepared Sample
RM 42	
Type: Predator BASS Cat ____	Sample No. TISS-031884-101204-DK001
Forage ____	Fillet, skin off ____
	Fillet, skin on, scaled 5
COMPOSITE No. 001	Whole ____
Sample A Species smb Length 25 cm Weight ~~2.2 g~~ cp 220 g Abnormalities ~~tremodes~~ trematodes cp on lower caudal fin	Sample A Weight ~~94.8~~ cp ~~0.948 g~~ 94.8 g
Sample B Species smb Length 25 cm Weight 180.2 g Abnormalities trematodes on lower caudal fin	Sample B Weight 56.8 g
Sample C Species smb Length 23 cm Weight 173.2 g Abnormalities None	Sample C Weight 58.0 g
Sample D Species smb Length 23 cm Weight 172.8 g Abnormalities Trematodes on anal fin	SampleD Weight 56.9 g
Sample E Species smb Length 23 cm Weight 137.8 g Abnormalities None	Sample E Weight 47.6 g

smb = small mouth bass

Processed 10/12/04 - noon
Captured Evening 10/11/04

10/12/04
1205

Live Sample	Prepared Sample
RM 33-45	Sample No. TISS-031884-101204-DK-002
Type: Predator____ Cat Channel	Fillet, skin off 5
Forage________	Fillet, skin on, scaled ______
	Whole ______
COMPOSITE No. 002	
Sample A Species channel cat Length 45 cm Weight 0.95 Kg Abnormalities None	Sample A Weight 192.5 g
Sample B Species channel cat Length 48 cm Weight 1.1 Kg Abnormalities None	Sample B Weight 198 g
Sample C Species channel cat Length 43.8 cm Weight 0.8 Kg Abnormalities None	Sample C Weight 185 g
Sample D Species channel cat Length 47 cm Weight 1.1 Kg Abnormalities None	SampleD Weight 187.3 g
Sample E Species channel cat Length 42 cm Weight 0.65 Kg Abnormalities None	Sample E Weight 149.9 g

Processed 10/12/04 – noon
Captured Evening 10/11/04

10/13/04

Live Sample

RM 42

Type: Predator _____ Cat _____

Forage Gizzard Shad

COMPOSITE No. 003 through 007

TISS-031884-101304-DK-~~003A~~ ~~004~~ 003

003 Sample A (15 fish)
Species Gizzard Shad
Length(cm): 11; 11; 11; 10.5; 9.5; 11; 11.3; 10.8; 11; 11; 12; 11, 10.5, 11.9; 11.
Weight (g): 14; 13; 11.2; 9.3; 8.2; 12.1; 13.6; 10.3; 13.9; 11.5; 15.1; 9.2; 10.2; 15.6; 8.7.
Abnormalities None

TISS-031884-101304-DK-~~003B~~ 004

004 Sample B (15 fish)
Species Gizzard Shad
Length (cm): 10; 10.5, 11; 12; 11.5; 14; 9.5; 13.5, 10.3; 10.7; 10; 10; 10.5; 9; 10.5.
Weight (g): 5.8; 10.4; 13.1; 17.2; 14.3; 25.6; 9.3; 21.5; 7.6; 9.6; 8.7; 9.8; 12.6; 8; 8.7
Abnormalities None

005 Sample C (15 fish)
Species Gizzard Shad
Length(cm): 10; 11; 9.5; 11; 10; 10.3; 13; 10.5; 10.5; 10.5; 10.5; 12.5; 11.4; 10; 10.2.
Weight (g): 9.3; 12.1; 6.6; 10.5; 9.4; 16.9; 19.5; 11.9; 11.5; 11; 10.2; 14.6; 13.6; 9; 9.6
Abnormalities None

006 Sample D (15 fish)
Species Gizzard Shad
Length (cm): 11; 11.5; 10; 11.5, 12.9, 10.9; 11.5; 10.5; 8.5; 11.2; 10.5; 11; 10.5; 10.5; 10.
Weight (g): 11.5; 13.9; 9.4; 13.1; 16.1; 9.6; 14; 12.4; 5.8; 12.6; 10.8; 12.6; 11.2; 9.6; 9.4.
Abnormalities None

007 Sample E (15 fish)
Species Gizzard Shad
Length (cm): 13; 16; 12; 11.5; 13.5; 11; 10.5; 10.3, 12.5; 11; 11; 10.4; 11; 11.4; 20.
Weight (g): 22.7; 36.3; 14.6; 12.5; 16.5; 12.7; 9.2; 18.2; 15; 11.4; 10.3; 8.7, 12.7; 13.2; 81
Abnormalities None

Prepared Sample

Sample No. TISS-031884-101304-DK-003 thru 00[illegible]

Fillet, skin off _____

Fillet, skin on, scaled _____

Whole 75 (5 sets of 15 fish)

Sample A TISS-031884-101304-DK-~~003A~~ 003
Weight 15 fish (whole) 1200

Sample B TISS-031884-101304-DK-~~003B~~ 004
Weight 15 fish (whole) 1210

Sample C TISS-031884-101304-DK-~~003C~~ 005
Weight 15 fish (whole) 1220

Sample D TISS-031884-101304-DK-~~003D~~ 006
Weight 15 fish (whole) 1230

Sample E TISS-031884-101304-DK-~~003E~~ 00[illegible]
Weight 15 fish (whole) 1240

c:\my documents\fish fielddatasheet.doc

AR101002

Live Sample	Prepared Sample 10/13/04 1415
RM 33-45	Sample No. TISS-031884-101304-DK-008
Type: Predator____ Cat Channel	Fillet, skin off 5
Forage________	Fillet, skin on, scaled ____
	Whole ____
COMPOSITE No. 008	
Sample A Species Channel Cat Length 50 cm Weight 1.1 Kg Abnormalities None	Sample A Weight 70.1 g
Sample B Species Channel cat Length 46 cm Weight 1 Kg Abnormalities None	Sample B Weight 178 g
Sample C Species Channel cat Length 35 cm Weight 0.4 Kg Abnormalities None	Sample C Weight 45 g
Sample D Species Channel cat Length 36 cm Weight 0.4 Kg Abnormalities None	SampleD Weight 73 g
Sample E Species Channel cat Length 38 cm Weight 0.5 Kg Abnormalities None	Sample E Weight 77.2 g

10/13/04
1500

Live Sample	Prepared Sample
RM 33-45	Sample No. TISS-031884-101304-DK-009
Type: Predator ____ Cat Channel	Fillet, skin off 5
Forage ____	Fillet, skin on, scaled ____
	Whole ____
COMPOSITE No. 009	
Sample A Species Channel cat Length 40cm Weight 0.8Kg Abnormalities None	Sample A Weight 116g
Sample B Species Channel cat Length 38 cm Weight 1.05Kg Abnormalities None	Sample B Weight 85g
Sample C Species Channel cat. Length 42cm Weight 0.7Kg Abnormalities None	Sample C Weight 132g
Sample D Species Channel cat Length 42 cm Weight 1.25 Kg Abnormalities None	SampleD Weight 114g
Sample E Species Channel cat Length 29 cm Weight 200g (0.2Kg) Abnormalities None	Sample E Weight 35g.

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AR101004

10/13/04

Live Sample	Prepared Sample
RM 33-45	Sample No. TISS-031884-101304-DC-010
Type: Predator ___ Cat Channel	Fillet, skin off 5
Forage ___	Fillet, skin on, scaled ___
	Whole ___
COMPOSITE No. 010	
Sample A Species channel cat Length 43cm Weight 0.9Kg Abnormalities None	Sample A Weight 155 g
Sample B Species Channel cat Length 38cm Weight 0.5Kg Abnormalities None	Sample B Weight 102 g
Sample C Species Channel cat Length 43cm Weight 0.7Kg Abnormalities None	Sample C Weight 155g
Sample D Species channel cat Length 44cm Weight 0.8Kg Abnormalities None	SampleD Weight 111g
Sample E Species channel cat Length 49cm Weight 1Kg Abnormalities None	Sample E Weight 182g

15/04

10/13/04
1600

Live Sample	Prepared Sample
RM 42	Sample No. TISS-031884-101304-DK-011
Type: Predator ~~Sm~~ Bass Cat ____	Fillet, skin off ____
Forage ____	Fillet, skin on, scaled 5
	Whole ____
COMPOSITE No. 011	
Sample A Species spotted bass Length 25cm Weight 188g Abnormalities None	Sample A Weight 76g
Sample B Species spotted bass Length 29cm Weight 179 g Abnormalities None	Sample B Weight 139g
Sample C Species Spotted bass Length 28cm Weight 142 g Abnormalities None	Sample C Weight 45g
Sample D Species smbass Length 18cm Weight 71 g Abnormalities None	SampleD Weight 24g
Sample E Species spotted bass Length 19cm Weight 84g Abnormalities None	Sample E Weight 30g

10/13/04
1640

Live Sample	Prepared Sample
RM 42	Sample No. TISS-031884-101304-DK-012
Type: Predator Bass Cat____ Forage____	Fillet, skin off____ Fillet, skin on, scaled 5 Whole____
COMPOSITE No. 012	
Sample A Species Spotted bass Length 26 cm Weight 400g Abnormalities None	Sample A Weight 88.4g
Sample B Species sm bass Length 26 cm Weight 0.35Kg Abnormalities None	Sample B Weight 75g
Sample C Species Spotted bass Length 29cm Weight 1Kg Abnormalities None	Sample C Weight 132g
Sample D Species Sm bass Length 24cm Weight 158g Abnormalities None	SampleD Weight 64g
Sample E Species Spotted bass Length 19cm Weight 75g Abnormalities None	Sample E Weight 26g

10/14/04

Live Sample	Prepared Sample
RM 33	
Type: **Predator** ____ **Cat** ____	**Sample No.** TISS-031884-101404-DK-013-through 01
Forage Gizzard Shad	**Fillet, skin off** ____
	Fillet, skin on, scaled ____
COMPOSITE No. 013-017	**Whole** 75 (5 sets of 15 fish)

013 Sample A
Species Gizzard Shad
Length (cm): 15, 11; 11; 13; 11.5; 10; 10; 10.5; 11; 10; 8; 9.5; 10; 9.5; 10
Weight (g): 31.6; 11.8; 10.8; 17.6, 12; 8.6; 8.3, 10.7; 9.5; 10; 3.9; 7.2; 6.5; 8.3; 8.9
Abnormalities None

Sample A TISS-031884-101404-DK-013 143
Weight 15 whole fish

014 Sample B
Species Gizzard Shad
Length (cm): 11; 13; 11; 10.5; 10.5; 10; 10.5; 11; 11; 11, 10.5; 12; 10.5; 12.5; 10.5.
Weight (g): 11.1; 19.8; 12.5; 11, 10.7; 10.2; 9.9; 10.2; 10.8; 12.1; 8.8; 14.6; 12.1; 17.2; 11.1
Abnormalities None

Sample B TISS-031884-101404-DK-014 144
Weight 15 whole fish

015 Sample C
Species Gizzard Shad
Length (cm): 11.5; 12.5; 10; 11.5; 11.5; 11; 13; 14.5; 12.5; 11.5; 10.5; 10.5; 10; 10.5; 13.5
Weight (g): 13.5; 17.6; 10.7; 15.6; 15.4; 13.2; 10.2; 29.7; 21.2; 12.5; 10.1; 10.7; 9.7; 11.2; 23.9
Abnormalities None

Sample C TISS-031884-101404-DK-015 145
Weight 15 whole fish

016 Sample D
Species Gizzard Shad
Length (cm): 13; 9.5; 11; 11.5; 10.5; 10.5; 11.5; 13; 13, 10.5; 11.5; 15; 9.5; 11; 10.5
Weight (g): 21.2; 10.6, 11.8; 15.4; 10.8; 9.8; 12.6, 20.2; 19.6; 11.3; 13.9, 39.6; 9.2; 10.6; 11.1
Abnormalities None

SampleD TISS-031884-101404-DK-016 150
Weight 15 whole fish

017 Sample E
Species Gizzard Shad
Length (cm): 11; 12, 14, 14; 11; 10; 11, 14; 11.5, 11; 10.5, 11.5; 10.5; 10.5, 10
Weight (g): 11.2, 15.8; 24.1; 26.1; 13.7, 10.1; 12.6; 27.1; 15.8; 12.1, 11.9; 13.2; 9.6; 12.1; 10.2
Abnormalities None

Sample E TISS-031884-101404-DK-017 151
Weight 15 whole fish

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10/14/04

Live Sample	Prepared Sample
RM 33	
Type: Predator_____ Cat_____	Sample No. TISS-031884-101404-DK-018 thru 022
Forage Gizzard Shad	Fillet, skin off_____
	Fillet, skin on, scaled _____
COMPOSITE No. 018 - 022 (Duplicate Sample)	Whole 75 (5 sets of 15)
Sample A	Sample A TISS-031884-101404-DK-018 1540
Species Gizzard Shad	Weight 15 whole fish
Length (cm): 10, 11, 10.5; 12; 11, 10.5; 13.5; 10; 11.5; 15; 10.5; 10; 10.5, 10; 10;	
Weight (g): 10.9; 13.3; 11.4; 19.1; 13.2; 10.7; 24.2; 7.9; 13.9; 25.8; 11.2; 9.7; 11.9; 10.9; 10.4	
Abnormalities None	
Sample B	Sample B TISS-031884-101404-DK-019 1550
Species Gizzard Shad	Weight 15 whole fish
Length(cm): 15; 11; 11.5; 15; 11; 11.5; 10.5; ~~12.1~~; 10; 10.5; 10.5; 10.5; 11; 11; 11; 10;	
Weight(g): 35.2; 10.8; 12.9; 27.4; 13.6; 13.1; 12.1; 8.1; 9.1; 11.3; 10.8; 12.2; 15.9; 11.2; 9.2.	
Abnormalities None	
Sample C	Sample C TISS-031884-101404-DK-020 1600
Species Gizzard Shad	Weight 15 whole fish
Length(cm): 13.5; 12; 14; 10.5; 11.5; 11; 10; 13; 15; 11; 10; 11.5; 12.5; 9.5; 12;	
Weight(g): 25.9; 16; 24.8; 9.3, 15.5; 11.8; 10.5; 22.6; 39; 12.9; 9.1; 14; 17.4; 8; 15.2	
Abnormalities None	
Sample D	SampleD TISS-031884-101504-DK-021 1005
Species Gizzard Shad	Weight 15 whole fish
Length(cm) 13.5; 10.5; 9.5; 10; 14.5; 9.5; 11; 10; 10; 10; 9.5; 12.5; 11; 11.5; 11;	
Weight(g) 30; 10.1; 6.4; 9.2, 29.1; 4.4; 8.3; 6.2; 5.6; 5.8; 5.7; 11.8; 10.1; 10.6; 9.3	
Abnormalities None	
Sample E	Sample E TISS-031884-101504-DK-022 1015
Species Gizzard Shad	Weight 15 whole fish
Length(cm) 10; 10.5; 10; 9.5; 11; 9.5; 10.5; 11.5; 10.5; 9; 9; 10; 11; 13; 12	
Weight(g) 6.5; 7.8; 7.0; 4.5; 8.4; 6.0; 8.7; 11.1; 8.3; 4.4; 4.5; 6.7; 9.4; 14.1; 15.3	
Abnormalities None	

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Live Sample	Prepared Sample 10/14/04 1620
RM 33	Sample No. TISS-031884-101404-DK-023
Type: Predator Bass Cat____	Fillet, skin off____
Forage____	Fillet, skin on, scaled 5
	Whole____
COMPOSITE No. 023	150 180 400 730
Sample A Species Spotted Bass Length 48cm Weight 2Kg Abnormalities None	Sample A Weight 400g + 150g + 180g = 730g
Sample B Species Spotted Bass Length 26cm Weight 0.3Kg Abnormalities None	Sample B Weight 82g
Sample C Species Spotted Bass Length 24cm Weight 194g Abnormalities None	Sample C Weight 56g
Sample D Species Spotted Bass Length 19cm Weight 89g Abnormalities None	SampleD Weight 25g
Sample E Species smbass Length 20cm Weight 98g Abnormalities None	Sample E Weight 26g

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Live Sample	Prepared Sample 10/14/04 1700
RM 33	Sample No. TISS-031884-101404-DK-024
Type: Predator Bass Cat___	Fillet, skin off
Forage___	Fillet, skin on, scaled 5
COMPOSITE No. 024	Whole
Sample A Species Spotted Bass Length 29 cm Weight 0.4Kg Abnormalities None	Sample A Weight 110g
Sample B Species spotted bass Length 20.5 cm Weight 127g Abnormalities None	Sample B Weight 42g
Sample C Species Spotted bass Length 21 cm Weight ~~210g~~ 145g Abnormalities None	Sample C Weight 47g
Sample D Species ~~Spotted~~ Sm bass Length 19 cm Weight 101 g Abnormalities None	SampleD Weight 31g
Sample E Species spotted bass Length 28cm Weight 0.4Kg Abnormalities None	Sample E Weight 108g

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1730

Live Sample	Prepared Sample
RM 33	Sample No. TISS-031884-101404-DK-025
Type: Predator Bass Cat____	Fillet, skin off____
Forage____	Fillet, skin on, scaled 5
COMPOSITE No. 025	Whole____
Sample A Species spotted bass Length 30cm Weight 0.45Kg Abnormalities None	Sample A Weight 127g
Sample B Species Spotted bass Length 24.5 cm Weight 192g Abnormalities None	Sample B Weight 68g
Sample C Species Sm bass Length 21 cm Weight 119g Abnormalities None	Sample C Weight 43g
Sample D Species Spotted bass Length 18cm Weight 85g Abnormalities None	SampleD Weight 31g
Sample E Species smbass. Length 26cm Weight 0.35Kg Abnormalities None	Sample E Weight 90.5g

Live Sample	Prepared Sample 10/15/04 1115
RM 33	Sample No. TISS-031884-101504-DK-026
Type: Predator Bass Cat ___ Forage ___	Fillet, skin off ___ Fillet, skin on, scaled 5 Whole ___
COMPOSITE No. 026	
Sample A Species spotted bass Length 24cm Weight 180g Abnormalities None	Sample A Weight 63g
Sample B Species spotted bass Length 25 cm Weight 0.3Kg Abnormalities None	Sample B Weight 69g
Sample C Species sm bass Length 27cm Weight 0.4Kg Abnormalities None	Sample C Weight 80g
Sample D Species sm bass Length 24cm Weight 170g Abnormalities None	SampleD Weight 57g
Sample E Species sm bass Length 26cm Weight 0.35Kg Abnormalities None	Sample E Weight 108g

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1150

Live Sample	Prepared Sample
RM 33	Sample No. TISS-031884-101504-DK-027
Type: Predator Bass Cat	Fillet, skin off
Forage	Fillet, skin on, scaled 5
COMPOSITE No. 027	Whole
Sample A Species smbass Length 32 cm Weight 0.6 Kg Abnormalities None	Sample A Weight 152 g
Sample B Species spotted bass Length 28 cm Weight 0.4 Kg Abnormalities None	Sample B Weight 101 g
Sample C Species smbass Length 23 cm Weight 142 g Abnormalities None	Sample C Weight 52 g
Sample D Species spotted bass Length 21 cm Weight 109 g Abnormalities None	SampleD Weight 41 g
Sample E Species spotted bass Length 19.5 cm Weight 118 g Abnormalities None	Sample E Weight 42 g

Live Sample	Prepared Sample 10/15/04 1240
RM 33	
	Sample No. TISS-031884-101504-DK-028 through 032
Type: Predator_____ Cat_____	Fillet, skin off
Forage Gizzard Shad	Fillet, skin on, scaled
	Whole 50 (5 sets of 10 fish)
COMPOSITE No. 028-032 (MSD Sample)	
Sample A	Sample A TISS-031884-101504-DK-028 1240
Species Gizzard Shad	Weight 10 whole fish
Length (cm) 15; 11; 11.5; 11; 14; 10.5; 10.5; 10.5; 11; 14.5	
Weight (g) 42; 12; 16; 10.9; 26.5; 10.7; 9.3; 10.6; 14; 31.2	
Abnormalities None	
Sample B	Sample B TISS-031884-101504-DK-029 1250
Species Gizzard Shad	Weight 10 whole fish
Length (cm) 13.5; 10; 13.5; 11; 14; 10; 12; 11; 11; 10;	
Weight (g) 25.3; 9.3; 23; 12.5; 27; 9.4; 14.8; 10.9; 13.7; 10.4	
Abnormalities None	
Sample C	Sample C TISS-031884-101504-DK-030 1300
Species Gizzard Shad	Weight 10 whole fish
Length (cm) 11.5; 10.5; 11.5; 11; 11; 10.5; 10; 12; 11; 11;	
Weight (g) 15; 11.4; 16.5; 14; 15.1; 12.4; 12.7; 17.5; 16.2; 16.1	
Abnormalities None	
Sample D	Sample D TISS-031884-101504-DK-031 1310
Species Gizzard Shad	Weight 10 whole fish
Length (cm) 12; 10; 12; 10; 10; 9.5; 9.5; 9.5; 9.5; 10	
Weight (g) 24; 13.1; 16.3; 14.9; 11.4; 11.2; 10.4; 10.1; 10.2; 9.2	
Abnormalities None	
Sample E	Sample E TISS-031884-101504-DK-032 1320
Species Gizzard Shad	Weight 10 whole fish
Length (cm) 13; 9.5; 10; 12; 11; 10; 11.5; 9; 11; 9	
Weight (g) 23.6; 11.4; 12.2; 18.1; 13.5; 11.4; 18.2; 9.5; 12.5; 8.1	
Abnormalities None	

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1430

Live Sample	Prepared Sample
RM 42	
Type: Predator bass Cat____	Sample No. TSS-031884-101504-DK-033
Forage________	Fillet, skin off________
	Fillet, skin on, scaled 5
	Whole ________
COMPOSITE No. 033	
Sample A Species spotted bass Length 27 cm Weight 0.4 Kg Abnormalities None	Sample A Weight 109 g
Sample B Species spotted bass Length 23 cm Weight 168 g Abnormalities None	Sample B Weight 57 g
Sample C Species spotted bass Length 25 cm Weight 0.3 Kg Abnormalities None	Sample C Weight 73 g
Sample D Species spotted bass Length 22 cm Weight 120 g Abnormalities None	SampleD Weight 38 g
Sample E Species spotted bass Length 24 cm Weight 0.3 Kg Abnormalities None	Sample E Weight 56 g

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Live Sample	Prepared Sample
RM 42	10/15/04 1500
Type: Predator Bass Cat ___ Forage ___	Sample No. TISS-03184-101504-DK-034
COMPOSITE No. 034	Fillet, skin off ___
	Fillet, skin on, scaled 5
	Whole ___
Sample A Species spotted bass Length 30 cm Weight 0.5Kg Abnormalities None	Sample A Weight 152g
Sample B Species spotted bass Length 27cm Weight 0.4Kg Abnormalities None	Sample B Weight 92g
Sample C Species spotted bass Length 20cm Weight 110g Abnormalities None	Sample C Weight 38g
Sample D Species Spotted bass Length 25cm Weight 0.4Kg Abnormalities None	SampleD Weight 67g
Sample E Species spotted bass Length 21cm Weight 111g Abnormalities None	Sample E Weight 37g

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1545

Live Sample	Prepared Sample
RM 33-45	
Type: Predator____ Cat Channel	Sample No. TISS-031884-101504-DK-035
Forage____	Fillet, skin off 5
	Fillet, skin on, scaled
	Whole
COMPOSITE No. 035	
Sample A Species Channel cat Length 39cm Weight 0.5Kg Abnormalities -None	Sample A Weight 77g
Sample B Species channel cat Length 29.5 cm Weight 210 g Abnormalities None	Sample B Weight 33g
Sample C Species channel cat Length 27cm Weight 160g Abnormalities None	Sample C Weight 29g
Sample D Species Channel cat Length 26.5cm Weight 138g Abnormalities None	SampleD Weight 22g
Sample E Species channel cat Length 27cm Weight 140g Abnormalities None	Sample E Weight 26g

Live Sample	Prepared Sample
RM 68	Sample No. TISS-031884-101604-DK-03
Type: Predator____ Cat____	Fillet, skin off________ -04
Forage GIZ. SHAD	Fillet, skin on, scaled ________
COMPOSITE No. 036-040	Whole X

036

Sample A
Species Gizzard Shad

Length	13	11.	13	13	15	14.5	12	11	14.5	13	12	13	13	13.5	13
Weight	20	11.5	20	22	34	27	18	15	31	23.5	17.7	22	21	22	23

Abnormalities

Sample A TISS-031884-101604-DK-036
Weight

11a

037

Sample B
Species Gizzard Shad

Length (cm)	13	13	13.5	13.5	13	14	13	14	14.5	13.5	14	14.5	14.5	14	12.5
Weight (g)	21.4	15.7	25.6	26.9	21	29	23.3	31.3	27.2	29.6	29.9	33.8	31.7	32.9	23.5

Abnormalities

Sample B TISS-031884-101804-DK-037
Weight

1130

038

Sample C
Species Gizzard Shad

Length (cm)	13.5	15	13.5	14	12	12.5	13.5	14	13.5	34	13	14	11	13.5	20
Weight (g)	27.4	40.7	27.2	33.3	19.4	22.6	27.5	27	31.7	31	27.9	28.1	16.6	28.1	73.8

Abnormalities

Sample C
Weight TISS-031884-101804-DK-038

1130

039

Sample D
Species Gizzard Shad

Length cm	24	24	25.5	18.5	27	24.5
Weight wt	142	169	144	60	171	159

Abnormalities

All gizzard shad - are large

SampleD TISS 031884-102104-DK-039
Weight

← Shipped 10/25/04

040

Sample E
Species
Length
Weight
Abnormalities

Sample E
Weight

Live Sample	Prepared Sample
RM 68	Sample No. TISS-031884-101604-DK-041
Type: Predator BASS Cat ___ Forage ___	Fillet, skin off ___ Fillet, skin on, scaled ___ Whole ___
COMPOSITE No. 041	
Sample A Species Spotted Length 47 cm Weight 1.6 kg Abnormalities	Sample A Weight 510 g
Sample B Species Spotted Length 22 cm Weight 145 g Abnormalities	Sample B Weight 47 g
Sample C Species Spotted Length 23 cm Weight 169 g Abnormalities	Sample C Weight 57 g
Sample D Species Spotted Length 24 cm Weight 143 g Abnormalities	SampleD Weight 45 g
Sample E Species Spotted Length 25 cm Weight 260 g Abnormalities	Sample E Weight 68 g

Live Sample	Prepared Sample
RM 68	Sample No. Tiss-031884-10L604-DK-042
Type: Predator BASS Cat ____	Fillet, skin off ____
Forage ____	Fillet, skin on, scaled X
COMPOSITE No. 042	Whole ____
Sample A Species Spotted Length 43cm Weight 1400g Abnormalities	Sample A Weight 440g
Sample B Species Spotted Length 28cm Weight 400g Abnormalities	Sample B Weight 92g
Sample C Species Spotted Length 23 cm Weight 136g Abnormalities	Sample C Weight 44g
Sample D Species Spotted Length 25cm Weight 300g Abnormalities	SampleD Weight 86g
Sample E Species Spotted Length 22cm Weight 132g Abnormalities	Sample E Weight 44g

Live Sample

RM 68

Type: Predator Bass Cat______

Forage________

COMPOSITE No. 043

Sample A
Species Spotted
Length 24.5 cm
Weight 310 g
Abnormalities

Sample B
Species Spotted
Length 26 cm
Weight 350 g
Abnormalities

Sample C
Species Spotted
Length 23 cm
Weight 145 g
Abnormalities

Sample D
Species Spotted
Length 21 cm
Weight 137 g
Abnormalities

Sample E
Species Spotted
Length 21 cm
Weight 134 g
Abnormalities

Prepared Sample

Sample No. Tiss-031884-101604-DK-043

Fillet, skin off________

Fillet, skin on, scaled X

Whole ________

Sample A
Weight 75 g

Sample B
Weight 88 g

Sample C
Weight 51 g

SampleD
Weight 45 g

Sample E
Weight 44g

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1135

Live Sample	Prepared Sample
RM 68	
Type: Predator Bass Cat ___ Forage ___	Sample No. TISS-031884-101604-DK-044
	Fillet, skin off ___
	Fillet, skin on, scaled X
	Whole ___
COMPOSITE No. 044	
Sample A Species Spotted Length 20.5cm Weight 112g Abnormalities	Sample A Weight 38g
Sample B Species Spotted Length 20cm Weight 113g Abnormalities	Sample B Weight 35g
Sample C Species Spotted Length 34cm Weight 101g Abnormalities	Sample C Weight 34g
Sample D Species spotted Length 26cm Weight 300g Abnormalities	SampleD Weight 85g
Sample E Species Length 30cm Weight 500Kg Abnormalities	Sample E Weight 145g

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Live Sample	Prepared Sample
RM 68	
Type: Predator Bass Cat ____ Forage ____	Sample No. TISS-031884-101804-DK-045
	Fillet, skin off ____
	Fillet, skin on, scaled 5
	Whole ____
COMPOSITE No. 045	
Sample A Species Spotted Length 28cm Weight 0.5Kg Abnormalities -	Sample A Weight 117g
Sample B Species Spotted Length 29cm Weight 0.4Kg Abnormalities -	Sample B Weight 113g
Sample C Species Smallmouth Length 25cm Weight 187g Abnormalities	Sample C Weight 62g
Sample D Species Small mouth Length 23cm Weight 162 g Abnormalities -	SampleD Weight 57g
Sample E Species Spotted Length 23cm Weight 160g Abnormalities	Sample E Weight 55.7g

10/21/04

Live Sample	Prepared Sample
RM 75-95	Sample No. TISS-031884-102104-DK-046
Type: Predator ____ Cat Channel	Fillet, skin off 5
Forage ____	Fillet, skin on, scaled ____
	Whole ____
COMPOSITE No. 046	
Sample A Species CCat Length 54cm Weight 1.5Kg Abnormalities None	Sample A Weight 236g
Sample B Species C cat Length 29cm Weight 1.6Kg Abnormalities Showed signs of being preyed upon.	Sample B Weight 206g
Sample C Species CCat Length 39cm Weight 0.6Kg Abnormalities None	Sample C Weight 88g
Sample D Species CCat Length 35cm Weight 0.4Kg Abnormalities None	SampleD Weight 54g
Sample E Species CCat Length 38cm Weight 0.6Kg Abnormalities None	Sample E Weight 109g

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Live Sample **RM** 75-95 **Type:** **Predator**____ **Cat** Channel **Forage**____ **COMPOSITE No.** 047	**Prepared Sample** **Sample No.** TISS-031884-102104-DK-047 **Fillet, skin off** 5 **Fillet, skin on, scaled** ____ **Whole** ____
Sample A Species ccat Length 65cm Weight 3.4Kg Abnormalities None	Sample A Weight 1Kg
Sample B Species ccat Length 52cm Weight 1.5Kg Abnormalities None	Sample B Weight 180g
Sample C Species ccat Length 50cm Weight 1.5Kg Abnormalities None	Sample C Weight 300g
Sample D Species ccat Length 28cm Weight 128g Abnormalities None	SampleD Weight 18g
Sample E Species C Catfish Length 58cm Weight 2.4Kg Abnormalities None	Sample E Weight 950g

Live Sample	Prepared Sample
RM 95	Sample No. Tiss-031884-102204-DK-048
Type: Predator____ Cat X	Fillet, skin off X - 5
Forage____	Fillet, skin on, scaled ____
COMPOSITE No. 048	Whole ____
Sample A Channel Catfish Species Length 49cm Weight 1.4kg Abnormalities none	Sample A Weight 225g
Sample B Species C. Catfish Length 44cm Weight 0.9kg Abnormalities none	Sample B Weight 162g
Sample C Species C. Catfish Length 52 cm Weight 1.6 kg Abnormalities none	Sample C Weight 190 g
Sample D Species C. Catfish Length 39cm Weight 0.7 kg Abnormalities none	SampleD Weight 61 g
Sample E Species C. Catfish Length 25cm Weight 116g Abnormalities none	Sample E Weight 27g

Live Sample	Prepared Sample
RM 95	Sample No. TISS-031884-102204-DK-049
Type: Predator____ Cat X	Fillet, skin off X
Forage____	Fillet, skin on, scaled ____
COMPOSITE No. 049	Whole ____
Sample A Species Channel Catfish Length 35cm Weight 0.5kg Abnormalities none	Sample A Weight 84g
Sample B Species C.Cat Length 23cm Weight 106 g Abnormalities none	Sample B Weight 28g
Sample C Species C. Cat Length 28 cm Weight 170g Abnormalities none	Sample C Weight 31g
Sample D Species C.Cat Length 33cm Weight 0.5kg Abnormalities none	SampleD Weight 52g
Sample E Species C Cat Length 48cm Weight 1.3kg Abnormalities none	Sample E Weight 210 g

Live Sample	Prepared Sample
RM 75-95	
Type: **Predator**_____ **Cat** X	**Sample No.** TISS03185411F704 DFK-050
Forage________	**Fillet, skin off** X
	Fillet, skin on, scaled ________
	Whole ________
COMPOSITE No. 050	
Sample A Species C. Catfish Length 51 cm Weight 1.4 Kg Abnormalities None	Sample A Weight 195 g
Sample B Species C. catfish Length 56 cm Weight 2.4 Kg Abnormalities None	Sample B Weight 410g
Sample C Species C. catfish Length 39 cm Weight 0.8 Kg Abnormalities None	Sample C Weight 73 g
Sample D Species C. catfish Length 57 cm Weight 2.2 Kg Abnormalities None	SampleD Weight 800g
Sample E Species [illegible] Length [illegible] Weight [illegible] Abnormalities [illegible]	Sample E Weight [illegible]

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Live Sample	Prepared Sample
RM 68	Sample No. TISS031884111704DFK-051
Type: Predator___ Cat___	Fillet, skin off -052
Forage X Gizzard Shad	Fillet, skin on, scaled
COMPOSITE No. 051-052	Whole 2 sets of 15 fish

Sample A -051
Species Gizzard Shad

Length (cm):	15	15.5	14.5	14.5	14	21	17	21	15.5
Weight (g):	28	41	34	30	28.5	102	64	85	41

Abnormalities None

Sample A TISS-031884-111704-DFK-051
Weight

14	14	16.5	14	13	14
28	28	41.5	28	21	29

Sample B -052
Species Gizzard Shad

Length (cm):	15	14	15	15	13	14	17	16	13
Weight (g):	30	32	30	31	22	27	47	34	24

Abnormalities None

Sample B TISS-031884-111704-DFK-052
Weight

14	14	13.5	15	17	19
31	29	25	34	47	77

Sample C
Species
Length
Weight
Abnormalities

Sample C
Weight

Sample D
Species
Length
Weight
Abnormalities

SampleD
Weight

Sample E
Species
Length
Weight
Abnormalities

Sample E
Weight

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2008

1240

Live Sample
RM 42 ~~[illegible]~~ bass

Type: **Predator** ✓ **Cat** ____
Forage ____

COMPOSITE No. 1
#1

Sample A
Species spotted bass (photo)
Length 31 cm
Weight 300g
Abnormalities —

Sample B
Species spotted
Length 29cm
Weight 305g
Abnormalities —

Sample C
Species spotted
Length 27cm
Weight 280g
Abnormalities —

Sample D
Species spotted
Length 27cm
Weight 240g
Abnormalities —

Sample E
Species ~~Spotted~~ large mouth (photo)
Length 26cm
Weight 230 g
Abnormalities —

Prepared Sample

Sample No. TISS031884-121708DFK-001
Fillet, skin off ____
Fillet, skin on, scaled ____
Whole X

1A
Sample A
Weight 300g (whole fish)

1B
Sample B
Weight 305g

1C
Sample C
Weight 280

1D
SampleD
Weight 240

1E
Sample E
Weight 230

1250 12/16/08

Live Sample	Prepared Sample
RM 42 Bass	**Sample No.** TSS03884-121708- DFK -002
Type: **Predator** ✓ **Cat** ____	**Fillet, skin off** ____
Forage ____	**Fillet, skin on, scaled** ____
2 **COMPOSITE No.** 2	**Whole** X
#2	
Sample A Species LM Length 30 cm Weight 390 g Abnormalities 0 —	2A Sample A Weight 390g (whole)
Sample B Species Spotted Length 31cm Weight 415g Abnormalities —	2B Sample B Weight 415g
Sample C Species spotted Length 23cm Weight 160g Abnormalities —	2C Sample C Weight 160g
Sample D Species spotted Length 22cm Weight 150g Abnormalities —	2D SampleD Weight 150g
Sample E Species Spotted Length 34 cm Weight 490 Abnormalities —	2E Sample E Weight 490g

✓

12/16/08

Live Sample	Prepared Sample
RM 42 Gizzard Shad	10:00
Type: Predator___ Cat___ Forage X	Sample No. TSS031884-121608DHC -003
	Fillet, skin off
	Fillet, skin on, scaled
	Whole X 2 fish per sample
COMPOSITE No. 3 10 fish per Composite	
Sample A Species Length 23cm / 24cm Weight 142g / 132g Abnormalities —	3A Sample A Weight 142+132 = 274g
Sample B Species Length 25cm / 25cm Weight ~~140cg~~ / 150g. Abnormalities	3B Sample B Weight 140 +150 290g
Sample C Species Length ~~26~~ 23cm (each) Weight 260g (combined) Abnormalities	3C Sample C Weight 260g
Sample D Species Length 27cm / 28cm Weight 190 / 180 Abnormalities	3D Sample D Weight 190 +180 370g
Sample E Species Length 22cm / 26cm Weight 120g / 210 Abnormalities	3E Sample E Weight 120 +210 330g

003-007 Sample ✓

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12/16/08

Gizzard Shad

Live Sample
RM 42

Type: Predator____ Cat____
Forage X

2 **COMPOSITE No.** 4

Sample A
Species
cm Length 21cm / 27
g Weight 110 / 210
Abnormalities

Sample B
Species
Length 26 / 27
Weight 140 / 190
Abnormalities

Sample C
Species
cm Length 25 / 25
g Weight 158 / 170
Abnormalities

Sample D
Species
Length 25 / 26
Weight 175 / 175
Abnormalities

Sample E
Species
Length 28 / 26
Weight 220 /
Abnormalities

Prepared Sample 10:30

Sample No. -004
Fillet, skin off
Fillet, skin on, scaled
Whole X 2 fish per sample

4A
Sample A
Weight 110
210
320g

4B
Sample B
Weight 140
+ 190
330g

4C
Sample C
Weight 158
+ 170
328g

4D
SampleD
Weight 175
+ 175
350g

4E
Sample E
Weight 220
+ 185
405g

✓

12/16/08 11:00

Live Sample RM 42 Gizzard Shad	Prepared Sample
Type: Forage X Predator___ Cat___	Sample No. -005
	Fillet, skin off
	Fillet, skin on, scaled
3 COMPOSITE No. 5	Whole X 2 fish/each
Sample A Species cm Length 27/25 g Weight 170/140 Abnormalities —	5A Sample A Weight 170 + 140 310
Sample B Species cm Length 28/24 Weight 180/158 Abnormalities	5B Sample B Weight 180 + 158 338g
Sample C Species Length 23/26 Weight 118/180 Abnormalities	Sample C 5C Weight 118 + 180 298g
Sample D Species Length 27cm (each) Weight combined 460g Abnormalities	SampleD 5D Weight 460g
Sample E Species Length 21cm/25cm Weight combined 320g Abnormalities	Sample E 5E Weight 320g

12/16/08
1130

Live Sample	Prepared Sample
Live Sample Gizzard Shad **RM** 42	**Prepared Sample**
Type: **Forage** X **Predator** ___ **Cat** ___	**Sample No.** -006 **Fillet, skin off** ___ **Fillet, skin on, scaled** ___ **Whole** X 2 fish / sample
4 **COMPOSITE No.** 6 (10 fish)	
Sample A Species Length 27cm (each) Weight combined 440g Abnormalities —	Sample A 6A Weight 440g combined
Sample B Species Length 23/24 Weight 125/150 Abnormalities —	Sample B 6B Weight 125 + 150 = 275g
Sample C Species Length 23/21 cm Weight 140/90 g Abnormalities —	Sample C 6C Weight 140 + 90 = 230g
Sample D Species Length 26 cm/27 Weight 140/180 Abnormalities —	SampleD 6D Weight 140 + 180 = 320g
Sample E Species Length 25/21 Weight 140/100 Abnormalities —	Sample E 6E Weight 140 + 100 = 240g

✓

12/16/08

Live Sample RM 42 Gizzard Shad	**Prepared Sample** 1200
Type: Forage X **Predator** ____ **Cat** ____	**Sample No.** -007
	Fillet, skin off
	Fillet, skin on, scaled
	Whole X 2 fish / sample
5 **COMPOSITE No.** 7 (10 fish)	
Sample A Species Length 25/28 cm Weight 180/210 g Abnormalities —	Sample A 7A Weight 180 +210 390g
Sample B Species Length 24cm each Weight 310g (combined) Abnormalities	Sample B 7B Weight 310g
Sample C Species Length 24cm (each) Weight combined 260g Abnormalities —	Sample C 7C Weight 260g
Sample D Species Length 26/24 Weight 160/120 Abnormalities —	SampleD 7D Weight 160 +120 280g
Sample E Species Length 27/25 Weight 180/160 Abnormalities —	Sample E 7E Weight 180 +160 340g

1300 001 ✓
002
12/16/08 008
009
010

Live Sample Bass
RM 42

Type: Predator ✓ Cat____
Forage____

3 COMPOSITE No. 8 (5 fish/composite)
#3

Sample A
Species Sm
cm Length 31
g Weight 400g
Abnormalities

Sample B
Species spotted
Length 32
Weight 470g
Abnormalities

Sample C
Species spotted
Length 27cm
Weight 230g
Abnormalities

Sample D
Species Spotted
Length 26
Weight 180
Abnormalities

Sample E
Species Spotted
Length 30
Weight 340g
Abnormalities

Prepared Sample

Sample No. TBS03884-121708-DFK -008
Fillet, skin off____
Fillet, skin on, scaled____
Whole X 1 fish/sample

Sample A 8A
Weight 400g

Sample B 8B
Weight 470g

Sample C 8C
Weight 230g

'SampleD 8D
Weight 180g

Sample E 8E
Weight 340g

1310 12/16/08

Bard

Live Sample	**Prepared Sample**
RM 42	**Sample No.** DSS021884-121708 DFK -009
Type: **Predator** ✓ **Cat**	**Fillet, skin off**
Forage	**Fillet, skin on, scaled**
	Whole X 1 fish / sample
4 **COMPOSITE No.** 9 5 fish / comp #4	
Sample A Species Spotted Length 22 Weight 110 Abnormalities —	Sample A 9A Weight 110g
Sample B Species SM Length 23 Weight 160g Abnormalities —	Sample B 9B Weight 160g
Sample C Species SM Length 23 Weight 150 Abnormalities —	Sample C Weight 150g
Sample D Species Spotted Length 24 Weight 150 Abnormalities —	SampleD Weight 150g
Sample E Species Spotted Length 22 Weight 120 Abnormalities —	Sample E Weight 120g

1320

Live Sample	Prepared Sample
RM 42 Bass	Sample No. TRSS 031884-RM08DFK010
Type: Predator ✓ Cat ____	Fillet, skin off ____
Forage ____	Fillet, skin on, scaled ____
	Whole X 1 fish/sample
5 COMPOSITE No. 10 5 fish/comp #5	
Sample A Species Spotted Length 27 cm Weight 240 g Abnormalities —	Sample A 10A Weight 240g
Sample B Species Spotted Length 26 Weight 240 Abnormalities —	Sample B Weight 240g
Sample C Species Spotted Length 22 Weight 120g Abnormalities —	Sample C Weight 120g
Sample D Species Spotted Length 21 Weight 90 Abnormalities —	SampleD Weight 90g
Sample E Species Spotted Length 21 Weight 100 Abnormalities —	Sample E Weight 100g

-011
-012
-013
-014
-015

(33-45) Channel Catfish

0830 12/16/08

Live Sample
RM ~~4E~~

Type: **Predator**____ **Cat** X
Forage____

1 **COMPOSITE No.** 11 5 fish composite
#1

Sample A male
Species Channel
cm Length 50 cm
Weight 1400 g (1.4 Kg)
Abnormalities —

Sample B
Species Channel male
Length 48 cm
Weight 1 Kg
Abnormalities —

Sample C
Species Channel female
Length 51 cm
Weight 1700 g
Abnormalities —

Sample D Channel female
Species
Length 31 cm
Weight 260 g
Abnormalities —

Sample E
Species Channel
Length 35 cm
Weight 380 g
Abnormalities —

Prepared Sample

Sample No. TISS 031884 - 121708 DFK 011
Fillet, skin off____
Fillet, skin on, scaled____
Whole X 1 fish/sample

Sample A 11 A
Weight 1400 g (1.4 Kg)

Sample B 11 B
Weight 1 Kg = 1000 g

Sample C 11 C
Weight 1700 g (1.7 Kg)

SampleD 11 D
Weight 260 g

Sample E 11 E
Weight 380 g

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AR101041

0850 12/16/08

Live Sample	Prepared Sample
RM ~~#2~~ 33-45 Channel catfish	Sample No: TISS031884121708-DFK -012
Type: Predator____ Cat X	Fillet, skin off
Forage____	Fillet, skin on, scaled
	Whole X 1 fish / sample
2 COMPOSITE No. 12 #2 5 fish / composite	
Sample A Species Channel Length 46 cm Weight 1300 g Abnormalities —	Sample A 12 A Weight 1300 g
Sample B Species Channel Length 47 cm Weight 1500 g Abnormalities —	Sample B 12 B Weight 1500 g
Sample C Species channel Length 47 cm Weight 1700 g Abnormalities —	Sample C 12 C Weight 1700 g
Sample D Species channel Length 52 cm Weight 1500 g Abnormalities —	SampleD 12 D Weight 1500 g
Sample E Species channel Length 53 cm Weight 1700 g Abnormalities —	Sample E 12 E Weight 1700 g

✓

0900 12/16/08

Live Sample	Prepared Sample
RM ~~42~~ 33-45	Sample No. TISS 031884-121708-DFK-013
Type: Predator____ Cat X	Fillet, skin off
Forage____	Fillet, skin on, scaled
	Whole X 1 fish/Sample
3 COMPOSITE No. 013 5 fish/Composite #3	
Sample A Species Channel cat Length 44 cm Weight 1200g Abnormalities —	Sample A 13A Weight 1200g
Sample B Species Channel Length 42 cm Weight 900g Abnormalities —	Sample B 13B Weight 900g
Sample C Species Sauger Length 37cm Weight 510g Abnormalities —	Sample C 13C Weight 510g
Sample D Species Sauger Length 33cm Weight 358g Abnormalities —	SampleD 13D Weight 358g
Sample E Species Sauger Length 37cm Weight 490g Abnormalities —	Sample E 13E Weight 490g

✓

0915 12/17/08

Live Sample	Prepared Sample
RM 33-45	**Sample No.** T7SS031884-121708-DFK-014
Type: **Predator**____ **Cat** X	**Fillet, skin off** X
Forage____	**Fillet, skin on, scaled** ____
	Whole X 1 fish/sample
4 **COMPOSITE No.** #4 (014) 5 fish/comp.	
Sample A Species Channel cat. cm Length 43 g Weight 900g Abnormalities —	Sample A 14A Weight 900g
Sample B Species Channel cat. Length 46 Weight 1000g Abnormalities —	Sample B 14B Weight 1000g
Sample C Species channel cat Length 41 cm Weight 800g Abnormalities —	Sample C 14C Weight 800g
Sample D Species sauger Length 36 Weight 380 Abnormalities —	SampleD 14D Weight 380g
Sample E Species sauger Length 35 Weight 400 Abnormalities —	Sample E 14E Weight 400g

✓

0930 12/17/08

Live Sample	Prepared Sample
RM 33-45	**Sample No.** T7SS 031884-121708-DFK-015
Type: **Predator**___ **Cat** X **Forage**___	**Fillet, skin off** X **Fillet, skin on, scaled** ___ **Whole** 1 fish/sample
5 **COMPOSITE No.** #5 (015) 5 fish/composite	
Sample A Species sauger cm Length 33 g Weight 340g Abnormalities	Sample A 15A Weight 340g
Sample B Sauger Species Length 34 Weight 350g Abnormalities —	Sample B 15B Weight 350g
Sample C Species Sauger Length 32 Weight 290 Abnormalities —	Sample C 15C Weight 290g
Sample D Species Sauger Length 33 Weight 330g Abnormalities —	SampleD 15D Weight 330g
Sample E Species Sauger Length 32 Weight 240g Abnormalities 0	Sample E 15E Weight 240g

-016 thru -020

✓

0940 12/17/08

Live Sample RM 33 Gizzard Shad	**Prepared Sample**
Type: **Forage** ✓ **Predator** ___ **Cat** ___	**Sample No.** TISS031884-121708-DFK -016 **Fillet, skin off** ___ **Fillet, skin on, scaled** ___ **Whole** X 2 fish per sample
1 **COMPOSITE No.** 016 #1 — 10 fish per composite	
Sample A Species cm Length 19/21 g Weight 70/100 Abnormalities —	Sample A 16A Weight 70 +100 170g
Sample B Species Length 24/20 Weight 140/70 Abnormalities —	Sample B 16B Weight 140 + 70 210 g
Sample C Species Length 22/24 Weight 90/130 Abnormalities —	Sample C 16C Weight 90 +130 220 g
Sample D Species Length 25/20 Weight 160/80 Abnormalities —	SampleD 16D Weight 160 + 80 240 g
Sample E Species Length 21/27 Weight 95/190 Abnormalities —	Sample E 16E Weight 95 +190 285g

✓

1000 12/17/08

Live Sample Gizzard Shad RM 33 Type: Predator____ Cat____ Forage ✓ 2 COMPOSITE No. #2 (017) 10 fish/comp.	**Prepared Sample** Sample No. -017 Fillet, skin off Fillet, skin on, scaled Whole X 2 fish/sample
Sample A Species cm Length 29/28 g Weight 240/240 Abnormalities —	Sample A 17A Weight 240 + 240 = 480g
Sample B Species Length 21/26 Weight 80/140 Abnormalities —	Sample B 17B Weight 80 + 140 = 220g
Sample C Species Length 26/24 Weight 185/140 Abnormalities —	Sample C 17C Weight 185 + 140 = 325g
Sample D Species Length 29/25 Weight 270/160 Abnormalities —	SampleD 17D Weight 270 + 160 = 430g
Sample E Species Length 29/31 Weight 320/285 Abnormalities	Sample E 17E Weight 320 + 285 = 605g

✓

1020 12/17/08

Live Sample Gizzard Shad	**Prepared Sample**
RM 33	**Sample No.** -018
Type: Forage ✓ **Predator**____ **Cat**____	**Fillet, skin off**____ **Fillet, skin on, scaled**____ **Whole** X 2 fish/sample
3 **COMPOSITE No.** #3 (018) 10 fish/comp.	
Sample A Species cm Length 23 | 22 g Weight 110 | 100 Abnormalities —	Sample A 18A Weight 110 + 100 = 210g
Sample B Species Length 20 | 23 Weight 70 | 120 Abnormalities —	Sample B 18B Weight 70 + 120 = 190g
Sample C Species Length 32cm / 28 Weight 380 | 220 Abnormalities ___	Sample C 18C Weight 380 + 220 = 600g
Sample D Species Length 25 / 26 Weight 180 | 140 Abnormalities ___	SampleD 18D Weight 180 + 140 = 320g
Sample E Species Length 18/20 Weight 65 | 70 Abnormalities ___	Sample E 18E Weight 65 + 70 = 135g

✓

1040 12/17/08

Gizzard Shad

Live Sample
RM 33

Type: Predator____ Cat____
Forage ✓

4 COMPOSITE No. #4 (019) 10 fish per comp.

Sample A
Species
cm Length 22 | 22
g Weight 90 | 95
Abnormalities —

Sample B
Species
Length 20 | 23
Weight 80 | 110
Abnormalities —

Sample C
Species
Length 20cm | 26
Weight 70 | 160
Abnormalities —

Sample D
Species
Length 23 | 23
Weight 120 | 120
Abnormalities —

Sample E
Species
Length 27 | 26
Weight 210 | 190
Abnormalities —

Prepared Sample

Sample No. -019
Fillet, skin off____
Fillet, skin on, scaled____
Whole X 2 fish / sample

Sample A 19A
Weight
90
+95
185 g

Sample B 19B
Weight
80
+110
190 g

Sample C 19C
Weight
70
+160
230 g

SampleD 19D
Weight
120
+120
240 g

Sample E 19E
Weight
210
+190
400 g

✓

1100 12/17/08

Live Sample	Prepared Sample
Gizzard Shad	
RM 33	Sample No. -020
Type: ✓ Predator____ Cat____	Fillet, skin off
Forage____	Fillet, skin on, scaled
	Whole X 2 fish/sample
5 COMPOSITE No. #5 (020) 10 fish/comp.	
Sample A Species Length 22/20 cm Weight 90/65 g Abnormalities —	Sample A 20A Weight 90 + 65 = 155 g
Sample B Species Length 22/22 Weight 100/100 Abnormalities —	Sample B 20B Weight 100 + 100 = 200 g
Sample C Species Length 26/25 Weight 170/180 Abnormalities —	Sample C 20C Weight 170 + 180 = 350 g
Sample D Species Length 26/24 Weight 170/150 Abnormalities —	SampleD 20D Weight 170 + 150 = 320 g
Sample E Species Length 21/24 Weight 80/180 Abnormalities —	Sample E 20E Weight 80 + 180 = 260 g

-021 thru -025 ✓

1110 12/17/08

Live Sample	Prepared Sample
Live Sample Baro **RM** 33 **Type:** **Predator** ✓ **Cat** **Forage**	**Prepared Sample** **Sample No.** TISS 031884-121708-DFK -021 **Fillet, skin off** **Fillet, skin on, scaled** X **Whole** 1 fish/sample
1 **COMPOSITE No.** #1 (021) 5 fish/composite	
Sample A Species LM Length 32 cm Weight 530g g Abnormalities —	Sample A 21 A Weight 530g
Sample B spotted Species Length 32 Weight 520g Abnormalities —	Sample B 21 B Weight 520g
Sample C Species spotted Length 24 cm Weight 180 Abnormalities —	Sample C 21 C Weight 180g
Sample D spotted Species Length 25 cm Weight 210 Abnormalities	SampleD 21 D Weight 210g
Sample E Species Spotted Length 23 Weight 150 Abnormalities —	Sample E 21 E Weight 150g

✓

1130 12/17/08

Live Sample	Prepared Sample
RM 33 Baro	
Type: **Predator** ✓ **Cat** ___	**Sample No.** TISS031884-121708-DFK -022
Forage ___	**Fillet, skin off** ___
	Fillet, skin on, scaled X
	Whole 1 fish/sample
2 **COMPOSITE No.** #2 (022) 5 fish/ comp.	
Sample A Species LM cm Length 35cm g Weight 660 Abnormalities —	Sample A 22A Weight 660g
Sample B Species SM Length 24 Weight 180 Abnormalities —	Sample B 22B Weight 180g
Sample C Species spotted Length 23 Weight 170 Abnormalities —	Sample C 22C Weight 170g
Sample D Species Spotted Length 23 Weight 150 Abnormalities —	SampleD 22D Weight 150g
Sample E Species Spotted Length 25 Weight 230 Abnormalities —	Sample E 22 E Weight 230g

✓

1150 12/17/08

Live Sample	Prepared Sample
Bass	
RM 33	**Sample No.** -023
Type: **Predator** ✓ **Cat** ___ **Forage** ___	**Fillet, skin off** ___
	Fillet, skin on, scaled X
	Whole X 1 fish/sample
3 **COMPOSITE No.** #3 (023) 5 fish/comp.	
Sample A Species Spotted Length 27 cm Weight 240 g Abnormalities —	Sample A 23A Weight 240g
Sample B Species LM Length 35 Weight 680g Abnormalities —	Sample B 23B Weight 680g
Sample C Species Spotted Length 22 Weight 140 Abnormalities —	Sample C 23C Weight 140g
Sample D Species Spotted Length 22 Weight 140 Abnormalities —	SampleD 23D Weight 140g
Sample E Species Spotted Length 21 Weight 110 Abnormalities	Sample E 23E Weight 110g

✓

1210 12/17/08

Live Sample	Prepared Sample
RM 33 Baro	**Sample No.** -024
Type: **Predator** ✓ **Cat**____	**Fillet, skin off**____
Forage____	**Fillet, skin on, scaled** X
	Whole 1 fish/Sample
4 **COMPOSITE No.** #4 (024) 5 fish/comp.	
Sample A Species Spotted Length 25 cm Weight 220 g Abnormalities —	Sample A 24 A Weight 220g
Sample B Species Spotted Length 25 Weight 250 Abnormalities —	Sample B 24 B Weight 250g
Sample C Species Spotted Length 26 Weight 240 Abnormalities —	Sample C 24 C Weight 240g
Sample D Species Spotted Length 25 Weight 280g Abnormalities —	SampleD 24 D Weight 280g
Sample E Species Spotted Length 22 Weight 110 Abnormalities —	Sample E 24 E Weight 110g

✓

1230 12/17/08

Live Sample Bass
RM 33

Type: **Predator** ✓ **Cat**____
Forage________

5 **COMPOSITE No.** #5 (025)

Sample A
Species Spotted
cm Length 21
g Weight 110
Abnormalities —

Sample B
Species spotted
Length 19
Weight 85
Abnormalities —

Sample C
Species spotted
Length 19
Weight 80g
Abnormalities —

Sample D
Species spotted
Length 21
Weight 120
Abnormalities —

Sample E
Species spotted
Length 19
Weight 90
Abnormalities —

Prepared Sample

Sample No. TISS031884-121708DFK025
Fillet, skin off________
Fillet, skin on, scaled X
Whole 1 fish / sample

Sample A 25A
Weight 110g

Sample B 25 B
Weight 85g

Sample C 25 C
Weight 80g

SampleD 25 D
Weight 120g

Sample E 25 E
Weight 90g

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AR101055

026-030 ✓

1438 12/18/08

Live Sample Bass	Prepared Sample
RM 68	Sample No. TSS031884-121808DFHC026
Type: Predator ✓ Cat ___	Fillet, skin off ___
Forage ___	Fillet, skin on, scaled X
	Whole 1 fish/sample
1 COMPOSITE No. #1 (026) 5 fish/comp.	
Sample A Species SM cm Length 32 Weight 440g Abnormalities —	Sample A 26A Weight 440g
Sample B Species ~~striped~~ Spotted Length 29 Weight 320 g Abnormalities —	Sample B 26B Weight 320g
Sample C Species SM Length 33 Weight 460g Abnormalities —	Sample C 26C Weight 460g
Sample D Species SM Length 31 Weight 470 Abnormalities —	SampleD 26D Weight 470g
Sample E Species Spotted Length 26 Weight 220 Abnormalities —	Sample E 26E Weight 220g

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1446 12/18/08

Baro

Live Sample	**Prepared Sample**
RM 68	**Sample No.** TSS031804-121808-DFK-027
Type: **Predator** ✓ **Cat** ___	**Fillet, skin off** ___
Forage ___	**Fillet, skin on, scaled** X
	Whole 1 fish/sample
2 **COMPOSITE No.** #2 (027) 5 fish comp.	
Sample A Species spotted Length 26 cm Weight 260 g Abnormalities —	Sample A 27A Weight 260g
Sample B Species SM Length 30 Weight 340 Abnormalities —	Sample B 27B Weight 340g
Sample C Species spotted Length 25 Weight 210 Abnormalities —	Sample C 27C Weight 210g
Sample D Species spotted Length 25 Weight 240 Abnormalities —	SampleD 27D Weight 240g
Sample E Species SM Length 30 Weight 340 Abnormalities	Sample E 27E Weight 340g

1455 12/18/08

Live Sample	Prepared Sample
RM 68 Bard	Sample No. TISS031884-121808-DFC028
Type: Predator ✓ Cat___	Fillet, skin off___
Forage___	Fillet, skin on, scaled X
	Whole 1 fish/Sample
3 COMPOSITE No. #3 (028) 5 fish comp.	
Sample A	Sample A 28A
Species SM	Weight 160g
cm Length 24	
g Weight 160	
Abnormalities —	
Sample B	Sample B 28B
Species LM	Weight 240g
Length 25	
Weight 240	
Abnormalities —	
Sample C	Sample C 28C
Species hybrid (spotted)	Weight 250g
Length 26	
Weight 250	
Abnormalities —	
Sample D	SampleD 28D
Species SM (hybrid?)	Weight 340g
Length 30	
Weight 340	
Abnormalities —	
Sample E	Sample E 28E
Species LM	Weight 280g
Length 28	
Weight 280	
Abnormalities —	

1500 ~~AK~~ 12/18/08

Bars

Live Sample **RM** 68 **Type:** **Predator** ✓ **Cat**____ **Forage**____ **COMPOSITE No.** #4 (029)	**Prepared Sample** **Sample No.** -029 **Fillet, skin off**____ **Fillet, skin on, scaled** X **Whole** 1 fish/Sample
Sample A Species Spotted Length 23 Weight 160 Abnormalities ____	Sample A 29A Weight 160g
Sample B Species SM Length 28 Weight 320 Abnormalities ____	Sample B 29B Weight 320g
Sample C LM Species Length 26 Weight 260g Abnormalities ____	Sample C 29C Weight 260g
Sample D Species spotted Length 22 Weight 120g Abnormalities ____	SampleD 29D Weight 120g
Sample E Species Spotted Length 26 Weight 220g Abnormalities ____	Sample E 29E Weight 220g

y

cm

g

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1505
~~1500~~ 12/18/08

Live Sample
RM 68 Baro

Type: **Predator** ✓ **Cat**
Forage

COMPOSITE No. #5 (030)
5 fish/comp.

5

Sample A
Species SM
Length 31 cm
Weight 380 g
Abnormalities —

Sample B
Species spotted
Length 25
Weight 200
Abnormalities —

Sample C
Species spotted
Length 25
Weight 240
Abnormalities —

Sample D
Species spotted
Length 26
Weight 210
Abnormalities —

Sample E
Species SM
Length 23
Weight 140
Abnormalities —

Prepared Sample

Sample No. -030
Fillet, skin off
Fillet, skin on, scaled X
Whole 1 fish/sample

Sample A 30A
Weight 380g

Sample B 30B
Weight 200g

Sample C 30 C
Weight 240g

SampleD 30 D
Weight 210g

Sample E 30 E
Weight 140g

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AR101060

✓031
✓032
033-035 (open)

12/18/08 ✓
1515

Gizzard Shad

Live Sample	Prepared Sample
RM 68	Sample No. TSS031884-121808-DFK-031
Type: Predator____ Cat____	Fillet, skin off
Forage ✓	Fillet, skin on, scaled
	Whole X 1 fish/sample
COMPOSITE No. #1 (031) 5 fish/comp.	
Sample A Species Length 31 cm Weight ~~350~~ CP 380 Abnormalities —	Sample A 031A 1 fish Weight ~~280g~~ 380g
Sample B Species Length 31 Weight 300 Abnormalities —	Sample B 031B Weight 300g
Sample C Species Length 34 Weight 380 Abnormalities —	Sample C 31C Weight 380g
Sample D Species Length 26 Weight 140 Abnormalities —	SampleD 31D Weight 140g
Sample E Species Length 32 Weight 310 Abnormalities —	Sample E 31E Weight 310g

✓

1525 12/18/08

Gizzard Shad

Live Sample	Prepared Sample
RM 68	Sample No. TSS 031884-121808-DK-032
Type: ✓ Predator___ Cat___	Fillet, skin off
Forage ✓	Fillet, skin on, scaled
	Whole 1 fish/sample
2 COMPOSITE No. #2 (032) 5 fish/comp.	
Sample A	Sample A 32 A
Species	Weight 140g
cm Length 26	
g Weight 140	
Abnormalities —	
Sample B	Sample B 32 B
Species	Weight 280g
Length 30	
Weight 280	
Abnormalities —	
Sample C	Sample C 32 C
Species	Weight 280g
Length 31	
Weight 280	
Abnormalities —	
Sample D	SampleD 32 D
Species	Weight 345g
Length 32	
Weight 345	
Abnormalities —	
Sample E	Sample E 32 E
Species	Weight 360g
Length 32	
Weight 360	
Abnormalities —	

1430
12/22/08

Live Sample Gizzard Shad	Prepared Sample
RM 68	Sample No: TSS 031884-122208-DFK -033
Type: Predator____ Cat____ Forage____	Fillet, skin off____ Fillet, skin on, scaled____ Whole X
COMPOSITE No. #3 5 fish/comp	1 fish/sample
Sample A Species Length 33 cm Weight 370g g Abnormalities —	Sample A 33A Weight 370g
Sample B Species Length 30 Weight 310g Abnormalities —	Sample B 33B Weight 310g
Sample C Species Length 30 Weight 240 Abnormalities —	Sample C 33C Weight 240g
Sample D Species Length 28 Weight 190 Abnormalities —	SampleD 33D Weight 190g
Sample E Species Length 35 Weight 410 Abnormalities —	Sample E 33E Weight 410 g

1440

12/22/08

Gizzard Shad

Live Sample	**Prepared Sample**
RM 68	**Sample No.** TJSS-031884-122208-DFK-034
Type: **Predator**____ **Cat**____ **Forage**____	**Fillet, skin off**____
	Fillet, skin on, scaled____
	Whole X 1 fish/sample
COMPOSITE No. #4 5 fish/comp.	
Sample A Species cm Length 31 g Weight 240g Abnormalities —	Sample A 34A Weight 240g
Sample B Species Length 30 Weight 180 Abnormalities —	Sample B 34B Weight 180g
Sample C Species Length 31 Weight 390 Abnormalities —	Sample C 34C Weight 390g
Sample D Species Length 29 Weight 180 Abnormalities —	SampleD 34D Weight 180g
Sample E Species Length 35 Weight 470 Abnormalities —	Sample E 34E Weight 470g

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1450 12/22/08

Live Sample	Prepared Sample
Live Sample Gizzard Shad **RM** 68 **Type:** **Predator**____ **Cat** X **Forage**____ **COMPOSITE No.** #5 5 fish/comp	**Sample No.** TSS 031884-122208-DFK -035 **Fillet, skin off**____ **Fillet, skin on, scaled**____ **Whole** X 1 fish/Sample
Sample A Species Length 36 cm Weight 460 g Abnormalities —	Sample A 35 A Weight 460g
Sample B Species Length 37 Weight 510 Abnormalities —	Sample B 35 B Weight 510g
Sample C Species Length 35 Weight 470 Abnormalities —	Sample C 35 C Weight 470g
Sample D Species Length 34 Weight 460 Abnormalities —	SampleD 35 D Weight 460g
Sample E Species Length 42 cm Weight 510 g Abnormalities —	Sample E 35 E Weight 510g

036✓
037✓
038
039
040

1535
~~1335~~ 12/18/08

Live Sample	**Prepared Sample**
RM 75-95 Sanger	**Sample No.** TISS031884-121808-DFK -036
Type: **Predator**___ **Cat** X	**Fillet, skin off** X
Forage___	**Fillet, skin on, scaled**___
	Whole X 1 fish / Sample
1 **COMPOSITE No.** #1 (036) 5 fish / comp.	
Sample A Species Sanger cm Length 34 g Weight 320 Abnormalities —	Sample A 36A Weight 320g
Sample B Species Sanger Length 30 Weight 200 Abnormalities —	Sample B 36B Weight 200g
Sample C Species Sanger Length 27 Weight 150 Abnormalities —	Sample C 36C Weight 150g
Sample D Species Sanger Length 29 Weight 180 Abnormalities —	SampleD 36D Weight 180g
Sample E Species Sanger Length 29 Weight 180 Abnormalities —	Sample E 36E Weight 180g

1541 12/18/08

Live Sample
RM 75-95 Sauger

Type: Predator____ Cat X
Forage____

COMPOSITE No. #2 (037)
5 fish / comp

✓

Sample A
Species Sauger
Length 36 cm
Weight 360 g
Abnormalities —

Sample B
Species Sauger
Length 27
Weight 140
Abnormalities —

Sample C
Species Sauger
Length 26
Weight 140
Abnormalities —

Sample D
Species Sauger
Length 35
Weight 340
Abnormalities —

Sample E
Species Sauger
Length 32
Weight 240
Abnormalities —

Prepared Sample

Sample No. TISS 031884-121808-DFK-037
Fillet, skin off X
Fillet, skin on, scaled ____
Whole 1 fish/sample

Sample A 37A
Weight 360g

Sample B 37B
Weight 140g

Sample C 37C
Weight 140g

SampleD 37D
Weight 340g

Sample E 37E
Weight 240g

Live Sample **RM** 75-95 **Type:** **Predator**____ **Cat** X **Forage**________ **COMPOSITE No.** #3	**Prepared Sample** **Sample No.** TI5503I884-010809-DAK-038 **Fillet, skin off** X **Fillet, skin on, scaled** ________ **Whole** ________
Sample A Species Channel cat Length 45cm Weight 560g Abnormalities —	Sample A 038 A Weight 560g
Sample B Species channelcat Length 42cm Weight 550g Abnormalities —	Sample B 038B Weight 550g incomplete composite sent to lab 1/8/09
Sample C Species Length Weight Abnormalities	Sample C Weight
Sample D Species Length Weight Abnormalities	SampleD Weight
Sample E Species Length Weight Abnormalities	Sample E Weight

APPENDIX I

CORE LOGS

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-03
DATE COMPLETED: December 12, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	ML-SILT, trace sand, very loose, uniform, dark gray/brown		SE-031884-120207-DD-068			
	ML-SILT, trace sand, dark gray/brown	0.42	SE-031884-121307-DD-274			
2						
			SE-031884-121307-DD-275			
4						
	- 1" sand lens at 4.8ft BGS		SE-031884-121307-DD-276		89	
6						
	- 1" sand lens at 6.3ft BGS - 3" sand lens at 6.6ft BGS					
	ML-SILT, fine sand, wood fragments, dark gray/brown	7.00	SE-031884-121307-DD-277			
8						
	ML-SILT, trace sand, dark gray/brown	8.25	SE-031884-121307-DD-278			
	END OF BOREHOLE @ 8.9ft BGS NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
10		10.00				

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS (oval) GRAIN SIZE ANALYSIS (rectangle)

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-04
DATE COMPLETED: December 12, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	ML-SILT, wedge of muck and organic material, grain size coal, slightly firm		SE-031884-120107-DD-067			
	- soft, brown, wet at 0.4ft BGS					
1	- bits of debris and organic matter, slightly firmer, brown at 0.9ft BGS		SE-031884-121207-DD-269			
	- 0.09' slightly sandy lens at 1.6ft BGS					
	- slightly firmer, color changing to lighter gray at 1.8ft BGS					
2						
	- 10" lens of black organic material at 2.6ft BGS					
3			SE-031884-121207-DD-270			
	- slightly firm at 3.4ft BGS					
4	- 0.5' fine silt, clay/silt at 4.0ft BGS				82	
	- clay/silt, slightly firm, gray at 4.5ft BGS					
5			SE-031884-121207-DD-271			
	- very firm, gray, moist at 5.8ft BGS					
6						
	- 0.16' slightly sandy lens at 6.4ft BGS					
	- 0.25 lens of black organic matter at 6.6ft BGS					
7	ML-SILT, mostly firm, light gray	6.83	SE-031884-121207-DD-272			
	OL-ORGANIC SILT, firm, stiff, organic odor	7.25				
8			SE-031884-121207-DD-273			
	END OF BOREHOLE @ 8.2ft BGS					
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ▭

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: COR-04
PROJECT NUMBER: 031884
DATE COMPLETED: December 12, 2007
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
		10.00				
11						
12						
13						
14						
15						
16						
17						
18						
19						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS GRAIN SIZE ANALYSIS

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: COR-05
PROJECT NUMBER: 031884
DATE COMPLETED: February 21, 2008
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	SP-SAND, with coal, brown		SE-031884-120107-DD-065/066 (FD)		100	
	END OF BOREHOLE @ 0.7ft BGS	0.70				
1	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
2						
3						
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS GRAIN SIZE ANALYSIS

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-07
DATE COMPLETED: December 14, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	OL-ORGANIC SILT, soft, wet	0.08				
	ML-SILT, firmer than above, gray		SE-031884-120107-DD-063			
	- bits of organic matter at 0.8ft BGS					
1			SE-031884-121407-DD-282			
	- firmer, bits of coal at 1.3ft BGS				100	
	- firm, gray at 1.7ft BGS					
2	- some clay at 2.1ft BGS					
			SE-031884-121407-DD-283			
3	END OF BOREHOLE @ 3.0ft BGS	3.00				
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ▭

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-08
DATE COMPLETED: December 12, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML-SILT, very loose, watery, dark gray/brown - trace fine sand, trace coal, very loose AT 0.08ft BGS	0.29	SE-031884-120107-DD-061			
1	SM-SILTY SAND, flecks of coal, dark gray/brown - gray with brown streaks at 1.4ft BGS - trace coal, fine sand at 1.9ft BGS - lens of fine granular coal at 2.0ft BGS - trace fine sand, firmer, diesel odor at 2.1ft BGS - coal lens at 2.3ft BGS	2.50	SE-031884-121307-DD-279		100	
	ML-SILT, trace fine sand, firm, stained black, diesel and/or gasoline odor	2.79				
3	SM-SILTY SAND, firm, coal lens	2.83	SE-031884-DD-121307-DD-280			
	ML-SILT, firm, coal lens - firmer, black stain, diesel odor at 3.3ft BGS	3.42				
	SM-SILTY SAND, trace coal, firm, diesel odor	3.50				
	ML-SILT, trace fine sand	3.75				
4	MLS-SANDY SILT, increase in sand content	4.00				
	END OF BOREHOLE @ 4.0ft BGS NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ GRAIN SIZE ANALYSIS ▭

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT

PROJECT NUMBER: 031884

CLIENT: MONSANTO COMPANY

LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-09

DATE COMPLETED: December 14, 2007

DRILLING METHOD: VIBRACORE

FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	- mottling at 0.1ft BGS OL-ORGANIC SILT, loose, brown - small amount of organic matter, firmer silt at 0.2ft BGS - stained black, diesel odor at 0.9ft BGS		SE-031884-120107-DD-059			
1	ML-SILT, with fine sand, trace organic matter	1.00	SE-031884-121507-DD-332		85	
2	- trace clay, dense at 2.0ft BGS - trace sand, some organic matter at 2.3ft BGS		SE-031884-121507-DD-333 (EPA Split)			
3	END OF BOREHOLE @ 2.8ft BGS NOTE: GROUND SURFACE IS TOP OF SEDIMENT	3.30				
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ▭

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-11
DATE COMPLETED: December 14, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	OL-ORGANIC SILT, some wood, muck, loose, light brown, watery, diesel odor	0.25	SE-031884-120107-DD-057			
1	SM-SILTY SAND, fine grained, wood, pieces of glass		SE-031884-121507-DD-331		80	
2	END OF BOREHOLE @ 2.0ft BGS					
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT, DIESEL ODOR WHILE HOMOGENIZING	2.50				
3						
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS GRAIN SIZE ANALYSIS

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: COR-12
PROJECT NUMBER: 031884
DATE COMPLETED: December 15, 2007
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	OL-ORGANIC SILT, brown muck	0.17	SE-031884-120107-DD-056			
	ML-SILT, loose, dark gray/brown		SE-031884-121507-DD-334 (EPA Split)		72	
1	MLS-SANDY SILT, firm, dark gray/brown	1.00				
2	END OF BOREHOLE @ 1.8ft BGS NOTE: GROUND SURFACE IS TOP OF SEDIMENT	2.50				
3						
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS GRAIN SIZE ANALYSIS

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: COR-15
PROJECT NUMBER: 031884
DATE COMPLETED: February 23, 2008
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML-SILT, trace fine sand, trace leaves, very loose, light brown, saturated, sewage/H_2S odor	0.50	SE-031884-120107-DD-053 (MS/MSD)			
	SP-SAND, trace silt, fine grained, leaves and twigs, very loose, light brown, saturated - turns compact at 0.9ft BGS - no more leaves and twigs at 1.1ft BGS END OF BOREHOLE @ 1.6ft BGS NOTE: GROUND SURFACE IS TOP OF SEDIMENT	2.80	SE-031884-022308-DD-406		57	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS (oval) GRAIN SIZE ANALYSIS (box)

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: COR-16 (resampled)
PROJECT NUMBER: 031884
DATE COMPLETED: February 23, 2008
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	ML-SILT, trace sand, some leaves, very loose, medium brown, saturated		SE-031884-120107-DD-052			
	ML-SILT, trace sand, trace clay, compact, medium brown, moist	0.42	SE-031884-022308-DD-407		65	
1						
	SP-SAND, fine grained, with black organic material END OF BOREHOLE @ 1.3ft BGS NOTE: GROUND SURFACE IS TOP OF SEDIMENT	1.25				
2		2.00				
3						
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS (oval) GRAIN SIZE ANALYSIS (box)

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT

HOLE DESIGNATION: COR-19

PROJECT NUMBER: 031884

DATE COMPLETED: December 10, 2007

CLIENT: MONSANTO COMPANY

DRILLING METHOD: VIBRACORE

LOCATION: NITRO, WEST VIRGINIA

FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML-SILT, trace fine sand and clay, dense, brown - woody organic matter at 0.5ft BGS		SE-031884-113007-DD-044 SE-031884-121107-DD-220		100	
	END OF BOREHOLE @ 0.6ft BGS NOTE: GROUND SURFACE IS TOP OF SEDIMENT	0.60				

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS (oval) GRAIN SIZE ANALYSIS (box)

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-20
DATE COMPLETED: December 10, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	OL-ORGANIC SILT, silt with organic matter, loose, dark gray/brown, watery	0.33	SE-031884-113007-DD-042/043 (FD)			
1	ML-SILT, firm, dark gray/brown	1.25	SE-031884-121107-DD-218 (MS/MSD)			
	ML-SILT, with organic matter and pieces of wood, firm, dark gray/brown	1.42			100	
2	OL-ORGANIC SILT, with organic matter, dark gray/brown - trace fine sand at 2.0ft BGS	2.60	SE-031884-121107-DD-219			
3	END OF BOREHOLE @ 2.6ft BGS NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ▭

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: COR-21
PROJECT NUMBER: 031884
DATE COMPLETED: December 10, 2007
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML-SILT, high organic content (mostly leaves), soft, loose, dark brown, watery		SE-031884-113007-DD-041			
1			SE-031884-DD-121007-213/214 (-213 EPA Split)			
	COAL, mixing of some brown silt	1.08				
	ML-SILT, firm, mostly dark gray/brown with dark staining, hydrocarbon odor	1.50				
2	- coal fragment, less black staining at 2.0ft BGS					
	ML-SILT, some coal, some fine sand	2.17				
	- firm silt, flecks of coal at 2.6ft BGS					
3			SE-031884-DD-121007-215		65	
	- segment of coal at 3.4ft BGS - firm silt at 3.4ft BGS					
4	- dense silt at 4.2ft BGS					
5			SE-031884-DD-121007-216			
	- increasing clay content, some coal, dense silt at 5.3ft BGS					
6			SE-031884-DD-121007-217			
	END OF BOREHOLE @ 6.5ft BGS					
7	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ▭

STRATIGRAPHIC LOG (OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-21
DATE COMPLETED: December 10, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
		10.00				
11						
12						
13						
14						
15						
16						
17						
18						
19						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ○ GRAIN SIZE ANALYSIS □

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT

PROJECT NUMBER: 031884

CLIENT: MONSANTO COMPANY

LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-22

DATE COMPLETED: December 10, 2007

DRILLING METHOD: VIBRACORE

FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	OL-ORGANIC SILT, trace fine sand, load of organic matter (wood), loose, dark brown, watery	0.67	SE-031884-113007-DD-040			
1	ML-SILT, trace fine sand, some organic matter (wood), loose, dark brown - 0.5' dark brown at 1.0ft BGS - coal at 1.1ft BGS	1.25	SE-031884-121007-DD-180			
2	ML-SILT, firm, black staining with slight hydrocarbon odor - firm, brown at 1.5ft BGS	2.08			52	
	ML-SILT, brown, with lenses of brown sand and lenses of black stained sand	2.92				
3	ML-SILT, firm, brown - wood, firm, brown at 3.3ft BGS	3.67	SE-031884-121007-DD-181			
4	SM-SILTY SAND, fine, black staining, wood piece at end of corehole END OF BOREHOLE @ 4.1ft BGS NOTE: GROUND SURFACE IS TOP OF SEDIMENT	7.90				
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS GRAIN SIZE ANALYSIS

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: COR-23
PROJECT NUMBER: 031884
DATE COMPLETED: December 8, 2007
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	GM-SILTY GRAVEL, trace fine sand, trace gravel, some coal, leaves, roots, loose, gray	0.33	SE-031884-113007-DD-039			
	CL/ML-SILTY CLAY, with clay, trace fine sand, some fine grained coal					
1			SE-031884-120807-DD-179		77	
	- trace fine sand, some fine grained coal, occasional lenses of fine sand at 1.6ft BGS					
2						
	END OF BOREHOLE @ 2.3ft BGS					
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
3		3.00				
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ○ GRAIN SIZE ANALYSIS □

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG (OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: COR-25
PROJECT NUMBER: 031884
DATE COMPLETED: December 8, 2007
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	REC (%)	'N' VALUE
	MLS-SANDY SILT, organic matter (roots), brown (until 2") - 12" gray at 0.2ft BGS - 0.3' oxidized mottling at 0.4ft BGS		SE-031884-112907-031/032 (FD) SE-031884-120807-DD-178		100	
1	END OF BOREHOLE @ 1.2ft BGS NOTE: GROUND SURFACE IS TOP OF SEDIMENT	1.20				
2						
3						
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS (oval) GRAIN SIZE ANALYSIS (rectangle)

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-28
DATE COMPLETED: December 7, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	ML-SILT, trace fine sand, soft, brown		SE-031884-112907-DD-027			
	- firm, gray with brown mottling at 0.7ft BGS					
1	- gray, metallic, copper odor at 0.9ft BGS - trace fine sand lenses, metallic, copper odor at 1.0ft BGS - trace fine sand, dark gray with oxidized sand lenses, metallic, copper odor at 1.1ft BGS		SE-031884-120807-DD-176 (EPA Split)		87	
2	END OF BOREHOLE @ 2.0ft BGS	2.30				
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
3						
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ▭

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: COR-28A
PROJECT NUMBER: 031884
DATE COMPLETED: December 11, 2008
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: S.G. R.B. A.F. R.K. H.S.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	CL-SANDY CLAY, with silt, brown, wet		SE-031884-121108-SG-020		100	
	END OF BOREHOLE @ 0.5ft BGS	0.50				
1	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
2						
3						
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS GRAIN SIZE ANALYSIS

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-30
DATE COMPLETED: December 7, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	SP-SAND, with silt, trace fine sand, trace clay, leaves and woody debris, H_2S - 5" trace of coal at 0.2ft BGS - color changes from dark gray to rust, same color of bank material at 0.3ft BGS		SE-031884-112907-DD-024			
1			SE-031884-120707-DD-174		86	
2	- 4" rust color is becoming darker at 2.3ft BGS		SE-031884-120707-DD-175			
	END OF BOREHOLE @ 2.5ft BGS					
3	NOTE: GROUND SURFACE IS TOP OF SEDIMENT	2.90				
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ▭

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: COR-32A
PROJECT NUMBER: 031884
DATE COMPLETED: December 11, 2008
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: S.G. R.B. A.F. R.K. H.S.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	SM-SILTY SAND, trace root fibers, brown, wet		SE-031884-121108-SG-021 (EPA Split)		100	
1	SM-SILTY SAND, trace organic shells, gray/dark gray, wet	0.83				
	END OF BOREHOLE @ 1.5ft BGS	1.50				
2	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
3						
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS GRAIN SIZE ANALYSIS

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: COR-32B
PROJECT NUMBER: 031884
DATE COMPLETED: December 11, 2008
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: S.G. R.B. A.F. R.K. H.S.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	REC (%)	'N' VALUE
0	SM-SILTY SAND, trace organics (tree roots/debris), brown, wet					
1			SE-031884-121108-SG-016 (EPA Split)			
3			SE-031884-121108-SG-017 (MS/MSD, EPA Split)			
4.5					87	
5			SE-031884-121108-SG-018 (EPA Split)			
5.8	SM-SILTY SAND, fine grained, trace organics, gray, wet	5.80				
6.7			SE-031884-121108-SG-019 (EPA Split)			
7.8	END OF BOREHOLE @ 7.8ft BGS					
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
9		9.00				

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS (oval) GRAIN SIZE ANALYSIS (box)

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: COR-33
PROJECT NUMBER: 031884
DATE COMPLETED: December 6, 2007
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML-SILT, soft, uniform material, brown		SE-031884-112907-DD-019			
	- trace fine sand, trace fine gravel, gray at 0.2ft BGS					
1	- 1" slight staining, faint diesel odor at 0.9ft BGS		SE-031884-120607-DD-128 (EPA Split)			
	- trace fine sand, fine gravel, firm, gray at 1.2ft BGS				67	
2	END OF BOREHOLE @ 1.8ft BGS					
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
		2.70				
3						
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ▭

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: COR-35
PROJECT NUMBER: 031884
DATE COMPLETED: December 4, 2007
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	MLS-SANDY SILT, fine sand, leaves and twigs throughout, loose, brown		SE-031884-112907-DD-017			
1			SE-031884-120507-DD-086/087 (FD)			
	- 6" trace of fine grained coal, fine sand, brown at 1.6ft BGS					
2	- fine sand, brown, loose, with H_2S odor at 2.1ft BGS				90	
	SM-SILTY SAND, fine grained, brown - more compact at 2.8ft BGS	2.58				
3			SE-031884-120507-DD-088			
	MLS-SANDY SILT, trace leaves, twigs, brown	3.67				
4	SM-SANDY SILT, trace fine sand, with clay, brown	4.00	SE-031884-120507-DD-089			
	END OF BOREHOLE @ 4.5ft BGS					
5	NOTE: GROUND SURFACE IS TOP OF SEDIMENT	5.00				
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ GRAIN SIZE ANALYSIS ☐

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG (OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-36
DATE COMPLETED: December 5, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	SANDY SILT (MLS), very loose, trace fine sand		SE-031884-112907-DD-016			
			SE-031884-120507-DD-123			
	- twigs, increased amount of fine sand at 1.5ft BGS					
2	- increased density at 2.0ft BGS					
	- loose, stained black/dark gray, petroleum odor at 3.0ft BGS		SE-031884-120507-DD-124			
4	- firm, gray, petroleum odor at 4.0ft BGS					
	- black stained, strong petroleum odor at 4.5ft BGS - light brown at 4.7ft BGS					
	- dark gray/black stain, strong odor at 5.0ft BGS - grayish brown at 5.2ft BGS		SE-031884-120507-DD-125		91	
	- dark gray stain, faint odor at 5.7ft BGS - firmer at 5.8ft BGS					
6						
	- stained, dark gray, odor at 6.5ft BGS					
	- slight increase in fine sand, brown at 7.0ft BGS		SE-031884-120507-DD-126			
8						
			SE-031884-120507-DD-127			
	END OF BOREHOLE @ 9.1ft BGS					
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
10		10.00				

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ▭

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-36 (resampled)
DATE COMPLETED: December 10, 2008
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: S.G. R.B. A.F. R.K. H.S.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	ML-SANDY SILT, dark brown, wet					
1			SE-031884-121008-SG-007 (EPA Split)			
2						
3			SE-031884-121008-SG-008/009 (-008 EPA Split) (FD)			
4					100	
5	- shells noted, organic (roots) at 5.0ft BGS		SE-031884-121008-SG-010 (EPA Split)			
6						
7			SE-031884-121008-SG-011 (EPA Split)			
	SM-SILTY SAND, brown/dark brown, wet	7.20				
8	SP-SAND, with silt, trace shells, fine sand, brown, wet	8.20	SE-031884-121008-SG-012 (EPA Split)			
9	END OF BOREHOLE @ 9.2ft BGS	9.20				
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ○ GRAIN SIZE ANALYSIS □

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: COR-36A
PROJECT NUMBER: 031884
DATE COMPLETED: December 10, 2008
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: S.G. R.B. A.F. R.K. H.S.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	CL-SILTY CLAY, trace shells, with sand, brown, wet	0.80	SE-031884-121008-SG-006 (EPA Split)		100	
1	END OF BOREHOLE @ 0.8ft BGS					
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
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4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS GRAIN SIZE ANALYSIS

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-36B
DATE COMPLETED: December 10, 2008
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: S.G. R.B. A.F. R.K. H.S.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	SM-SAND, fine grained, dark brown, wet		SE-031884-121008-SG-013 (EPA Split)		100	
1	END OF BOREHOLE @ 1.2ft BGS	1.20				
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
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6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ▭

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-36C
DATE COMPLETED: December 10, 2008
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: S.G. R.B. A.F. R.K. H.S.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	SM-SILTY SAND, trace gravelly shells, dark brown, wet					
1			SE-031884-121008-SG-014 (EPA Split)			
2					94	
			SE-031884-121008-SG-015 (EPA Split)			
3	END OF BOREHOLE @ 3.3ft BGS	3.50				
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS GRAIN SIZE ANALYSIS

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-38
DATE COMPLETED: December 4, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML-SILT, trace fine sand, organic matter, loose, light brown/gray - 3" very loose with organic matter (leaves) at 0.0ft BGS		SE-031884-112807-DD-012 SE-031884-120407-DD-085 (MS/MSD)		74	
	MLS-SANDY SILT, light brown/gray - sand lenses at 1.6ft BGS END OF BOREHOLE @ 2.0ft BGS NOTE: GROUND SURFACE IS TOP OF SEDIMENT	1.50				
		2.70				

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS GRAIN SIZE ANALYSIS

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG (OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-39
DATE COMPLETED: December 4, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	MLG-GRAVELLY SILT, brown, strong hydrocarbon odor	0.33	SE-031884-112807-DD-011			
	ML-SILT, trace fine sand, strong hydrocarbon odor, dark gray/black, very loose	1.67	SE-031884-120407-DD-083 (EPA Split)			
	SM-SILTY SAND, black, strong hydrocarbon odor	2.17	SE-031884-120407-DD-084		76	
	MLS-SANDY SILT, compact, gray/light gray, strong hydrocarbon odor	3.70				
	END OF BOREHOLE @ 2.8ft BGS					
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS (oval) GRAIN SIZE ANALYSIS (box)

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-40
DATE COMPLETED: December 3, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	REC (%)	'N' VALUE
ML-SILT, trace fine sand, some leaves and twigs, soft, dark olive, slight H_2S on top section		SE-031884-112807-DD-010 SE-031884-120407-DD-79	100	
SM-SILTY SAND, firm, brown to dark olive	1.25			
ML-SILT, trace sand, loose, no plasticity, dark gray	2.58	SE-031884-120407-DD-80		
SM-SILTY SAND, compact, fine grained, brown	3.08			
END OF BOREHOLE @ 3.3ft BGS	3.30			

NOTE: GROUND SURFACE IS TOP OF SEDIMENT

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS GRAIN SIZE ANALYSIS

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-40 (resampled)
DATE COMPLETED: December 9, 2008
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: S.G. R.B. A.F. R.K. H.S.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
0–2	SM-SILTY SAND, loose, dark brown/black, wet	2.00	SE-031884-120908-SG-003 (EPA Split)			
2–5	SM-SILTY SAND, compact, brown ,wet	5.00	SE-031884-120908-SG-004 (EPA Split)		100	
5–5.5	SP-SAND, fine grained, compact, brown, wet	5.50	SE-031884-120908-SG-005 (MS/MSD. EPA Split)			
	END OF BOREHOLE @ 5.5ft BGS					
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ▭

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-41
DATE COMPLETED: December 4, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
	SM-SILTY SAND, loose, grayish brown	0.17	SE-031884-112807-DD-009			
	MLS-SANDY SILT, small oxidized sand lenses, grayish brown	0.75				
1	SM-SILTY SAND, grayish/brown - chunks of wood (4") at 0.75ft BGS	1.58	SE-031884-120407-DD-81			
	ML-SILT, trace fine sand, grayish/brown	1.92			60	
2	SM-SILTY SAND, fine grained, chunk of wood, grayish/brown END OF BOREHOLE @ 2.1ft BGS NOTE: GROUND SURFACE IS TOP OF SEDIMENT	3.50	SE-031884-120407-DD-82			
3						
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ▭

STRATIGRAPHIC LOG (OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: COR-42
PROJECT NUMBER: 031884
DATE COMPLETED: December 3, 2007
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML-SILT, brown		SE-031884-112807-DD-007 (MS/MSD)			
	SM-SILTY SAND, loose, gray	0.33				
1			SE-031884-120307-DD-78		100	
2	- trace sand, some clay, stiffer, gray at 1.9ft BGS					
	END OF BOREHOLE @ 2.4ft BGS	2.40				
3	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ▭

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: COR-42 (resampled)
DATE COMPLETED: December 9, 2008
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: S.G. R.B. A.F. R.K. H.S.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML-SANDY SILT, dark brown, wet		SE-031884-120908-SG-001/002 (-001 EPA Split) (FD)		100	
1	CL-SILTY CLAY, trace sand, brown/gray, wet	0.83				
	END OF BOREHOLE @ 1.5ft BGS	1.50				
2	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
3						
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS GRAIN SIZE ANALYSIS

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: COR-43
PROJECT NUMBER: 031884
DATE COMPLETED: December 3, 2007
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	MLS-SANDY SILT, dark brown, watery		SE-031884-112807-DD-006			
	SM-SILTY SAND, fine sand, fine coal particles, brown, wet, oxidized orange lenses - 0.5" oxidized transition layer at 1.25ft BGS	0.25	SE-031884-120307-DD-077		100	
	ML-SILT, some clay, gray, low moisture	1.25				
	END OF BOREHOLE @ 1.8ft BGS NOTE: GROUND SURFACE IS TOP OF SEDIMENT	1.80				

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS (oval) GRAIN SIZE ANALYSIS (box)

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: NRC-01
DATE COMPLETED: December 13, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	OL-ORGANIC MATERIAL (twigs, leaves, bark)	0.13				
	SP-SAND, with coal, brown, wet	0.25				
	END OF BOREHOLE @ 0.3ft BGS					
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					

1
2
3
4
5
6
7
8
9

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: NRC-02
DATE COMPLETED: December 12, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE
3	- 10" layer of wood at 3.1ft BGS		SE-031884-121207-DD-222 to 268		96	
	- 6" staining and slight diesel odor at 3.4ft BGS					
8	END OF BOREHOLE @ 7.7ft BGS	8.00				
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS GRAIN SIZE ANALYSIS

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT

PROJECT NUMBER: 031884

CLIENT: MONSANTO COMPANY

LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: NRC-03

DATE COMPLETED: December 14, 2007

DRILLING METHOD: VIBRACORE

FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML-SILT, trace find sand, wood pieces, uniform					
2	- black staining, no odor at 2.0ft BGS					
3	- large chunks of wood at 3.1ft BGS		SE-031884-121407-DD-284 to 330		82	
	MLS-SANDY SILT, chunks of wood, some black staining, slight diesel odor	3.50				
	END OF BOREHOLE @ 8.2ft BGS					
	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ▭

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG (OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: NRC-03
DATE COMPLETED: December 14, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
		10.00				
11						
12						
13						
14						
15						
16						
17						
18						
19						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ▭

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: NRC-04 (resampled)
DATE COMPLETED: February 19, 2008
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML-SILT, trace sand, trace coal, very loose, brown, saturated					
1	- dark gray, occasional 0.02" sand lenses, strong diesel odor at 0.8ft BGS					
2			SE-031884-022008-DD-375 to 405		100	
3	- compact, brown, no odor at 2.5ft BGS - 3" twig at 2.7ft BGS	3.50				
	END OF BOREHOLE @ 3.5ft BGS					
4						
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS GRAIN SIZE ANALYSIS

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: NRC-05
PROJECT NUMBER: 031884
DATE COMPLETED: December 10, 2007
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
			SE-031884-121007-DD-182 to 212			
1	- 2" woody chunks present in sections 42.5 to 47.5 at 1.3ft BGS					
	- 16" black staining and hydrocarbon odor at 1.8ft BGS					
2					58	
3						
	END OF BOREHOLE @ 3.5ft BGS					
4	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
5						
6		6.00				
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ☐

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
HOLE DESIGNATION: NRC-05 (resampled)
PROJECT NUMBER: 031884
DATE COMPLETED: February 19, 2008
CLIENT: MONSANTO COMPANY
DRILLING METHOD: VIBRACORE
LOCATION: NITRO, WEST VIRGINIA
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML-SILT, trace sand, leaves and twigs, very loose, brown, saturated					
1	- 5"x1.5" piece of coal, loose, dark gray, decreased moisture at 1.2ft BGS					
	- 0.84' subtle hydrocarbon odor at 1.6ft BGS					
2	- 0.08' piece of coal at 2.3ft BGS					
	- 2" lens of firm sand and coal at 2.6ft BGS		SE-031884-022008-DD-335 to 374			
3	ML-SILT, trace clay, trace sand, compact, brown	2.83				
	SM-SILT, with sand, firm, gray	3.33				
4	ML-SILT, trace clay, brown and gray	3.58			56	
5	END OF BOREHOLE @ 5.0ft BGS					
6						
7						
8						
9		9.00				

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ GRAIN SIZE ANALYSIS ☐

OVERBURDEN LOG 31884-1-REV 072409.GPJ CRA_CORP.GDT 8/5/09

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: NRC-07
DATE COMPLETED: December 5, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
0–3	ML-SILT, with fine sand, gray - 1" leaves, H_2S odor at 0.1ft BGS - 0.5" clay lens at 1.1ft BGS	3.00	SE-031884-120607-DD-129 TO 173		98	
3–6	ML-SILT, with fine sand, gray, diesel odor - chunk of wood at 3.3ft BGS - 1.5" stained black, diesel odor at 4.1ft BGS - 1" stained black, diesel odor at 4.4ft BGS - 0.5" stained black, diesel odor at 4.6ft BGS - 0.5" stained black, diesel odor at 5.1ft BGS - barely decomposed leaves at 5.9ft BGS	6.00				

END OF BOREHOLE @ 5.9ft BGS

NOTE: GROUND SURFACE IS TOP OF SEDIMENT

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS (oval) GRAIN SIZE ANALYSIS (rectangle)

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: NRC-08
DATE COMPLETED: December 4, 2007
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML-SILT, trace fine sand, loose, fine grained specks of coal, brown/gray	0.25				
	ML-SILT, with fine sand, fine grained coal, brown/gray	0.75				
1	ML-SANDY SILT, very fine grained coal	1.16				
2	ML-SILT, trace clay, trace fine sand, visible coal - 3" strip of plastic at 2.6ft BGS - rootlets at 2.9ft BGS	3.20	SE-031884-120507-DD-090 to 122		87	
3	ML-SANDY SILT	3.30				
4	ML-SILT, with clay, trace fine sand END OF BOREHOLE @ 3.9ft BGS NOTE: GROUND SURFACE IS TOP OF SEDIMENT	4.50				
5						
6						
7						
8						
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS GRAIN SIZE ANALYSIS

STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: KANAWHA RIVER PROJECT
PROJECT NUMBER: 031884
CLIENT: MONSANTO COMPANY
LOCATION: NITRO, WEST VIRGINIA

HOLE DESIGNATION: NRC-08 (resampled)
DATE COMPLETED: February 23, 2008
DRILLING METHOD: VIBRACORE
FIELD PERSONNEL: M.M. D.D. K.C. D.G.

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	ML-SILT, trace fine sand, very loose, light brown, saturated, organic odor					
1	SP-SAND, with silt, compact, fine grained, light brown/gray, moist	0.92				
	MLS-SANDY SILT, compact, light brown-gray, moist	1.33				
2	ML-SILT, trace fine sand, compact, light brown-gray, moist, few twigs	1.75				
	- fine sandy silt, brown-gray at 2.7ft BGS					
3	- 1" sand lens, leaves, dark gray, moist at 3.2ft BGS		SE-031884-022408-DD-408 to 454			
	- gray-brown at 3.3ft BGS					
	- few twigs, 0.5" sand lens with leaves at 3.7ft BGS				100	
4	- no organic material at 4.1ft BGS					
5						
	- fine silty sand, color changing to light brown at 5.5ft BGS					
6						
	- 2" lens fine sand at 6.4ft BGS					
	- trace sand, light brown, highly oxidized lens at 6.7ft BGS					
7	ML-SILT, trace clay, trace sand, compact, light brown, moist	6.75				
	END OF BOREHOLE @ 7.4ft BGS	7.40				
8	NOTE: GROUND SURFACE IS TOP OF SEDIMENT					
9						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS

APPENDIX J

BLACK CARBON SAMPLES STATISTICAL ANALYSIS DATA

TABLE J.1

SUMMARY OF SURFACE SEDIMENT COAL SET ANALYSIS
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

Location ID *Units*	Sample ID	*Fraction* *(um)*	*TOC by LK* [1] *(mg/kg)*	*Black Carbon by LK* [1] *(mg/kg)*	*2,3,7,8-TCDD* *(pg/g)*	*Solids* *%*	*TOC by 9060* [2] *(mg/kg)*
BC-COR-10A	S-031884-022408-DD-455 (A) [3]	>300	--	--	42	--	--
BC-COR-10A	S-031884-022408-DD-455 (B)	75-300	831	648	3.2	100	1,300
BC-COR-10A	S-031884-022408-DD-455 (C)	<75	3,000	500 U	3.6	100	1,200
BC-COR-10B	S-031884-022408-DD-456 (A) [3]	>300	--	--	49	--	--
BC-COR-10B	S-031884-022408-DD-456 (B)	75-300	874	500 U	1.4	100	1,000
BC-COR-10B	S-031884-022408-DD-456 (C)	<75	502	500 U	7.8	100	600 B
BC-COR-13A	S-031884-022408-DD-457 (A) [3]	>300	--	--	130	--	--
BC-COR-13A	S-031884-022408-DD-457 (B)	75-300	4,070	500 U	4.6	100	4,900
BC-COR-13A	S-031884-022408-DD-457 (C)	<75	1,150	1,440	13	100	2,700
BC-COR-13B	S-031884-022408-DD-458 (A) [3]	>300	--	--	74	--	--
BC-COR-13B	S-031884-022408-DD-458 (B)	75-300	1,400	1,080	7.9	100	700 B
BC-COR-13B	S-031884-022408-DD-458 (C)	<75	620	500 U	ND	100	900 B
BC-COR-37A	S-031884-022408-DD-459 (A) [3]	>300	--	--	ND	--	--
BC-COR-37A	S-031884-022408-DD-459 (B)	75-300	7,470	500 U	ND	100	5,100
BC-COR-37A	S-031884-022408-DD-459 (C)	<75	2,390	500 U	ND	100	3,000
BC-COR-37B	S-031884-022408-DD-460 (A)	>300	8,870	1,130	4.4	100	9,920
BC-COR-37B	S-031884-022408-DD-460 (B)	75-300	2,080	500 U	1.1	100	2,000
BC-COR-37B	S-031884-022408-DD-460 (C)	<75	1,410	500 U	ND	100	1,000
BC-COR-26A	S-031884-022408-DD-461 (A) [3]	>300	--	--	ND	--	--
BC-COR-26A	S-031884-022408-DD-461 (B)	75-300	2,780	500 U	ND	100	2,200
BC-COR-26A	S-031884-022408-DD-461 (C)	<75	1,030	500 U	ND	100	1,000
BC-COR-26B	S-031884-022408-DD-462 (A)	>300	66,300	87,200	ND	100	49,000
BC-COR-26B	S-031884-022408-DD-462 (B)	75-300	61,000	73,300	ND	100	39,300
BC-COR-26B	S-031884-022408-DD-462 (C)	<75	47,600	72,300	ND	100	22,000
COR-15	S-031884-022408-DD-406 (A)	>300	33,300	1,640	13	99	33,600
COR-15	S-031884-022408-DD-406 (B)	75-300	10,900	500 U	4.2	100	10,600
COR-15	S-031884-022408-DD-406 (C)	<75	37,600	533	4.9	100	14,600
COR-16	S-031884-022408-DD-407 (A)	>300	23,200	1,730	0.76 J	100	20,800
COR-16	S-031884-022408-DD-407 (B)	75-300	27,300	2,390	0.76 J	100	23,100
COR-16	S-031884-022408-DD-407 (C)	<75	43,100	2,270	0.77 J	100	49,500

Notes:
[1] Lloyd Kahn Methods
[2] Method 9060 (modified)
[3] Insufficient volume to perform TOC and black carbon analyses on samples
[4] Samples for COR-15 and COR-16 were not indentified on the COC for black carbon analysis but lab performed analysis
um - micrometers
mg/kg - milligrams per kilogram
pg/g - picograms per gram
J - Estimated concentration
JA - The analyte was positively identified but the quantitation is an estimate
U - Not present at or above the associated value
Q - Elevated reporting limit. The reporting limit is elevated due to high analyte levels.
B - Estimated result. Result is less than Reporting Limit

APPENDIX K

SEDFLUME ANALYSIS REPORT – SEA ENGINEERING, INC.

Sedflume Analysis
Kanawha River, West Virginia, USA

Prepared for:

Conestoga-Rovers & Associates

Prepared by:
Sea Engineering, Inc.
200 Washington Street, Suite 210
Santa Cruz, CA 95060
Tel: (831) 421-0871
Fax: (831) 421-0875

Summary

Sea Engineering, Inc. (SEI) conducted a Sedflume analysis on eighteen cores obtained from the Kanawha River, West Virginia. These cores were collected offshore in areas from 0.6 to 6.7 m of water depth. The primary goal of this work was to characterize the stability of the sediments within Kanawha River. The Sedflume analysis determines sediment erosion rates, critical shear stress, particle size and wet bulk density at depth intervals down the length of each core. The following is a brief physical description of the eighteen cores. The report contains details of the full Sedflume analysis

- Core COR07 was collected in 6.1 m water depth. The core consisted of a 1 mm light grey oxic layer overlying light grey silt with pockets of black material down core. Shell fragments and detritus were present throughout the core. The mean grain size of the core was 31.17 µm (silt).

- Core COR20 was collected in 6.1 m water depth. The core consisted of a 5 mm olive oxic layer overlying a 1 cm thick light grey layer. Below 1.5 cm, olive grey sediment persisted down core with pockets of light and dark grey sediment. Plant material was observed at the surface and present down core to the deepest depth interval. Gas bubbles were also observed down core. The mean grain size of the core was 23.70 µm (silt).

- Core COR30 was collected in 1.8 m of water depth. The core consisted of an approximate 2 mm olive grey oxic layer of 8 to 10 cm of olive grey sediment. Below 10 cm, yellowish orange sediment persisted to the end of the core. Plant material was observed from 8 cm to the deepest depth interval. Additionally, three large boulders (Wentworth Classification) were removed at 9.7 cm. The mean grain size of the core was 201.99 µm (sand).

- Core COR35 was collected in 1.5 m of water depth. The core consisted of a 2-3 mm oxic layer, overlying olive grey sediment with pockets of finer and coarser grained sediments. Three small sticks were present at surface. At 23 through 30 cm of core depth a distinctly coarser grained sediment layer was observed. Plant material was visible from 22 cm to the deepest depth interval. Gas bubbles were observed intermittently down core. The mean grain size of the core was 69.95 µm (sand).

- Core COR36 was collected in 0.9 m of water depth. The core consisted of a 2 mm oxic layer, overlying olive grey sediment with pockets of coarser and finer sediment. Pockets of dark grey sediment were present from 2 to 10 cm. Plant material was observed from 2 to 8 cm and 21 to 27 cm. Gas bubbles were observed intermittently down core. The mean grain size of the core was 51.62 µm (silt).

- Core COR39 was collected in 1.5 m of water depth. The core consisted of an approximate 14 cm light brown surface layer, overlying a 2 cm dark grey layer. Below the dark grey layer, olive grey silt persisted to the end of the core. Plant material was observed at the surface and continued down core to approximately 31 cm. Gas bubbles were present intermittently down core. The mean grain size of the core was 64.49 µm (sand).

- Core COR40 was collected in 0.6 m of water depth. The core consisted of an approximate 2 mm light brown oxic layer, overlying a yellowish orange sediment layer to a depth of 3 cm. At 3 cm to the end of the core olive grey sediment was observed. Pockets of dark grey sediment were observed from 3 to 14 cm. At 25 cm to the end of the core, the sediment got notably coarser. Plant material was observed from 5 cm to 15 cm. The mean grain size of the core was 110.22 µm (sand).

- Core COR42 was collected in 0.9 m of water depth. The core consisted of an approximate 2 mm dark grey oxic layer, overlying olive grey sediment with pockets of light and dark grey sediment. At 34 cm a rose colored sediment layer was present. Plant material (roots, leaves, and small sticks) and gas bubbles were present at the surface and throughout the core to the deepest depth interval. The mean grain size of the core was 55.55 µm (silt).

- Core KRSD01 was collected in 2.4 m of water depth. The core consisted of an approximate 2 mm dark grey oxic layer, overlying olive grey sediment with pockets of light and dark sediment. Gas bubbles and plant material were present down core. The mean grain size of the core was 51.05 µm (silt).

- Core KRSD04 was collected in 1.8 m of water depth. The core consisted of an approximate 2 mm light grey oxic layer overlying light grey sediment down core. Dark grey pockets of material were present from 0 to 6 cm. Gas bubbles are present intermittently down core. The mean grain size of the core was 35.83 µm (silt).

- Core KRSD05 was collected in 3.0 m of water depth. The core consisted of 2-3 mm light grey oxic layer, overlying light grey sediment with pockets of notably coarser grained material down core. At 37 cm a dark grey layer of material was observed. Plant material (roots, leaves, and small sticks) were present from 3 mm below surface to the deepest depth interval. Gas bubbles were observed intermittently from the surface to the end of the core. The mean grain size of the core was 41.96 µm (silt).

- Core KRSD10 was collected in 1.5 m of water depth. The core consisted of an approximate 1 mm thick yellowish orange oxic layer, overlying a 1 cm layer of light grey sediment. Below the light grey sediment, olive grey sediment with pockets of light and dark grey sediment persisted to the end of the core. Plant material (roots, leaves and small sticks) was present at the surface throughout the core to the deepest depth interval. At 6 to 9 cm large sticks, approximately 1 cm diameter, were removed from core. The mean grain size of the core was 85.07 µm (sand).

- Core KRSD14 was collected in 1.8 m of water depth. The core consisted of a 2 mm light brown oxic layer, overlying a light brown coarser grained layer to 3 cm. At 3 cm a layer of coarser grained, olive grey sand persisted to approximately 14 cm where a 1 cm thick dark grey layer was observed. Below the dark grey layer to the end of the core, light grey silt was present. Plant was observed material from the surface to the deepest depth interval. Gas bubbles were present intermittently from the surface to 14 cm. The mean grain size of the core was 47.93 µm (silt).

- Core KRSD20 was collected in 4.6 m of water depth. The core consisted of 0 to approximately 3 cm light brown surface layer overlying a layer of dark grey material from a depth of 3 to 8 cm. An olive grey layer was present from 8 cm to approximately 21 cm, where a visibly coarser grained olive grey layer persisted to the end of the core. Plant material (root, leaf, and small sticks) was observed at the surface and persisted to the deepest depth interval. The mean grain size of the core was 69.13 µm (sand).

- Core KRSD24 was collected in 0.6 m of water depth. The core consisted of a 2-3 mm olive grey oxic layer, overlying olive grey silt with pockets of light and dark grey silt down core. Plant material (leaves, roots, and small sticks) was observed at the surface and persisted down core. Gas bubbles were present intermittently to the deepest depth interval. The mean grain size of the core was 69.73 µm (sand).

- Core KRSD25was collected in 2.7 m of water depth. The core consisted of a 2 mm olive grey oxic layer over 16 cm of olive grey coarse grained sediment. Olive grey sediment was present from 16 cm to the end of the core. Plant material was found at the surface and persisted to the deepest depth interval. Gas bubbles were also observed intermittently down core. The mean grain size of the core was 62.57 µm (sand).

- Core KRSD28 was collected in 1.5 m of water depth. The core consisted of multiple sediment layers. At the surface a 2 mm thick olive grey oxic layer was overlying a 1 cm olive grey sediment layer. Below the olive grey sediment layer, from a core depth of 1 cm to 3-6 cm, a dark grey layer was present. From 3-6 cm to 33 cm a layer of yellowish orange fine to medium sand was observed. The final layer, from 33 cm to the end of the core, was a greenish grey silt/clay layer. Detritus was observed at the surface and at a core depth of 20 cm. The mean grain size of the core was 288.29 µm (sand).

- Core KRSD48 was collected in 0.9 m of water depth. The core consisted of approximately 1 mm light orange oxic layer over an approximate 1 cm thick dark grey layer. Olive grey sediment persisted down core from 1 cm to the end of the core with visible pockets of dark grey sediment and gas bubbles. Detritus (root and leaf material) were also observed at the surface and throughout the core. The mean grain size of the core was 33.13 µm (silt).

CONTENTS

Introduction

Sea Engineering, Inc. (SEI) conducted a Sedflume analysis on seven cores obtained at Kanawha River, West Virginia. These cores were collected offshore in areas from 0.6 to 6.7 m of water depth MLLW. The primary goal of this work was to characterize the stability of the sediments within the Kanawha River. The cores were eroded using Sedflume to determine erosion rates as a function of shear stress and depth. In addition, each core was sub-sampled at vertical intervals to determine sediment bulk density and particle size distribution. Critical shear stresses were determined through two interpolation techniques for each vertical interval sampled. The following report outlines the procedures used in the Sedflume analysis, presents the Sedflume data, and provides a summary of the results.

Experimental Procedures

A detailed description of Sedflume and its application are given in McNeil et al (1996) and Roberts et al (1998). The following section provides a general description of the Sedflume analysis conducted for this study.

Description of Sedflume

Sedflume is shown in Figure 1 and is essentially a straight flume that has a test section with an open bottom through which a rectangular cross-section core containing sediment can be inserted. The main components of the flume are the core; the test section; an inlet section for uniform, fully-developed, turbulent flow; a flow exit section; a water storage tank; and a pump to force water through the system. The coring tube, test section, inlet section, and exit section are made of clear acrylic so that the sediment-water interactions can be observed. The coring barrel has a rectangular cross-section, 10 cm by 15 cm, and can be up to 1 m in length.

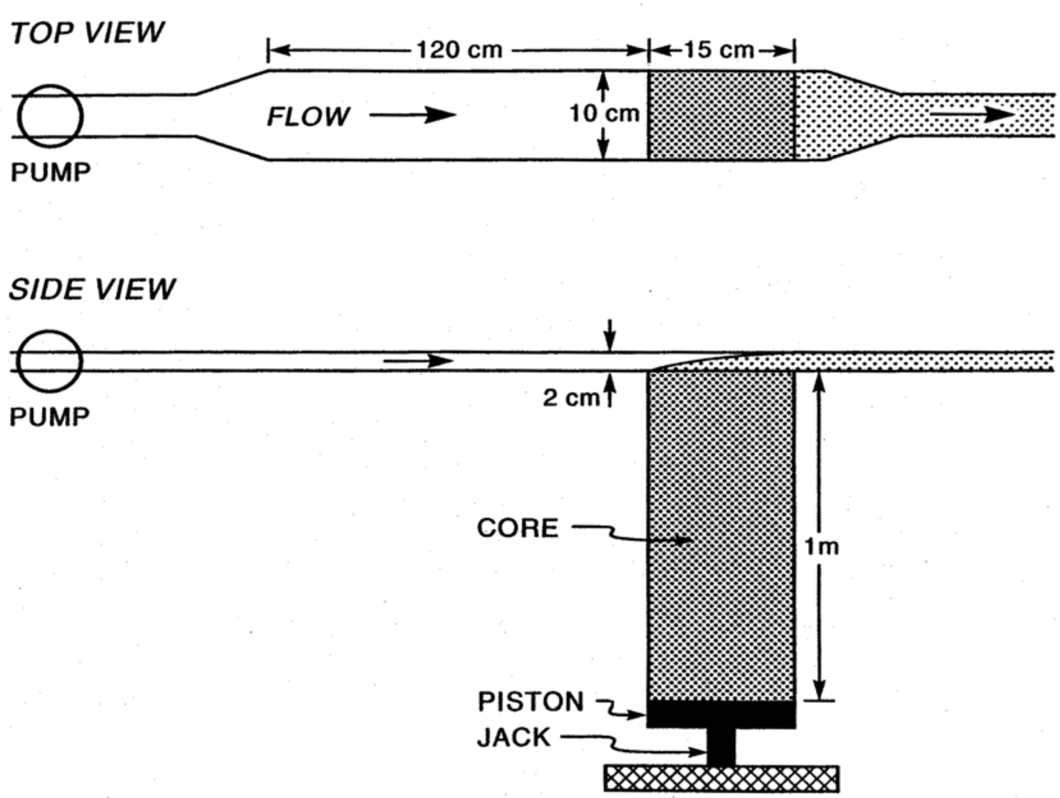


Figure 1. Sedflume Diagram

Water is pumped through the system from a 500 gallon storage tank, through a 5 cm diameter pipe, and then through a flow converter into the rectangular duct shown. This duct is 2 cm in height, 10 cm in width, and 120 cm in length; it connects to the test section, which has the same cross-sectional area and is 15 cm long. The flow converter changes the shape of the cross-section from circular to the rectangular duct shape while maintaining a constant cross-sectional area. A ball valve regulates the flow so that the flow into the duct can be carefully controlled. Also, there is a small valve in the duct immediately downstream from the test section that is opened at higher flow rates to keep the pressure in the duct and over the test section at atmospheric conditions.

At the start of each test, a core containing sediments collected from the site is prepared. The core and the sediment it contains are then inserted into the bottom of the test section. An operator moves the sediment upward using a piston that is inside the core and is connected to a hydraulic jack with a 1 m drive stroke. The jack is driven by the release of pressure that is regulated with a switch and valve system. By this means, the sediments can be raised and made level with the bottom of the test section. The speed of the hydraulic jack movement can be controlled at a variable rate in measurable increments as small as 0.5 mm.

Water is forced through the duct and the test section over the surface of the sediments. The shear produced by this flow causes the sediments to erode. As the sediments in the core erode, they are continually moved upward by the operator so that the sediment-water interface remains level with the bottom of the test and inlet sections. The erosion rate is recorded as the upward movement of the sediments in the coring tube over time.

Sedflume Core Collection

The sediment cores were collected from Kanawha River, WV by SEI personnel. At each coring location, a GPS system was used to position the vessel at a fixed sampling station. A pole was attached with clamps to the 10 cm by 15 cm rectangular core. A valve was temporarily affixed to the top of the core tube to provide suction when the core was pulled out of the sediment bed. The core was then lowered into the water and positioned perpendicular to the sediment bed. Pressure was applied by hand until at least 30 cm and no more than 60 cm of the core penetrated into the sediment bed.

Upon penetration of the core barrel into the sediment bed, the valve opens upward and allows the sediment to enter the core tube and water to exit without disturbing the sediment surface or deeper strata. When the barrel is lifted from the sediment bed, the valve closes and retains the sediment inside the core tube. During this sampling effort, the core was immediately inspected visually for length and quality. Undisturbed surface sediments were present in the core. The cores were capped and immediately shipped upright at ambient temperature to the SEI Sedflume Laboratory in Santa Cruz, CA. All cores arrived intact with sediment structure and surface preserved.

Measurements of Sediment Erosion Rates

The procedure for measuring the erosion rates of the sediments as a function of shear stress and depth were as follows. The sediment core was inserted into the Sedflume test section using the hydraulic jack until the sediment surface was even with the bottom of the Sedflume channel. A measurement was made of the core length. The flume was then run at a specific flow rate corresponding to a particular shear stress (McNeil et al., 1996). Erosion rates are obtained by measuring the core length at different time intervals, taking the difference between each successive measurement, and dividing by the time interval as shown in Equation 1:

$$E = \frac{\Delta z}{T} \tag{1}$$

E = Erosion rate
Δz = Amount of sediment eroded
T = Time

In order to measure erosion rates at several different shear stresses using only one core, the following procedure was used. Starting at a low shear stress, the flume was run sequentially at higher shear stresses with each succeeding shear stress being twice the previous one. Generally about four shear stresses are run sequentially. Each shear stress was run until at least 1 to 2 mm but no more than 2 cm were eroded for that shear stress.

The time interval was recorded for each run with a stopwatch. The flow was then increased to the next shear stress, and so on until the highest shear stress was run. This cycle was repeated until all of the sediment had eroded from the core. If after three cycles a particular shear stress showed a rate of erosion less than 10^{-4} cm/s, it was dropped from the cycle; if after many cycles the erosion rates decreased significantly, a higher shear stress was included in the cycle.

Determination of Critical Shear Stress

The critical shear stress of a sediment bed, τ_{cr}, is defined quantitatively as the shear stress at which a very small, but accurately measurable, rate of erosion occurs. For Sedflume studies, this rate of erosion has been practically defined as 10^{-4} cm/s. This represents 1 mm of erosion in approximately 15 minutes. Since it is difficult to measure τ_{cr} exactly at 10^{-4} cm/s, erosion rates were determined above and below 10^{-4} cm/s. The τ_{cr} was then determined by two interpolation techniques, linear and power law regression (McNeil et al. 1996; Roberts et al., 1998).

Measurement of Sediment Bulk Properties

In addition to erosion rate measurements, samples were collected to determine the water content, bulk density, and particle size of the sediments. Sub-samples were collected from the surface of the Sedflume cores at the end of each erosion cycle. This allowed 5 samples to be collected approximately every 5 cm for analysis.

Bulk density was determined in the SEI Sedflume laboratory by water content analysis using methods outlined in Hakanson and Jansson (2002). This consisted of determining the wet and dry weight of the collected sample to determine the water content, W, from Equation 2.

$$W = \frac{M_w - M_d}{M_w} \tag{2}$$

W = water content
M_w = wet weight of sample
M_d = dry weight of sample

Once the water content was calculated, the bulk density, ρ_b, was determined from Equation 3.

$$\rho_b = \frac{\rho_w \rho_s}{\rho_w + (\rho_s - \rho_w)W} \tag{3}$$

ρ_w = density of water (1 g/cm^3)
ρ_s = density of sediment particle (2.65 g/cm^3)

Particle size distributions were determined using laser diffraction analysis. Samples collected from the Sedflume core were prepared and inserted into a laser diffraction particle sizer (Beckman Coulter LS 13 320). Each sample was analyzed in three 1-

minute intervals and the results of the four analyses were averaged. This method is valid for particle sizes between 0.04 and 2000 μm. Any fraction over 2000 μm was weighed and compared to total sample weight to determine the weight percentage greater than 2000 μm.

Table 1 summarizes all measurements conducted during the Sedflume analysis.

Table 1. Parameters measured and computed for the Site.

Measurement	Definition	Units	Detection Limit
Bulk Density, ρ_b (wet/dry weight)	$\rho_b = \dfrac{\rho_w \rho_s}{\rho_w + (\rho_s - \rho_w)W}$	g/cm^3	Same as water content
Water Content	$W = \dfrac{M_w - M_d}{M_w}$	unit less	0.1g in sample weight ranging from 10 to 50 g
Particle Size Distribution	Distribution of particle sizes by volume percentage using laser diffraction	μm	0.04 μm – 2000 μm
Erosion Rate	$E = \Delta z/T$	cm/s	$\Delta z > 0.5$mm $T > 15$s
Critical Shear Stress τ_{cr}	Shear stress when erosion rate equals 10^{-4} cm/s	N/m^2	0 to 10.0 N/m^2 This value is interpolated as described in the text.

W = water content
M_w = wet weight of sample (g)
M_d = dry weight of sample (g)
Δz = amount of sediment eroded (cm)
T = time (s)
ρ_w = density of water (1 g/cm^3)
ρ_s = density of sediment (2.65 g/cm^3)

Erosion Rate Comparisons

A useful method of analyzing sediment characteristics at a specific site is to compare the inter-core and intra-core Sedflume erosion rates. This method provides a means to quantify the erosion susceptibility within each core as well as the general erosion susceptibility of the coring site. In this analysis, each core has been sub-sampled into separate depth intervals. Following the methods of Roberts et al (1998), the erosion rate for each interval can be approximated by

$$E = A\tau^n\rho^m \tag{4}$$

where E is the erosion rate (cm/s), τ is the shear stress (N/m^2) and ρ is the sediment bulk density (g/cm^3). A, n and m are constants that depend on the sediment characteristics. The equation used in this analysis is an abbreviated variation of Equation 4:

$$E = A\tau^n \tag{5}$$

where the sediment bulk density parameter is a function of the constant A. The variation of erosion rate with density cannot be typically determined in the field due to natural variation in other sediment properties (e.g. mineralogy and particle size). Therefore, the density term for a particular interval of approximately constant density is lumped into the constant A. For each depth interval, the measured Sedflume erosion rates (E) and applied shear stresses (τ) were used to determine the A and n constants that provide a best fit power law curve to the data for that interval. With good fits (i.e. $r^2 > 0.9$), these parameters can be used to predict erosion rates for the core interval of interest.

From this process an average erosion rate for a core can also be determined, and the erosion rate at each depth interval can then be directly compared to this average. The result is an erosion rate ratio which provides an estimation of the erosion susceptibility of each depth interval relative to the core average. This procedure highlights the depths of the core that will erode more rapidly and those that will tend to resist erosion, relative to the other intervals in the core. Intervals for which the r^2 is less than 0.8 or the interval has less than three data points are omitted from this comparison and will show up as blank intervals in the following plots.

In addition, a site-wide erosion rate average can be estimated that incorporates the data from all sampled cores. The erosion rate for each depth interval within a core is compared to the site-wide average and a graph of the erosion rate ratios for all of the cores is created. Again, the procedure highlights the cores and depth intervals at which the most rapid erosion would be expected (relative to the other core locations), and a spatial assessment of erosion probability can be generated.

In this analysis, two interpolation techniques were used to determine values of critical shear stress: a power law interpolation and a linear interpolation. For the former, a power law curve was created (in the form of Equation 5) by solving for the variables A and n by maximizing the correlation (r^2) to the measured data points. A solution for the critical shear stress can then be computed from Equation 5 by inserting an erosion rate of 10^{-4} cm/s. For the latter, a simple linear interpolation solves for the critical shear stress at an erosion rate of 10^{-4} cm/s based on the measured Sedflume data.

Results and Discussion

Table 2 provides the core location, coordinates, coring date and the depth of water for the eighteen cores collected in Kanawha River, WV. Figure 2 shows a map of the coring site with the coring locations.

Table 2. Core collection information.

Station ID	Water Depth* (m)	Collection Date	Collection Time (LST)	Latitude (DD MM SS N)	Longitude (DD MM SS W)
COR07	6.1	7/30/2009	09:50	38 32 39.5	81 53 01.5
COR20	6.1	7/29/2009	12:10	38 29 15.7	81 49 53.6
COR30	1.8	7/28/2009	15:06	38 27 04.4	81 49 39.3
COR35	1.5	7/28/2009	12:55	38 26 31.0	81 50 41.4
COR36	0.9	7/28/2009	13:20	38 26 32.2	81 50 52.2
COR39	1.5	7/28/2009	11:55	38 26 12.4	81 50 54.7
COR40	0.6	7/28/2009	10:20	38 26 06.2	81 50 57.5
COR42	0.9	7/28/2009	09:45	38 26 00.5	81 51 10.2
KRSD01	2.4	7/30/2009	08:50	38 31 40.6	81 54 24.7
KRSD04	1.8	7/30/2009	10:30	38 31 37.4	81 51 43.2
KRSD05	3.0	7/30/2009	11:15	38 30 53.1	81 50 45.5
KRSD10	1.5	7/29/2009	11:10	38 28 43.2	81 49 21.9
KRSD14	1.8	7/28/2009	16:00	38 27 14.8	81 49 40.8
KRSD20	4.6	7/28/2009	11:00	38 26 22.5	81 50 49.2
KRSD24	0.6	7/27/2009	15:46	38 25 14.1	81 51 06.1
KRSD25	2.7	7/27/2009	14:48	38 24 43.2	81 50 52.4
KRSD28	1.5	7/27/2009	14:16	38 23 45.3	81 50 31.0
KRSD48	0.9	7/29/2009	10:30	38 28 35.4	81 49 00.9

* Depths are measured from the water surface and are not corrected to any vertical datum.

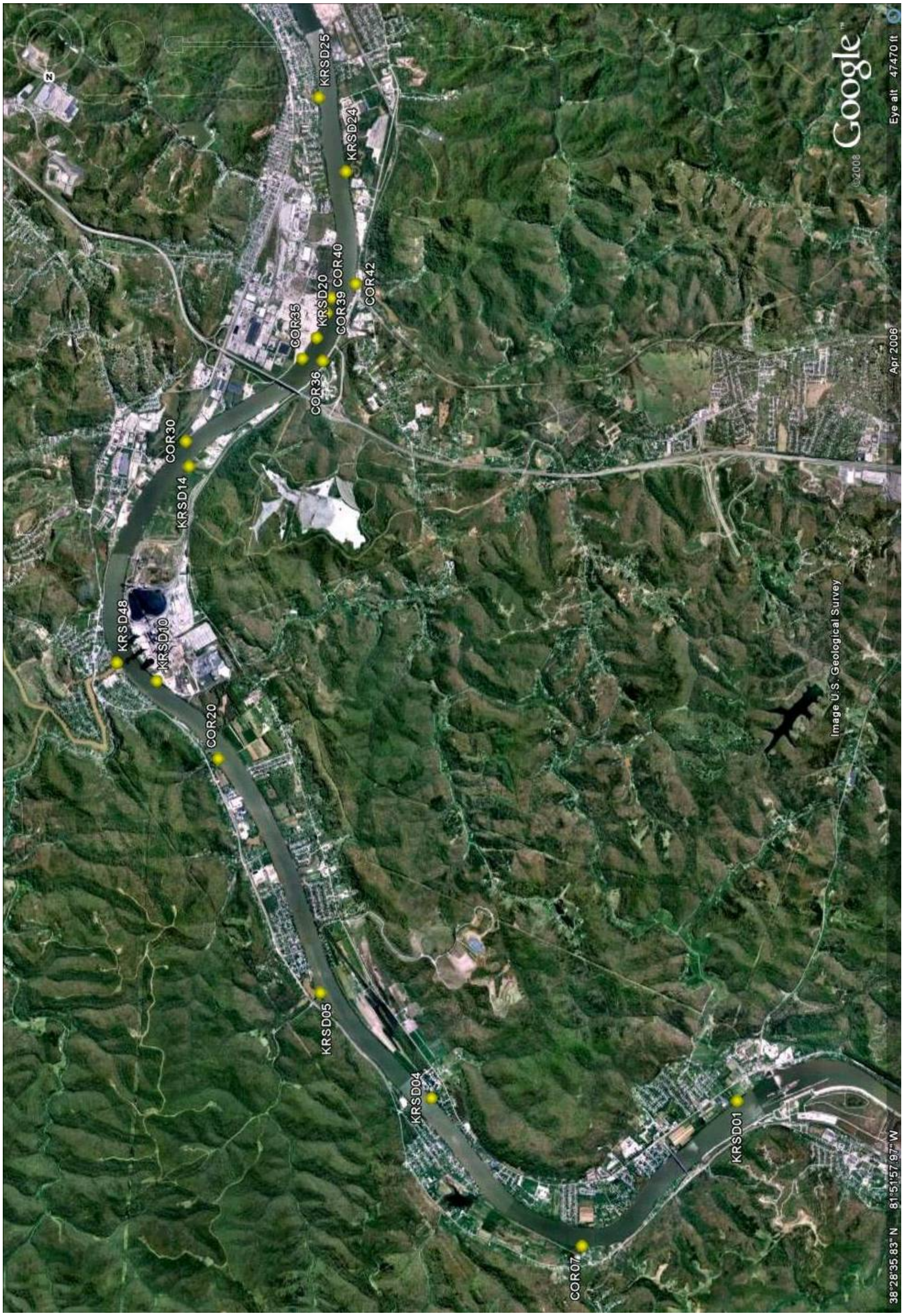


Figure 2. Map of core locations (Google Earth, 2009)

Core COR07

Core COR07 was collected in 6.1 m water depth. The core consisted of a 1 mm light grey oxic layer overlying light grey silt with pockets of black material down core. Shell fragments and detritus were present throughout the core. The mean grain size of the core was 31.17 µm (silt).

Figure 3 shows a photograph of the core and the erosion rate ratio (described in the *Erosion Rate Comparisons* section). The intra-core erosion rates provide a non-dimensional comparison of relative erosion rates down core. The dashed line is the core average and each bar shows the erosion rate ratio for that interval. The higher the value, the more erodible that layer of sediment is relative to the rest of the core. The sediment surface (depth = 0) is plotted at the top of the graph with depth into the sediments increasing down the Y-axis. Variations in erosion rate for each applied shear stress are shown. Figure 4 shows the bulk density and D_{50} (median particle size) as a function of depth. Figure 5 shows the power law curves used in the data analysis. Figure 6 shows an erosion rate plot shows each shear stress cycle run on the core, ranging from 0.1 to 9.0 N/m^2, as a function of depth. For plotting purposes, erosion rates of zero are plotted as 1×10^{-5} cm/s on the graph. Tables 3 and 4 summarize the measured data and provide a laboratory description of the data shown in the plots.

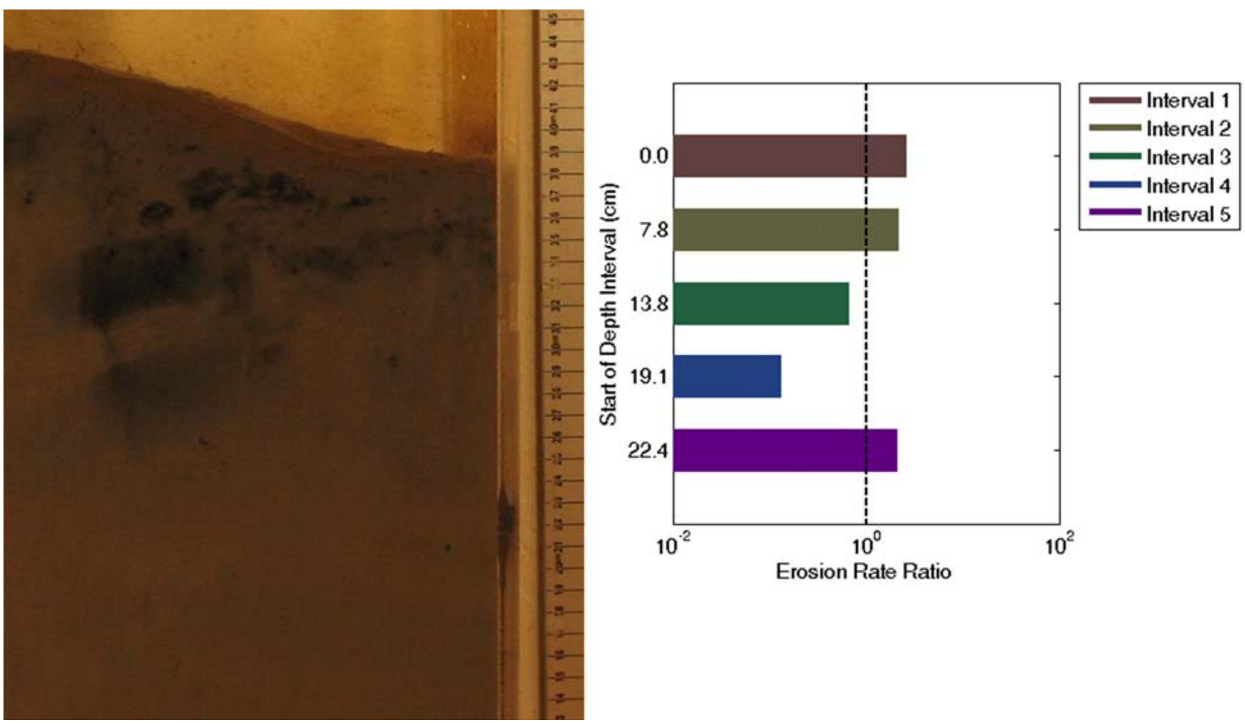


Figure 3. Picture of core COR07 aligned with intra-core erosion rate ratios.

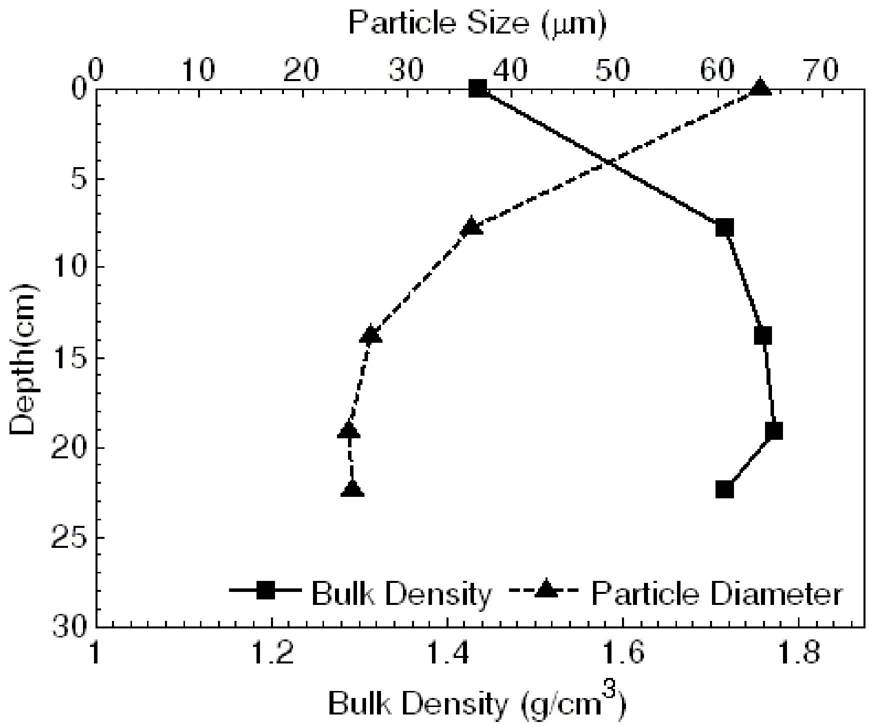


Figure 4. Bulk density and D_{50} with depth for core COR07.

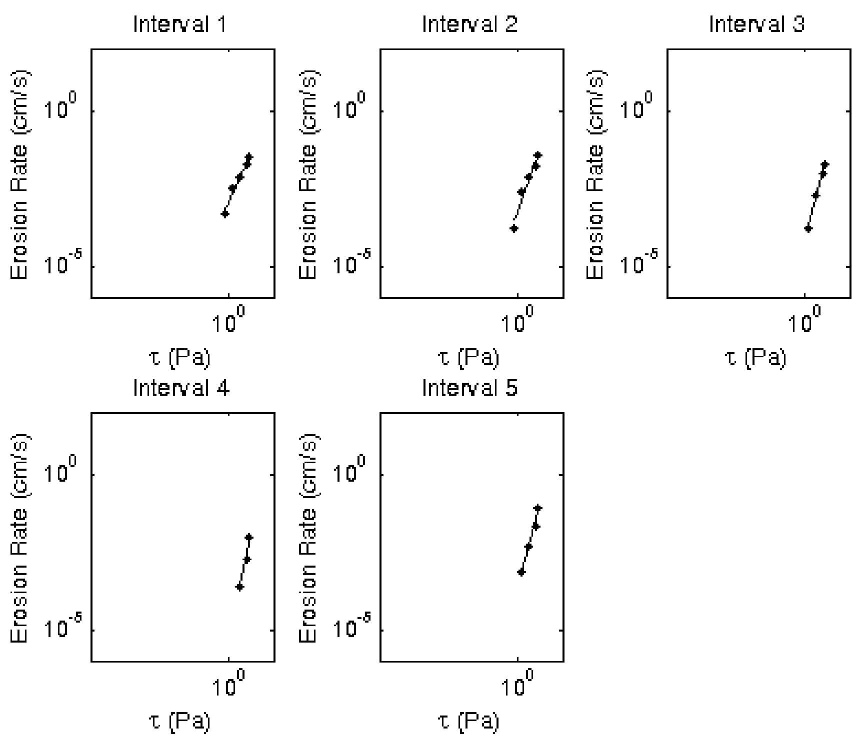


Figure 5. Power law curve fits for depth intervals in core COR07.

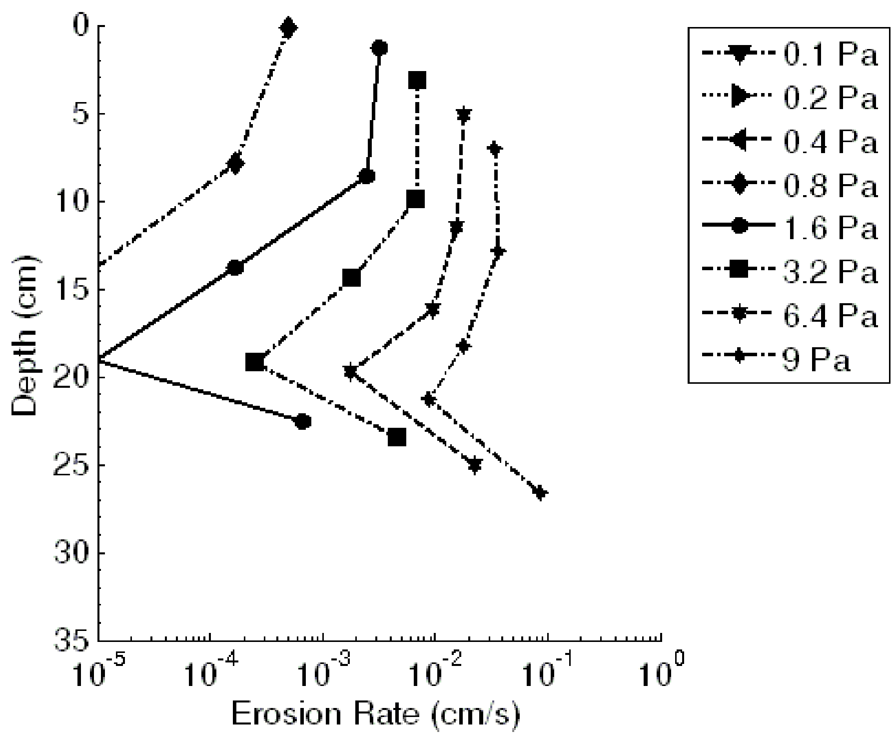


Figure 6. Measured Sedflume erosion rate data for core COR07.

Table 3. Power law best-fit variables for specified depth intervals in core COR07.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	7.8	9.79E-04	1.63	0.97
2	7.8	13.8	4.72E-04	2.03	0.94
3	13.8	19.1	5.73E-05	2.71	0.99
4	19.1	22.4	4.63E-06	3.35	0.98
5	22.4	27.5	1.85E-04	2.71	0.99

Table 4. Bulk density, D_{50}, critical shear stress with depth for COR07

Depth (cm)	D_{50} (μm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.00	63.98	1.44	0.25	0.48
7.80	36.24	1.72	0.47	0.64
13.80	26.51	1.76	1.23	1.28
19.10	24.43	1.77	2.50	2.24
22.40	24.66	1.72	0.80	0.92
Mean	**31.16**	**1.68**	**1.05**	**1.11**

Core COR20

Core COR20 was collected in 6.1 m water depth. The core consisted of a 5 mm olive oxic layer overlying a 1 cm thick light grey layer. Below 1.5 cm, olive grey sediment persisted down core with pockets of light and dark grey sediment. Plant material was observed at the surface and present down core to the deepest depth interval. Gas bubbles were also observed down core. The mean grain size of the core was 23.70 µm (silt).

Figure 7 through Figure 10 show the data results and analysis and Table 5 and Table 6 summarize the data.

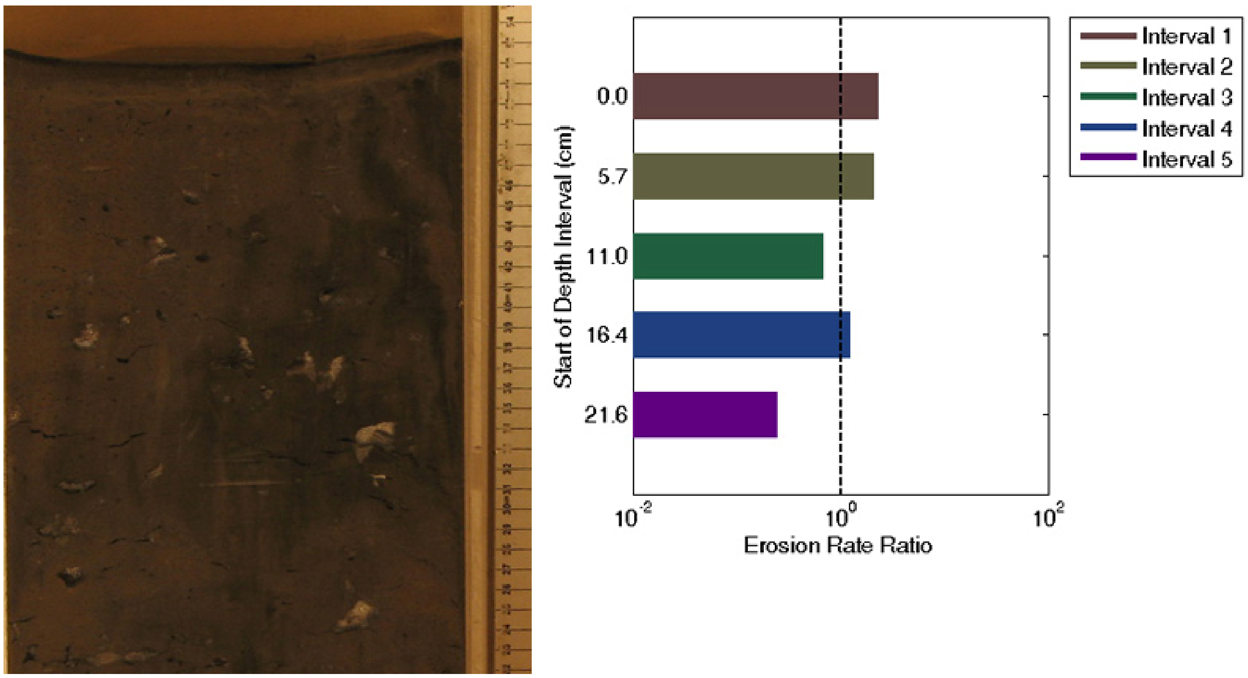


Figure 7. Picture of core COR20 aligned with Intra-core erosion rate ratios.

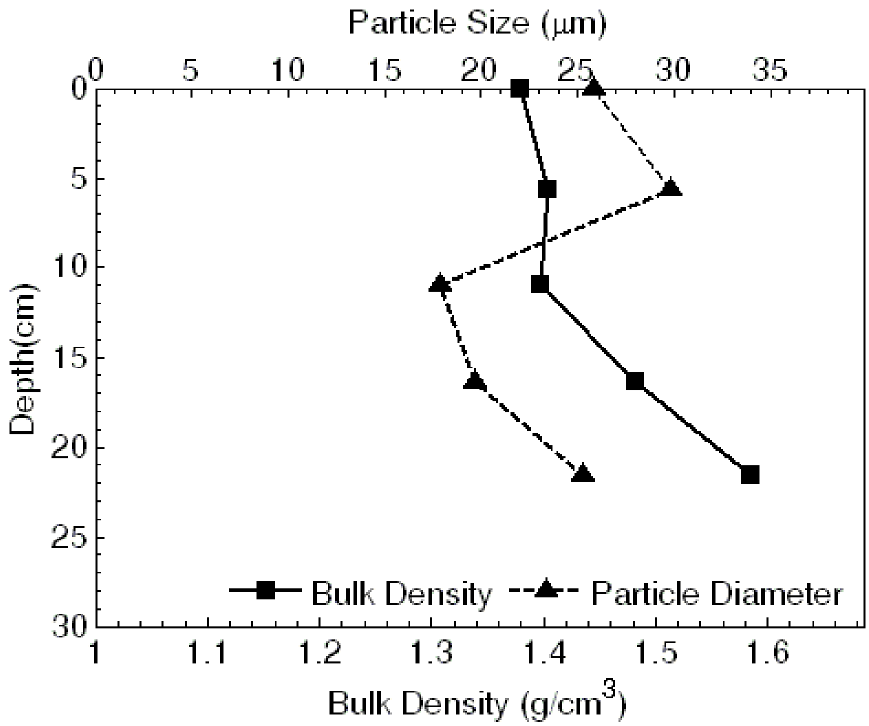


Figure 8. Bulk density and D_{50} with depth for core COR20.

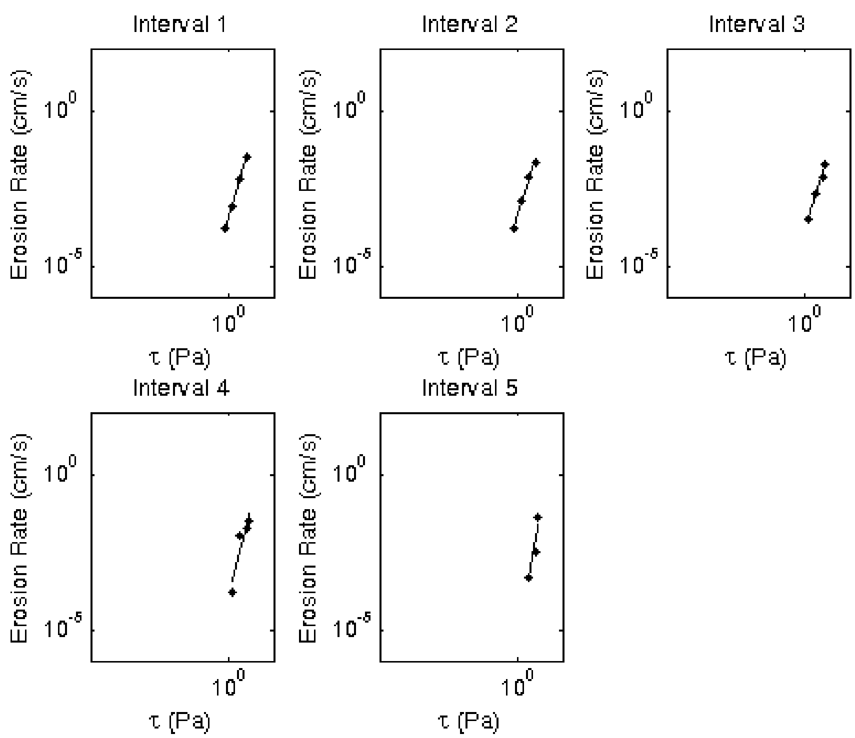


Figure 9. Best fit power law curves for depth intervals in core COR20.

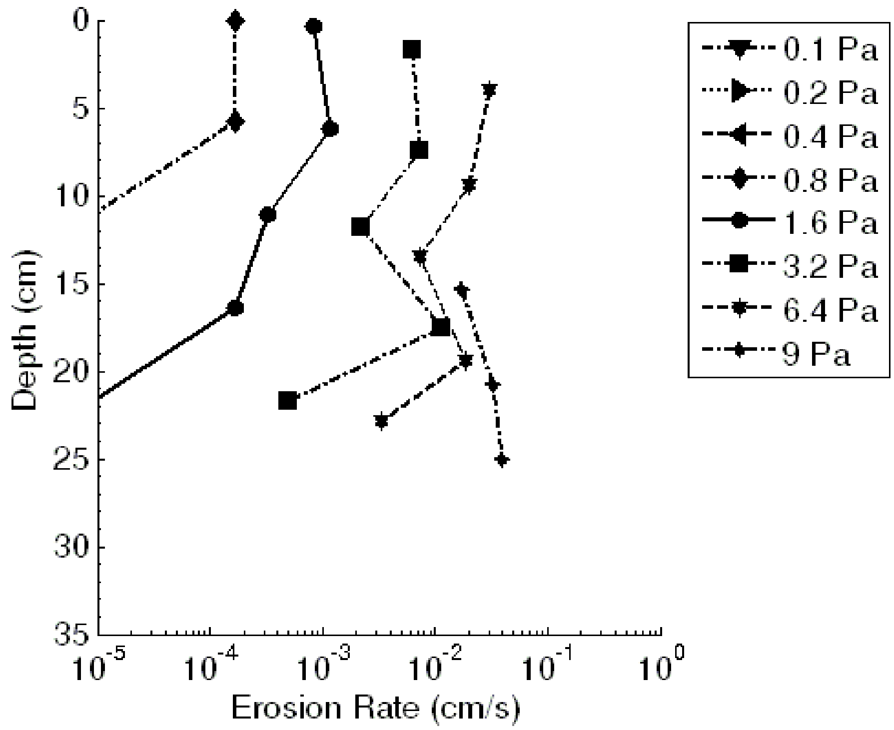


Figure 10. Sedflume erosion rate data for coreCOR20.

Table 5. Power law best-fit variables for specified depth intervals in core COR20.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	5.2	2.84E-04	2.54	1.00
2	5.7	10.4	3.42E-04	2.33	0.98
3	11.0	16.4	1.31E-04	2.22	0.99
4	16.4	21.3	9.97E-05	2.86	0.83
5	21.6	26.1	3.82E-06	4.00	0.93

Table 6. Bulk density, $D_{50,}$ critical shear stress with depth for COR20

Depth (cm)	D_{50} (μm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.00	25.86	1.38	0.66	0.64
5.70	29.83	1.40	0.59	0.64
11.00	17.87	1.40	0.89	1.04
16.40	19.64	1.48	1.00	1.28
21.60	25.29	1.59	2.26	1.92
Mean	**23.70**	**1.45**	**1.08**	**1.10**

Core COR30

Core COR30 was collected in 1.8 m of water depth. The core consisted of an approximate 2 mm olive grey oxic layer of 8 to 10 cm of olive grey sediment. Below 10 cm, yellowish orange sediment persisted to the end of the core. Plant material was observed from 8 cm to the deepest depth interval. Additionally, three large boulders (Wentworth Classification) were removed at 9.7 cm. The mean grain size of the core was 201.99 μm (sand).

Figure 11 through Figure 14 show the data results and analysis and Table 7 and Table 8 summarize the data.

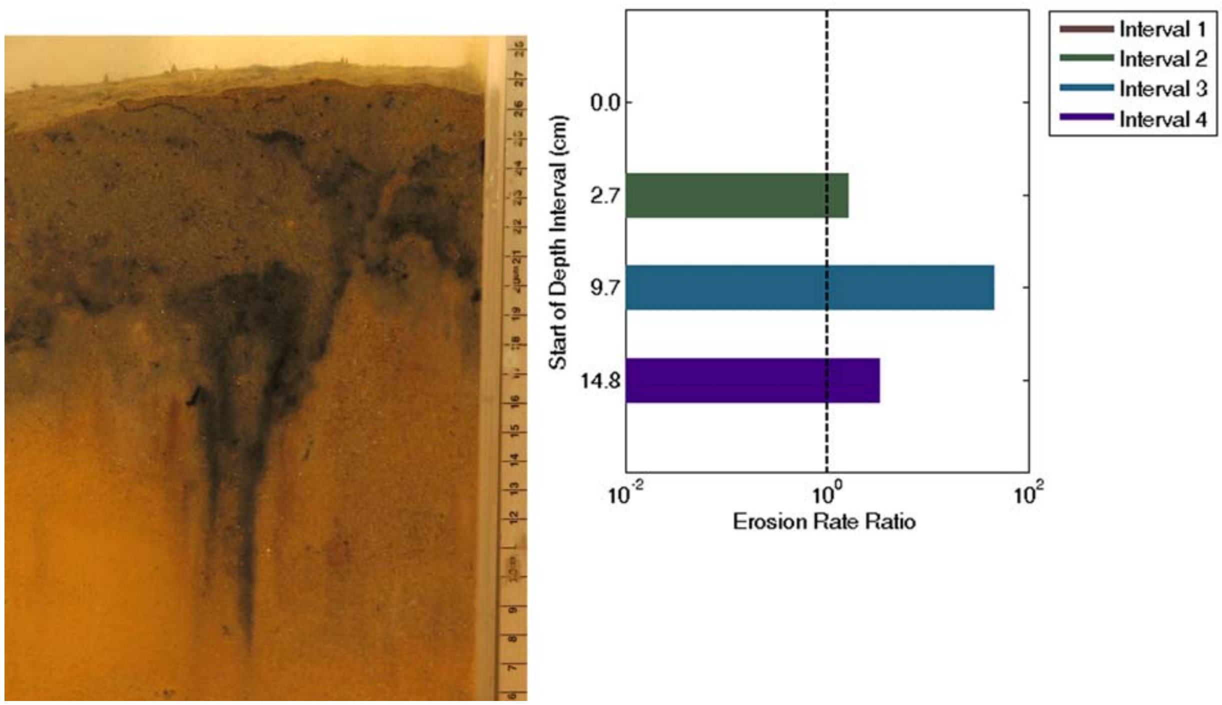


Figure 11. Picture of core COR30 aligned with Intra-core erosion rate ratios.

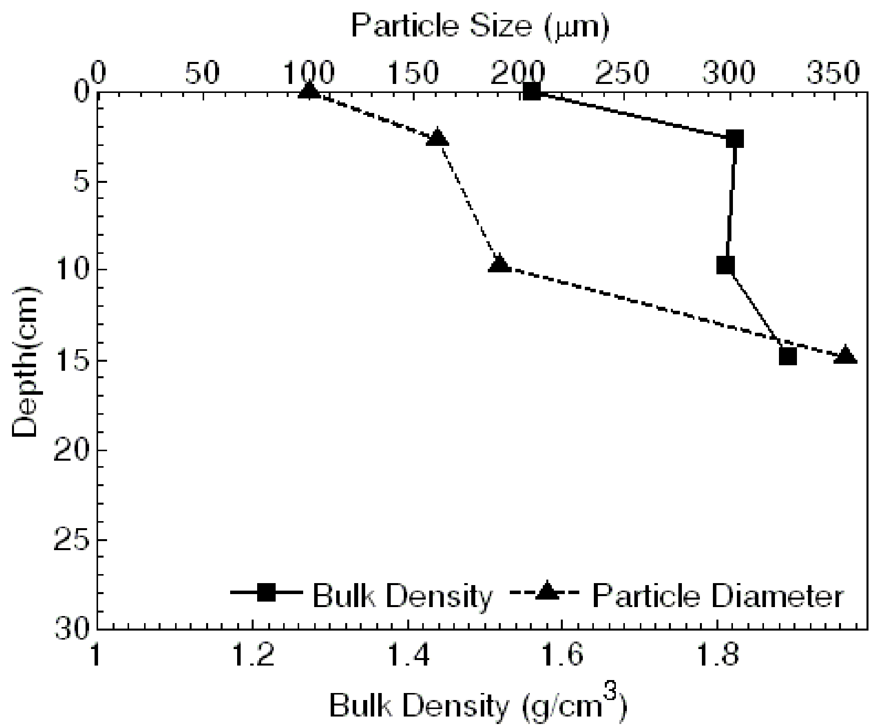


Figure 12. Bulk density and D_{50} with depth for core COR30.

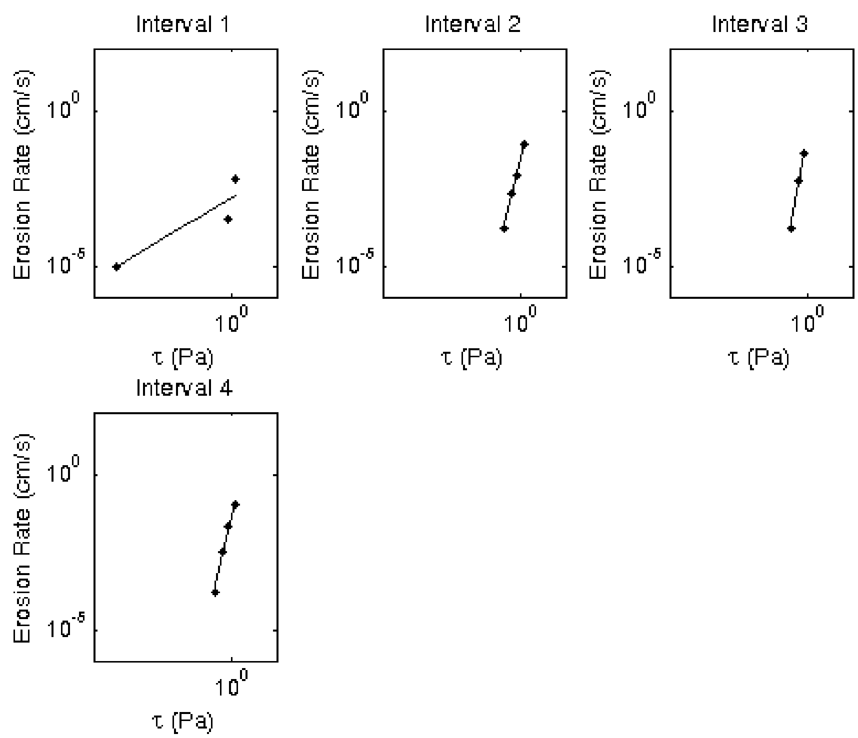


Figure 13. Best fit power law curves for depth intervals in core COR30.

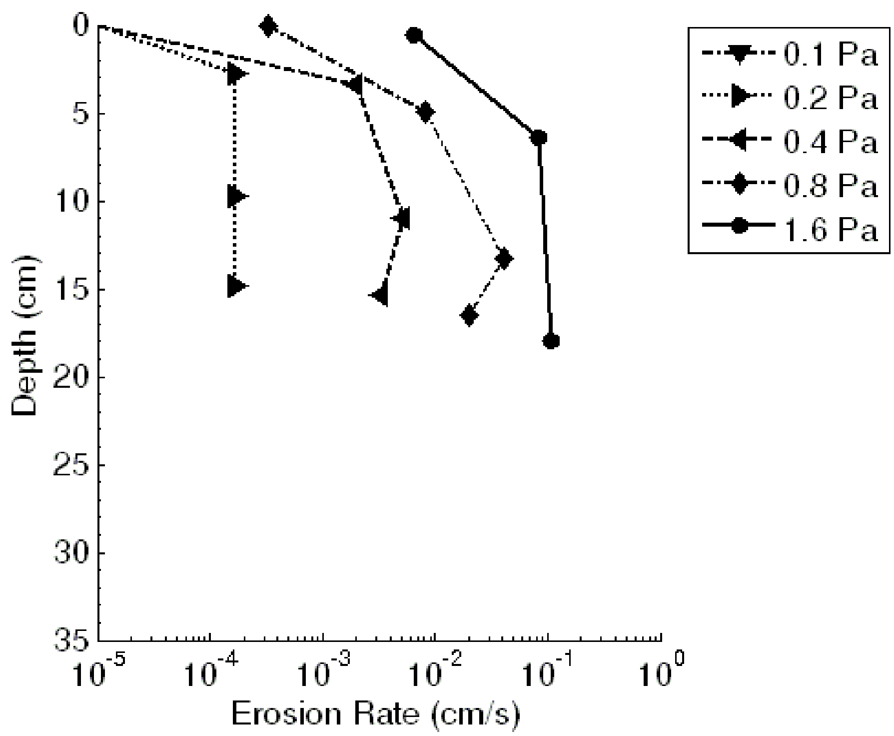


Figure 14. Sedflume erosion rate data for coreCOR30.

Table 7. Power law best-fit variables for specified depth intervals in core COR30.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	0.9	1.46E-03	0.44	0.83
2	2.7	7.0	2.03E-02	2.90	0.99
3	9.7	14.5	1.24E-01	3.97	0.98
4	14.8	18.7	3.32E-02	3.06	0.98

Table 8. Bulk density, $D_{50,}$ critical shear stress with depth for COR30.

Depth (cm)	D_{50} (µm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.0	100.68	1.56	-	0.52
2.7	161.56	1.82	0.16	0.16
9.7	190.75	1.81	0.17	0.16
14.8	354.96	1.89	0.15	0.16
Mean	**201.99**	**1.77**	**0.16**	**0.25**

Core COR35

Core COR35 was collected in 1.5 m of water depth. The core consisted of a 2-3 mm oxic layer, overlying olive grey sediment with pockets of finer and coarser grained sediments. Three small sticks were present at surface. At 23 through 30 cm of core depth a distinctly coarser grained sediment layer was observed. Plant material was visible from 22 cm to the deepest depth interval. Gas bubbles were observed intermittently down core. The mean grain size of the core was 69.95 µm (sand).

Figure 15 through Figure 18 show the data results and analysis and Table 9 and Table 10 summarize the data.

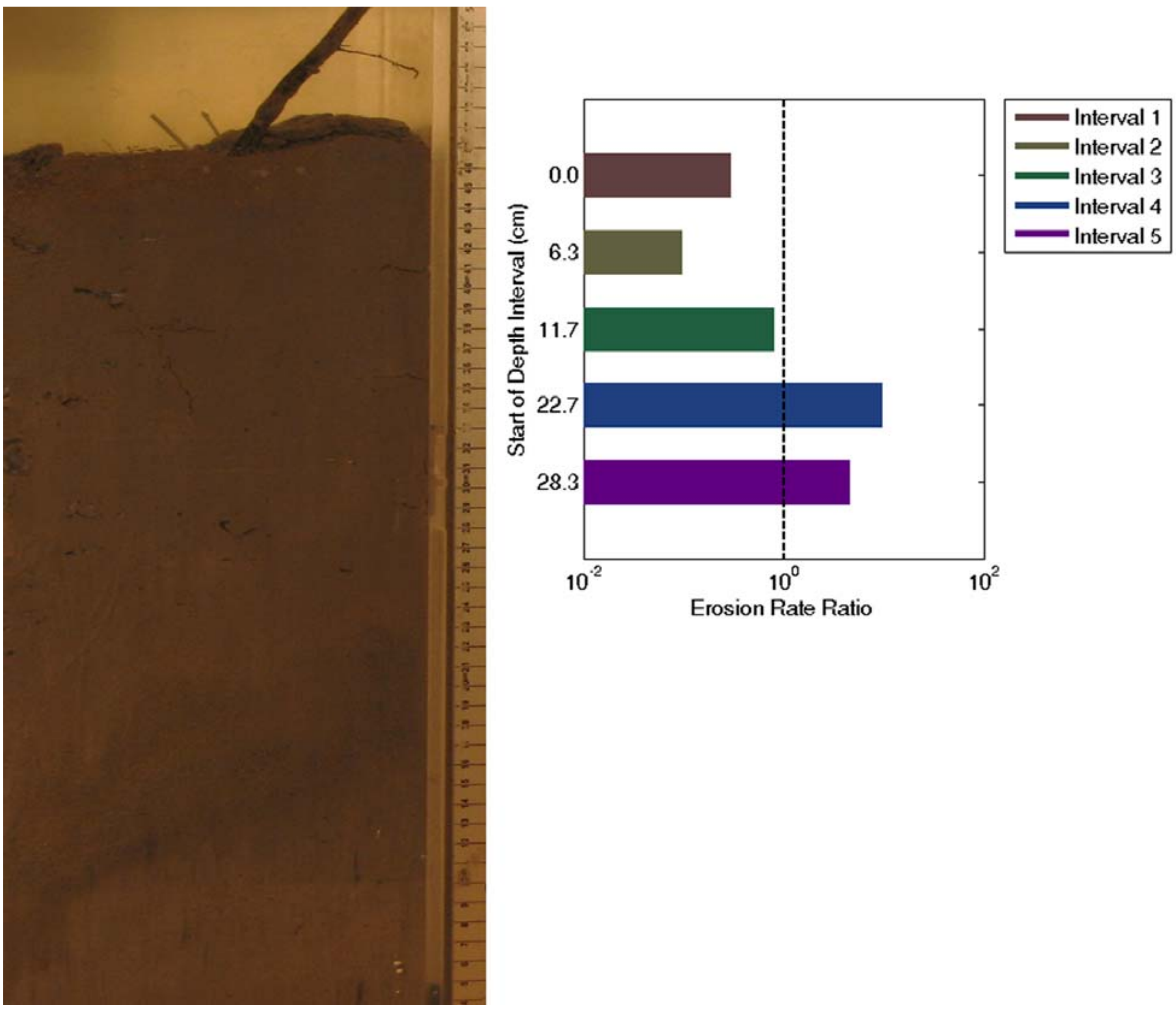


Figure 15. Picture of core COR35 aligned with Intra-core erosion rate ratios.

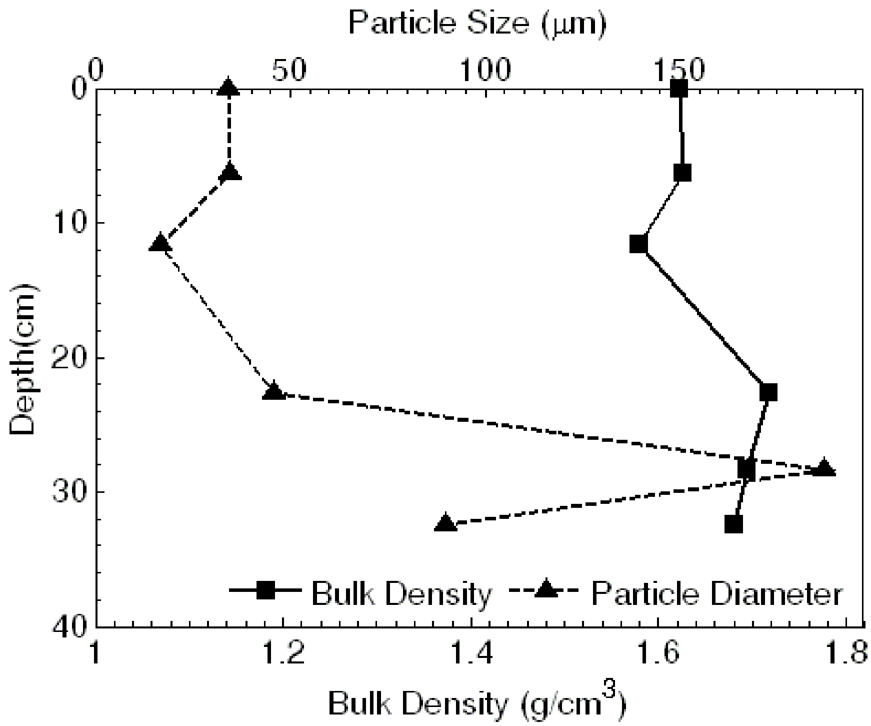


Figure 16. Bulk density and D_{50} with depth for core COR35.

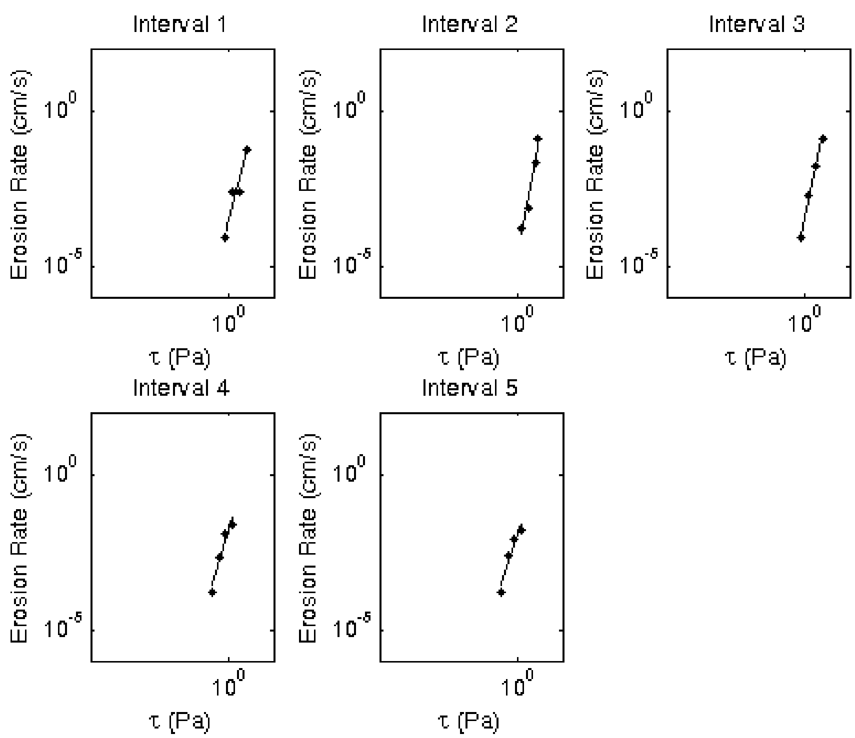


Figure 17. Best fit power law curves for depth intervals in core COR35.

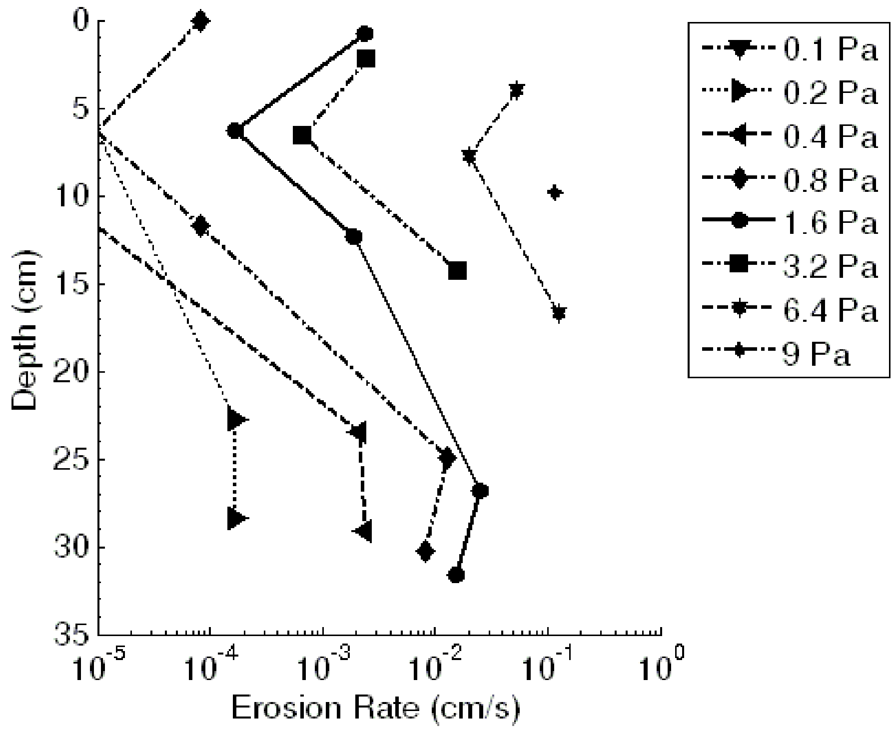


Figure 18. Sedflume erosion rate data for coreCOR35.

Table 9. Power law best-fit variables for specified depth intervals in core COR35.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	5.1	2.31E-04	2.81	0.90
2	6.3	10.8	1.66E-05	3.86	0.96
3	11.7	17.8	2.49E-04	3.47	0.99
4	22.7	27.9	1.30E-02	2.43	0.94
5	19.2	23.3	8.97E-03	2.14	0.92

Table 10. Bulk density, $D_{50,}$ critical shear stress with depth for COR35.

Depth (cm)	D_{50} (µm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.00	33.9520	1.62	0.74	0.81
6.30	34.4220	1.63	1.59	1.28
11.70	16.4500	1.58	0.77	0.81
22.70	45.9450	1.72	0.13	0.16
28.30	187.1280	1.70	0.12	0.16
32.40	89.8176	1.68	-	-
Mean	**69.9524**	**1.65**	**0.67**	**0.64**

Core COR36

Core COR36 was collected in 0.9 m of water depth. The core consisted of a 2 mm oxic layer, overlying olive grey sediment with pockets of coarser and finer sediment. Pockets of dark grey sediment were present from 2 to 10 cm. Plant material was observed from 2 to 8 cm and 21 to 27 cm. Gas bubbles were observed intermittently down core. The mean grain size of the core was 51.62 µm (silt).

Figure 19 through Figure 22 show the data results and analysis and Table 11 and Table 12 summarize the data.

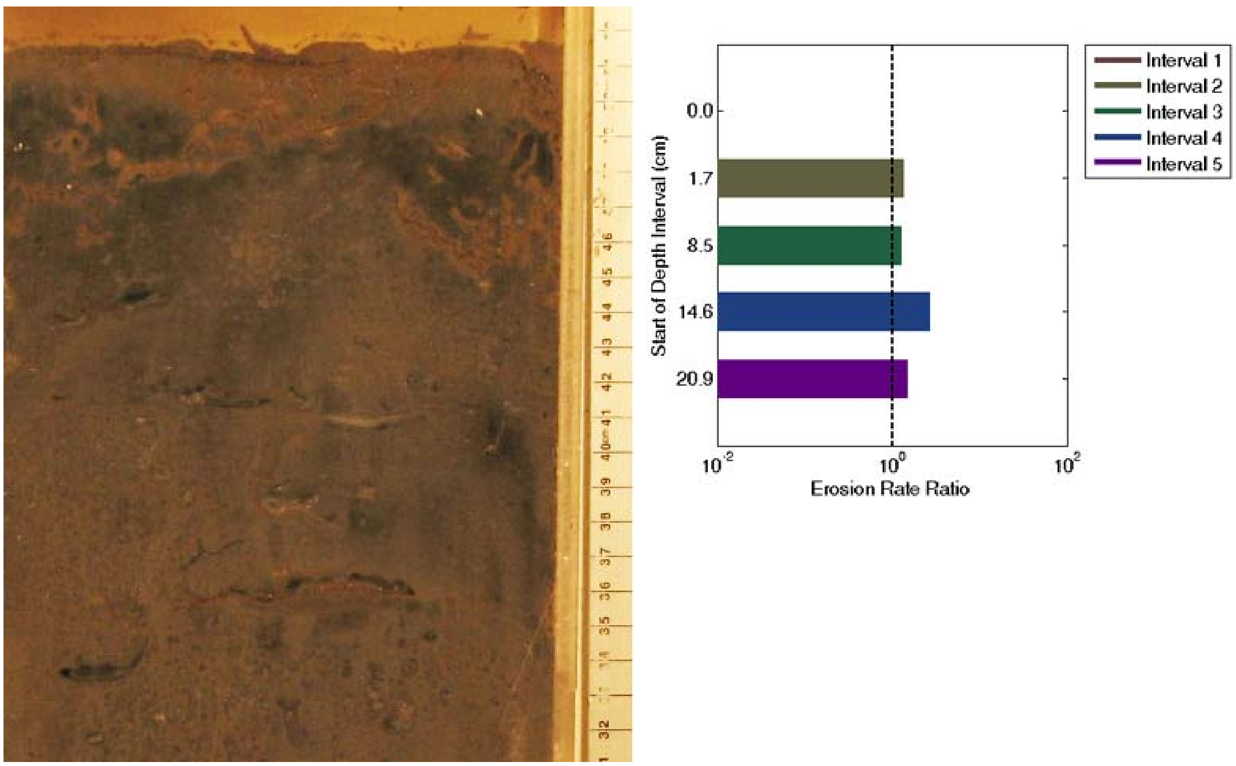


Figure 19. Picture of coreCOR36 aligned with Intra-core erosion rate ratios.

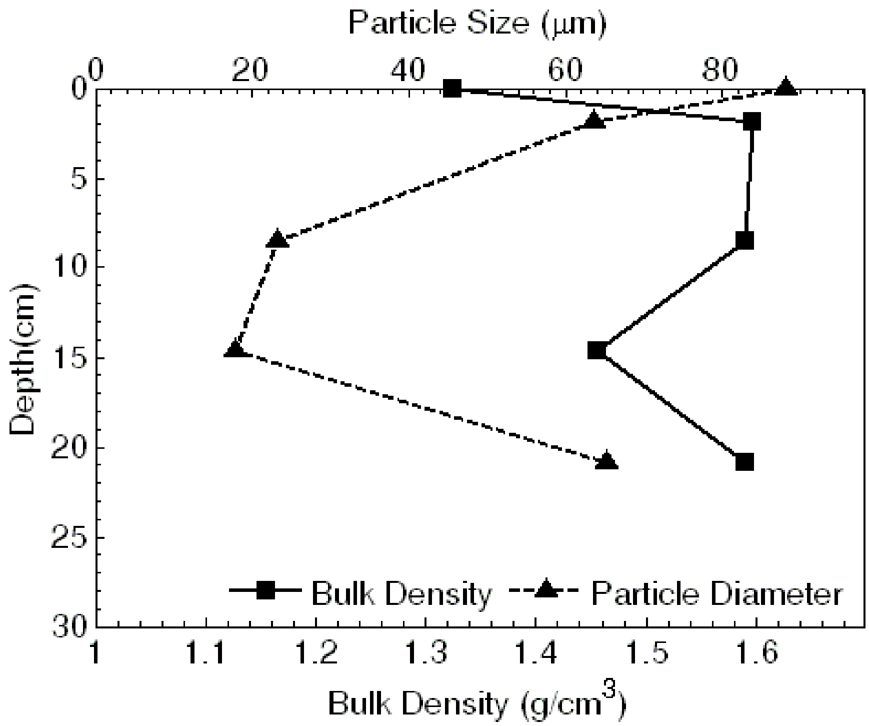


Figure 20. Bulk density and D_{50} with depth for core COR36.

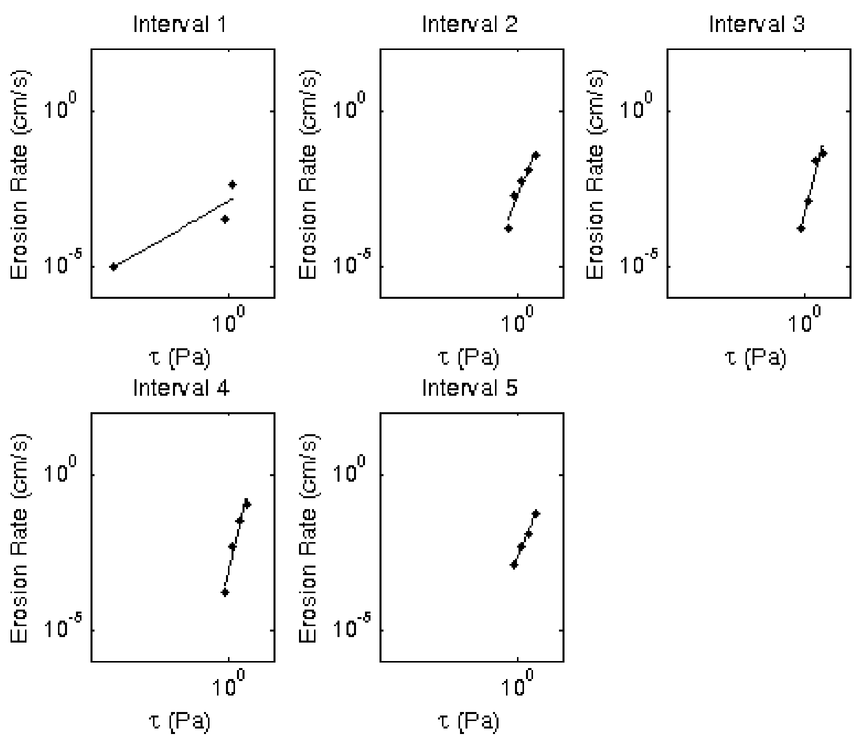


Figure 21. Best fit power law curves for depth intervals in core COR36.

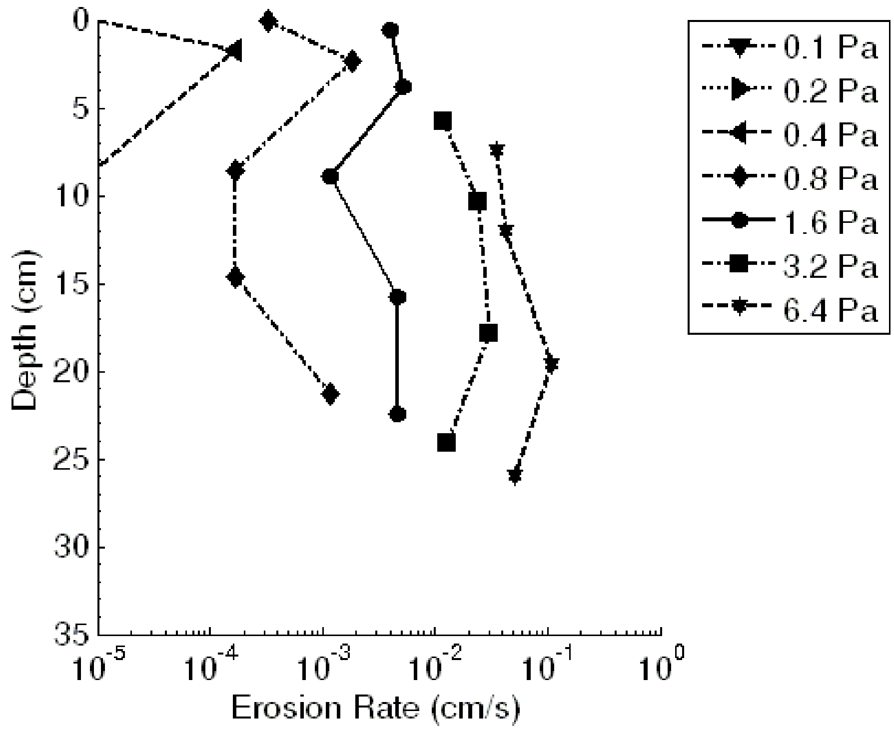


Figure 22. Sedflume erosion rate data for coreCOR36.

Table 11. Power law best-fit variables for specified depth intervals in core COR36.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	0.9	1.13E-03	0.42	0.87
2	1.7	8.1	1.57E-03	1.81	0.95
3	8.5	12.5	3.72E-04	2.83	0.94
4	14.6	20.4	5.81E-04	3.06	0.95
5	20.9	27.0	1.81E-03	1.78	1.00

Table 12. Bulk density, $D_{50,}$ critical shear stress with depth for COR36

Depth (cm)	D_{50} (µm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.00	88.02	1.32	-	0.52
1.90	63.60	1.60	0.22	0.32
8.50	23.34	1.59	0.63	0.64
14.60	17.86	1.46	0.56	0.64
20.90	65.29	1.59	0.20	0.43
Mean	**51.6219**	**1.51**	**0.40**	**0.51**

Core COR39

Core COR39 was collected in 1.5 m of water depth. The core consisted of an approximate 14 cm light brown surface layer, overlying a 2 cm dark grey layer. Below the dark grey layer, olive grey silt persisted to the end of the core. Plant material was observed at the surface and continued down core to approximately 31 cm. Gas bubbles were present intermittently down core. The mean grain size of the core was 64.49 µm (sand).

Figure 23 through Figure 26 show the data results and analysis and Table 13 and Table 14 summarize the data.

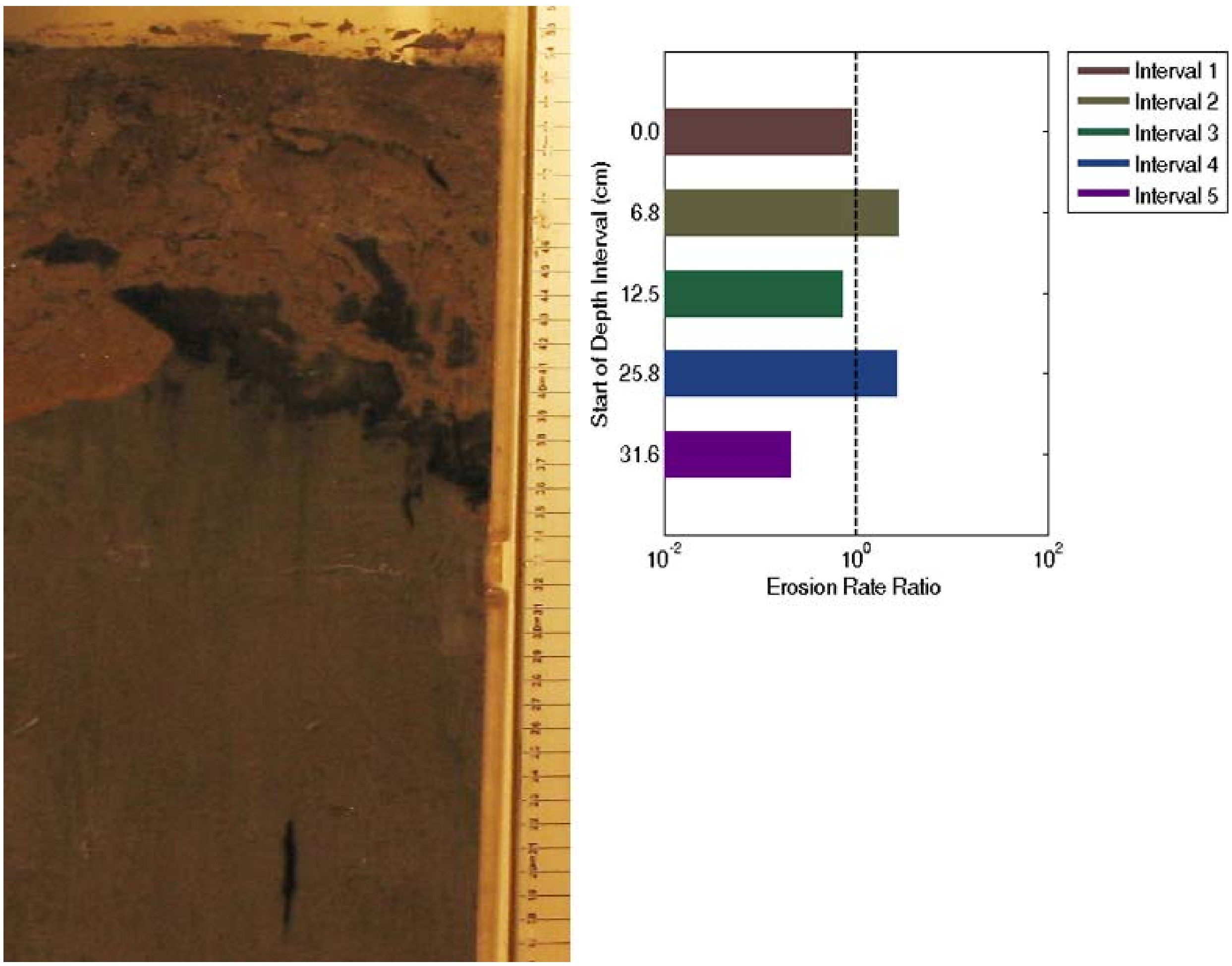


Figure 23. Picture of core COR39 aligned with Intra-core erosion rate ratios.

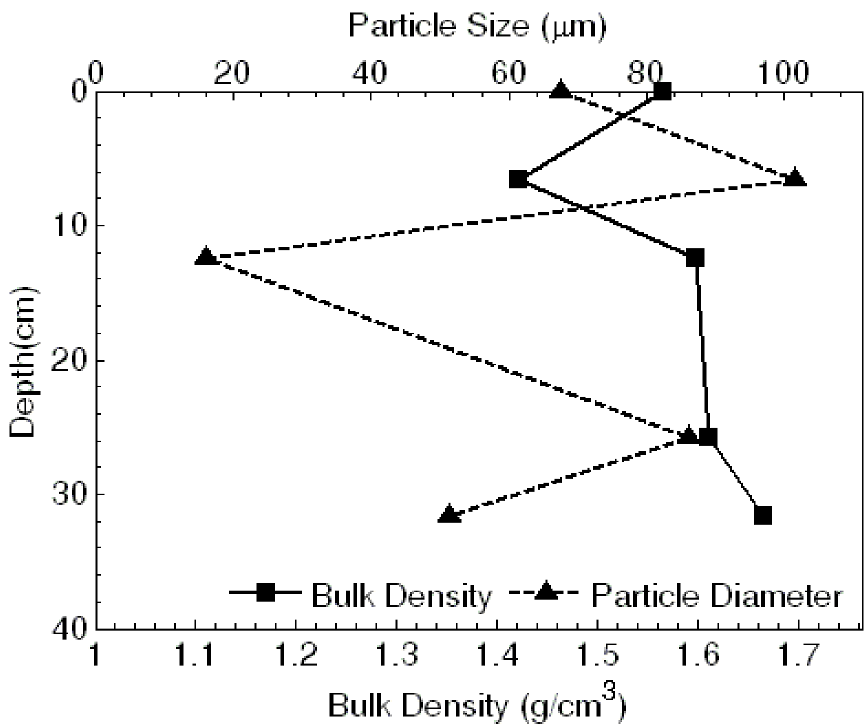


Figure 24. Bulk density and D_{50} with depth for core COR39.

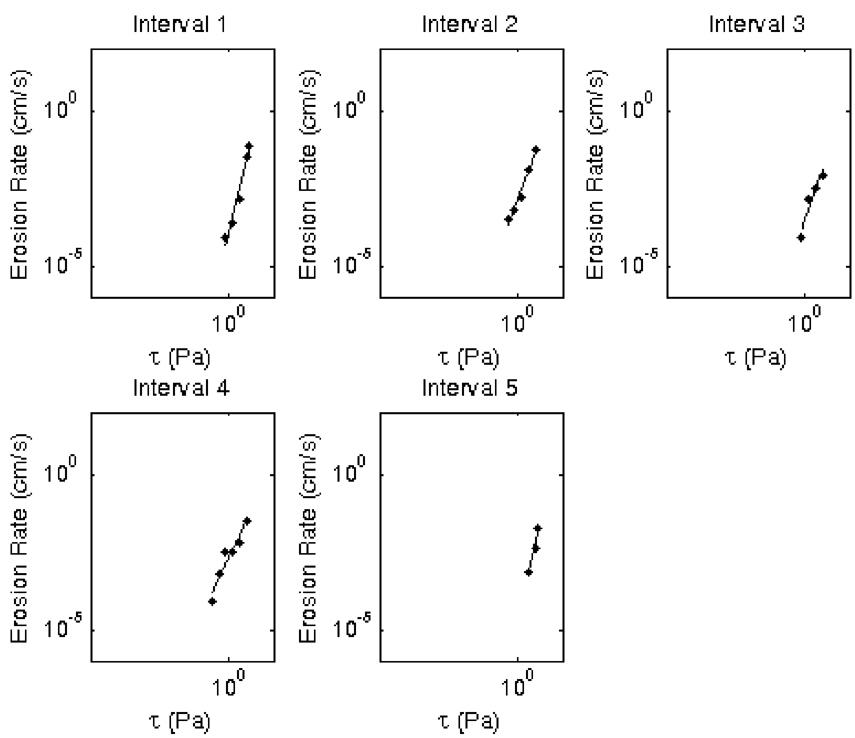


Figure 25. Best fit power law curves for depth intervals in core COR39.

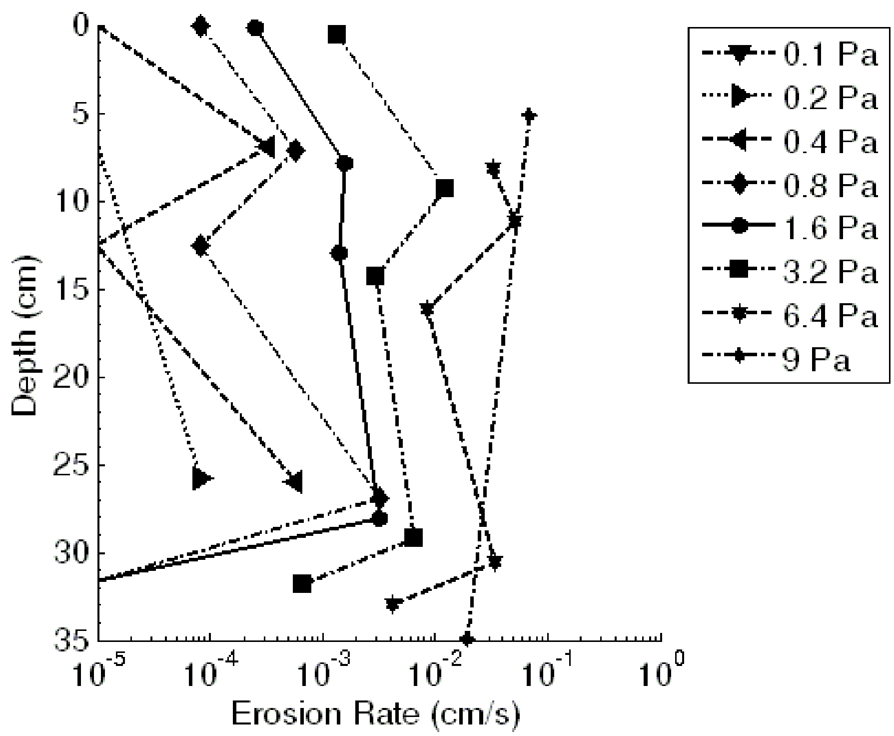


Figure 26. Sedflume erosion rate data for coreCOR39.

Table 13. Power law best-fit variables for specified depth intervals in core COR39.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	6.1	9.34E-05	2.93	0.97
2	6.8	11.9	1.18E-03	1.89	0.96
3	12.5	17.1	2.36E-04	2.10	0.91
4	25.8	31.4	1.81E-03	1.53	0.92
5	31.6	35.9	1.52E-05	3.17	0.98

Table 14. Bulk density, $D_{50,}$ critical shear stress with depth for COR39

Depth (cm)	D_{50} (μm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.00	67.57	1.56	1.02	0.88
6.60	101.45	1.42	0.27	0.26
12.50	16.02	1.60	0.67	0.81
25.80	86.05	1.61	0.15	0.21
31.60	51.40	1.66	1.81	1.84
Mean	**64.50**	**1.57**	**0.78**	**0.80**

Core COR40

Core COR40 was collected in 0.6 m of water depth. The core consisted of an approximate 2 mm light brown oxic layer, overlying a yellowish orange sediment layer to a depth of 3 cm. At 3 cm to the end of the core olive grey sediment was observed. Pockets of dark grey sediment were observed from 3 to 14 cm. At 25 cm to the end of the core, the sediment got notably coarser. Plant material was observed from 5 cm to 15 cm. The mean grain size of the core was 110.22 µm (sand).

Figure 27 through Figure 30 show the data results and analysis and Table 15 and Table 16 summarize the data.

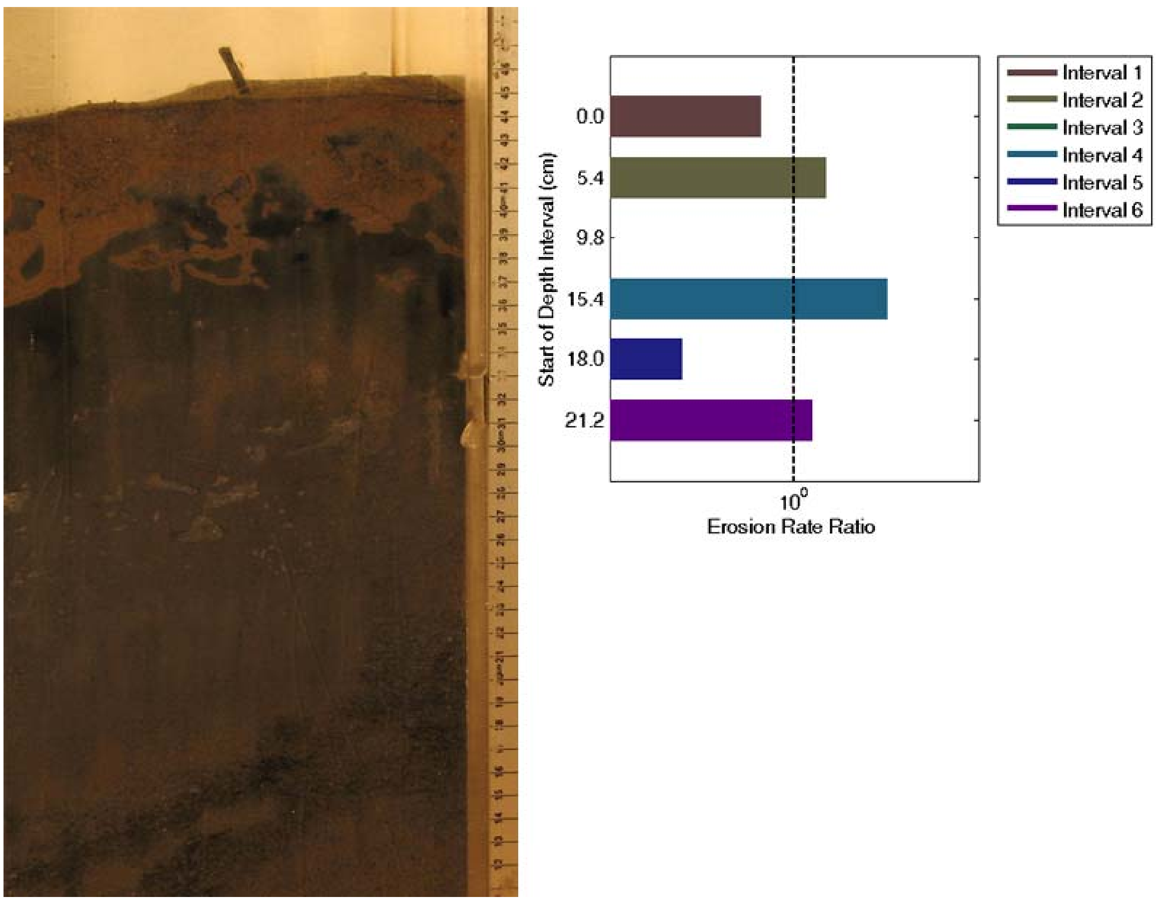


Figure 27. Picture of core COR40 aligned with Intra-core erosion rate ratios.

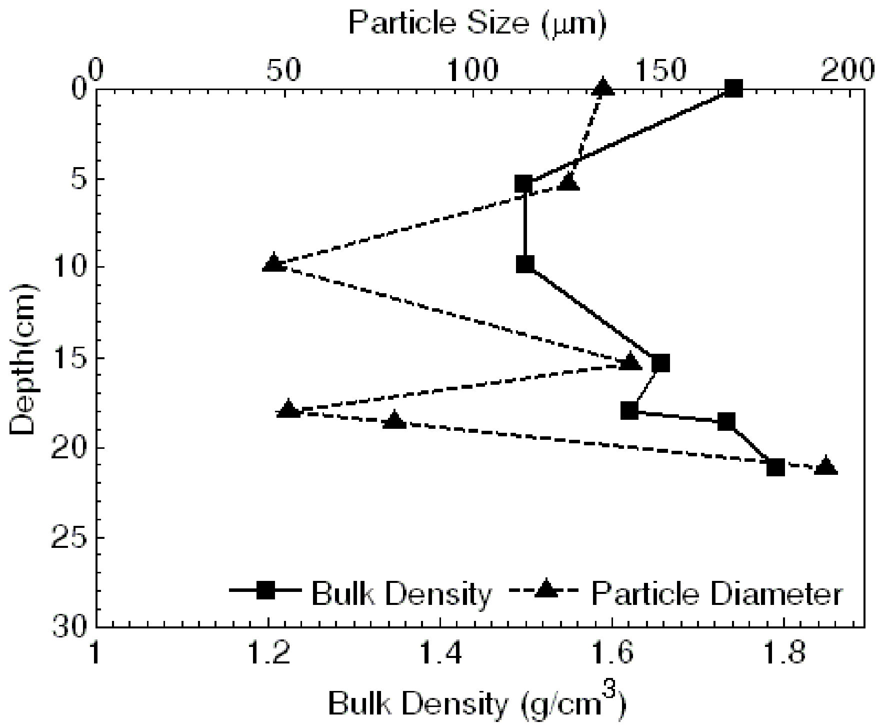


Figure 28. Bulk density and D_{50} with depth for core COR40.

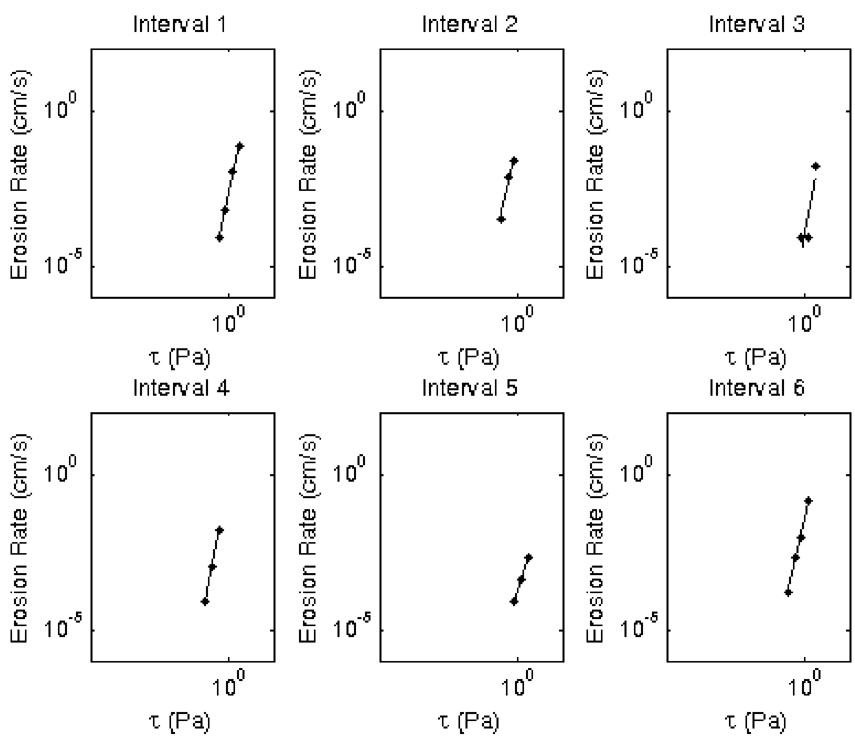


Figure 29. Best fit power law curves for depth intervals in core COR40.

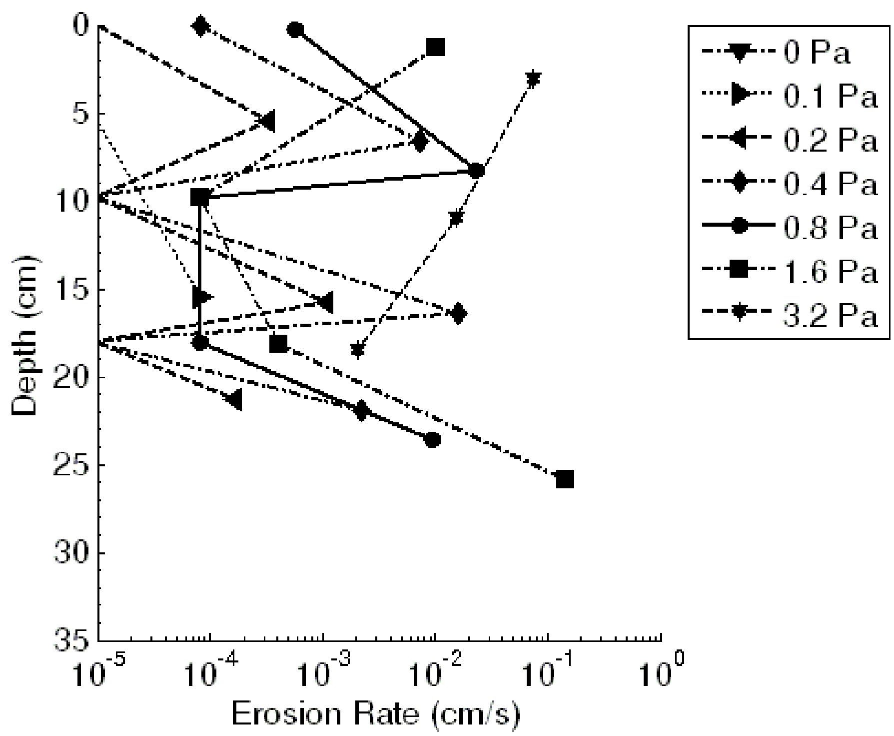


Figure 30. Sedflume erosion rate data for coreCOR40.

Table 15. Power law best-fit variables for specified depth intervals in core COR40.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	3.9	1.63E-03	3.35	0.99
2	5.4	8.9	6.38E-02	3.06	0.93
3	9.8	12.0	8.09E-05	3.77	0.75
4	15.4	16.7	4.96E-01	3.78	1.00
5	18.0	18.6	1.40E-04	2.32	1.00
6	21.2	27.3	2.85E-02	3.15	0.99

Table 16. Bulk density, $D_{50,}$ critical shear stress with depth for COR40.

Depth (cm)	**D_{50} (μm)**	**ρ_b (g/cm^3)**	**Power Law τ_{cr} (Pa)**	**Linear Interpolation τ_{cr} (Pa)**
0.00	134.23	1.74	0.43	0.41
5.40	125.25	1.50	0.12	0.13
9.80	47.11	1.50	-	1.60
15.40	141.45	1.66	0.11	0.10
18.00	51.11	1.62	0.87	0.84
18.60	79.00	1.73	0.17	0.16
21.20	193.43	1.79	-	-
Mean	**110.22**	**1.65**	**0.34**	**0.54**

Core COR42

Core COR42 was collected in 0.9 m of water depth. The core consisted of an approximate 2 mm dark grey oxic layer, overlying olive grey sediment with pockets of light and dark grey sediment. At 34 cm a rose colored sediment layer was present. Plant material (roots, leaves, and small sticks) and gas bubbles were present at the surface and throughout the core to the deepest depth interval. The mean grain size of the core was 55.55 µm (silt).

Figure 31 through Figure 34 show the data results and analysis and Table 17 and Table 18 summarize the data.

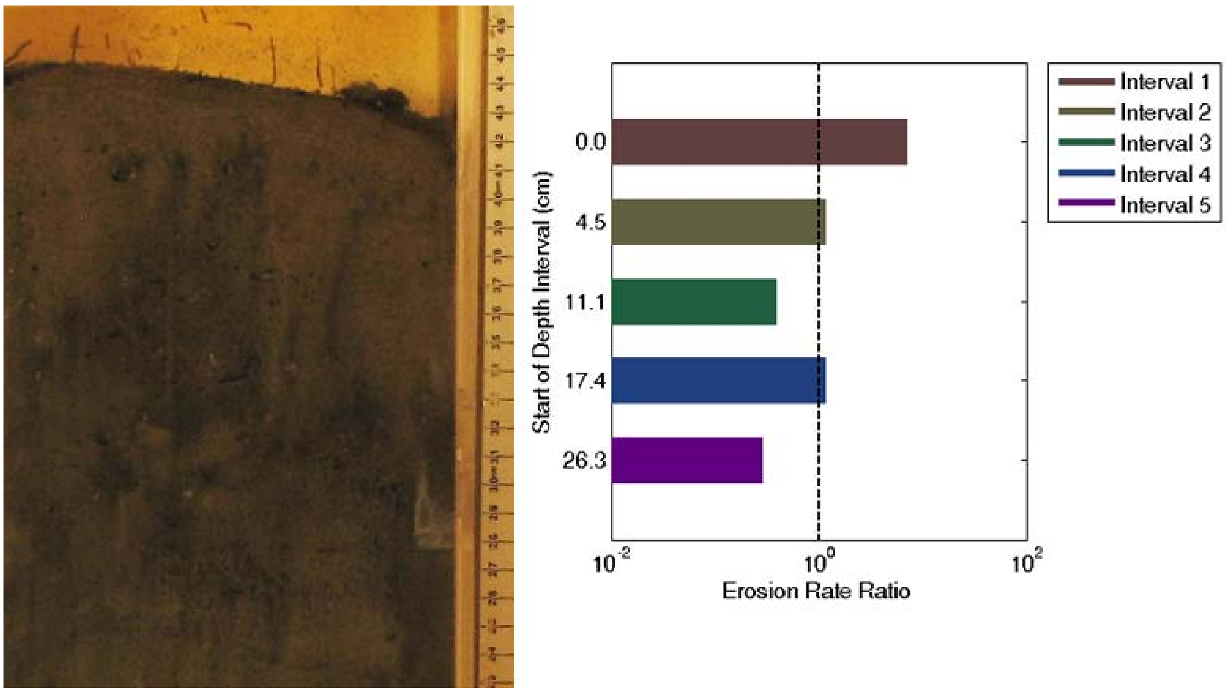


Figure 31. Picture of core COR42 aligned with Intra-core erosion rate ratios.

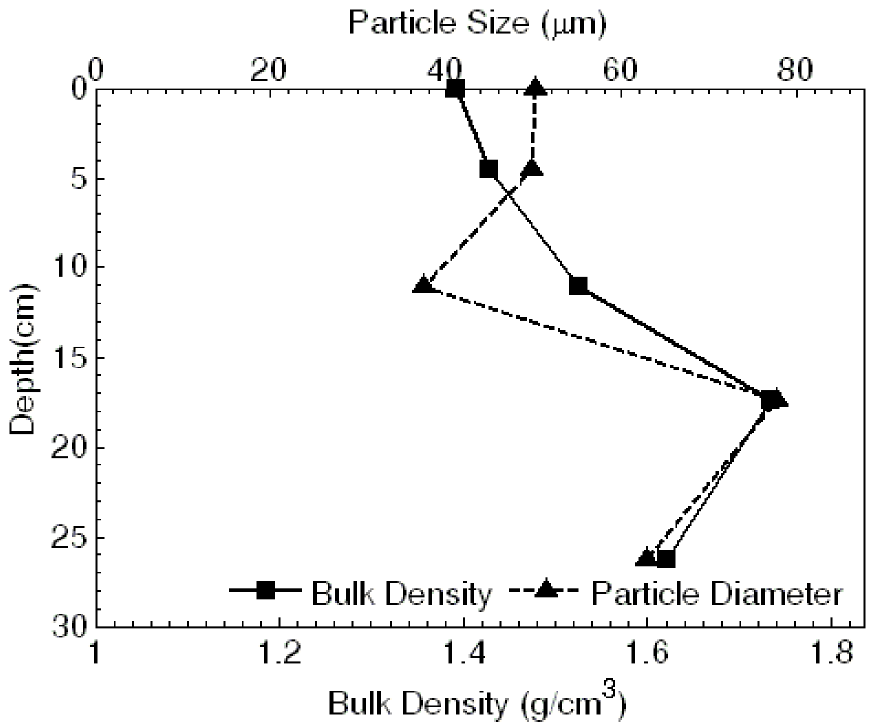


Figure 32. Bulk density and D_{50} with depth for core COR42.

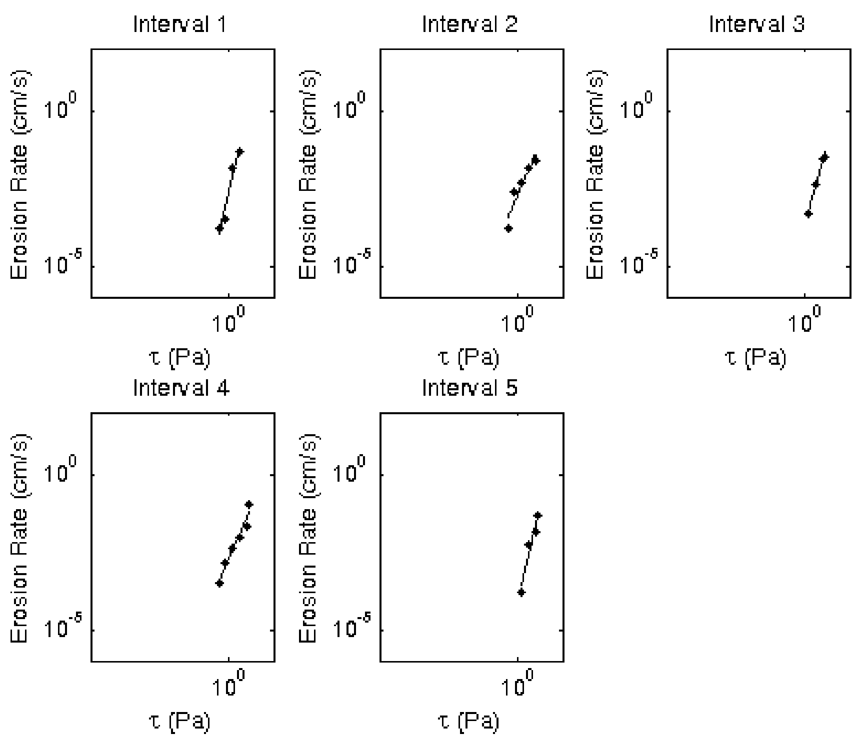


Figure 33. Best fit power law curves for depth intervals in core COR42.

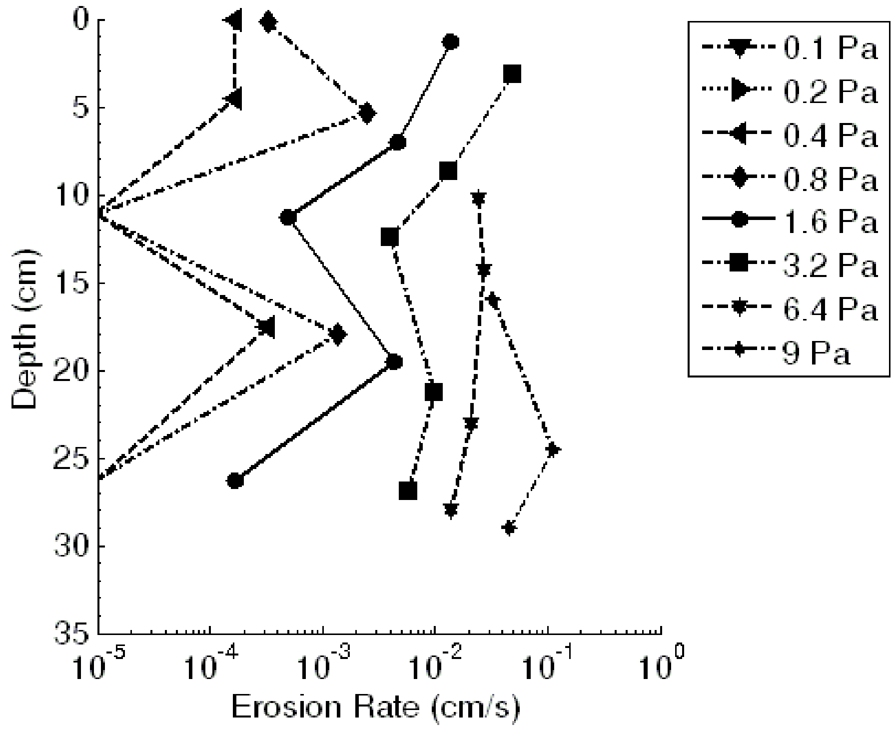


Figure 34. Sedflume erosion rate data for coreCOR42.

Table 17. Power law best-fit variables for specified depth intervals in core COR42.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	4.1	1.71E-03	3.00	0.93
2	4.5	11.0	1.64E-03	1.68	0.90
3	11.1	16.8	1.82E-04	2.51	0.98
4	17.4	25.1	1.67E-03	1.67	0.97
5	26.3	29.7	6.65E-05	3.03	0.93

Table 18. Bulk density, D_{50}, critical shear stress with depth for COR42.

Depth (cm)	D_{50} (μm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.00	50.24	1.39	0.39	0.32
4.50	49.65	1.43	0.19	0.32
11.10	37.37	1.53	0.79	0.96
17.40	77.59	1.73	0.19	0.26
26.30	62.91	1.62	1.14	1.28
Mean	**55.55**	**1.54**	**0.54**	**0.63**

Core KRSD01

Core KRSD01 was collected in 2.4 m of water depth. The core consisted of an approximate 2 mm dark grey oxic layer, overlying olive grey sediment with pockets of light and dark sediment. Gas bubbles and plant material were present down core. The mean grain size of the core was 51.05 µm (silt).

Figure 35 through Figure 38 show the data results and analysis and Table 19 and Table 20 summarize the data.

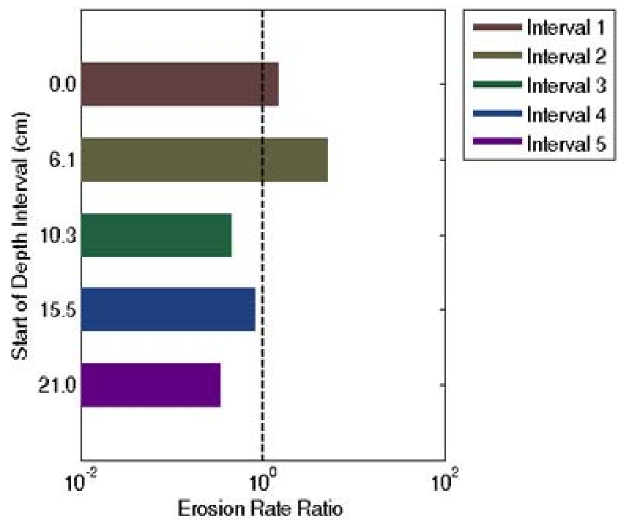


Figure 35. Picture of core KRSD01 aligned with Intra-core erosion rate ratios.

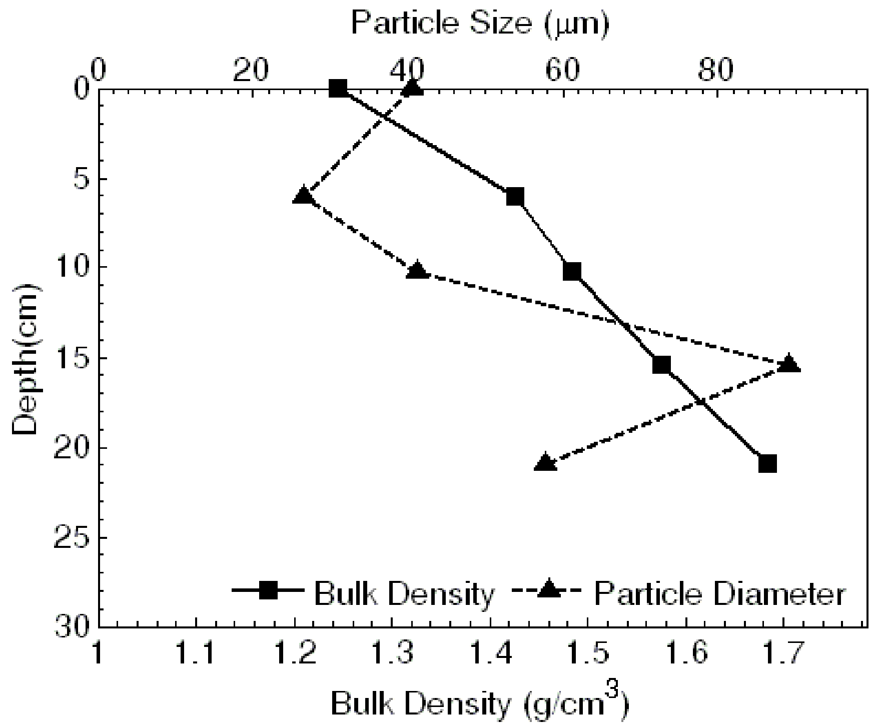


Figure 36. Bulk density and D_{50} with depth for core KRSD01.

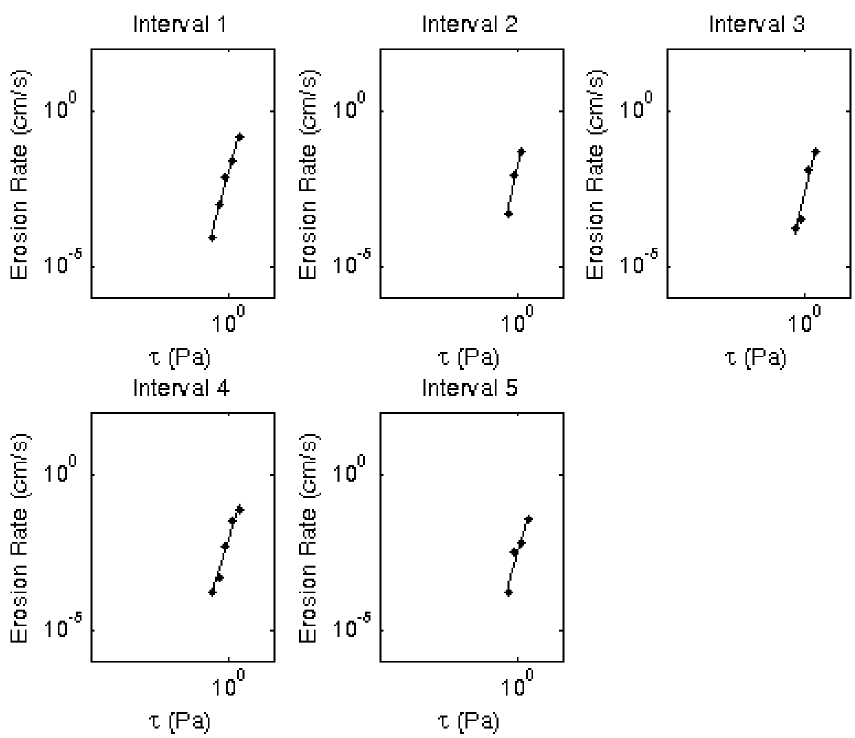


Figure 37. Best fit power law curves for depth intervals in core KRSD01.

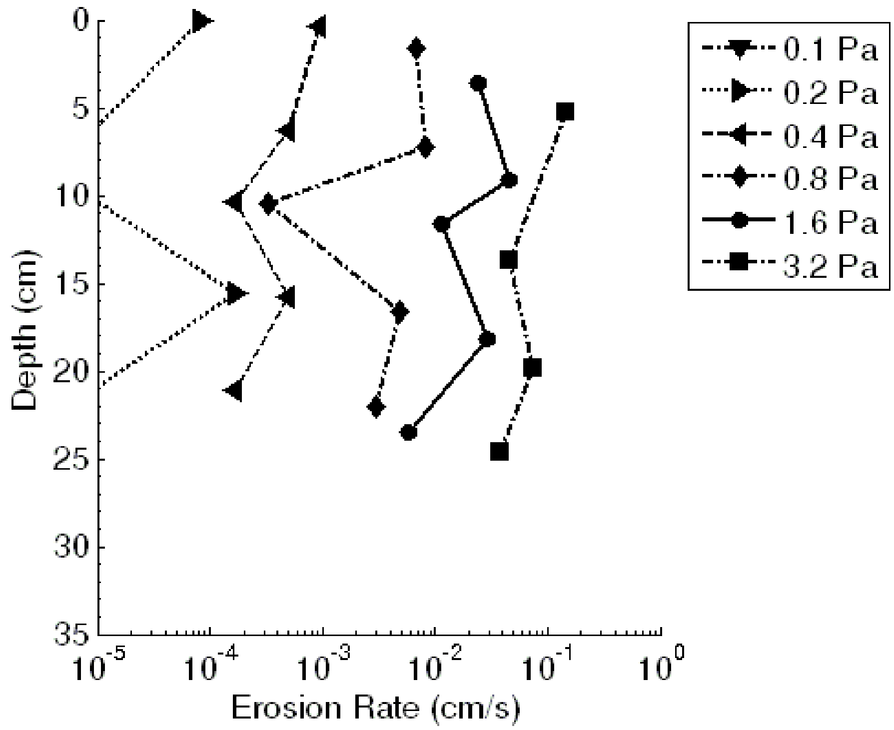


Figure 38. Sedflume erosion rate data for coreKRSD01.

Table 19. Power law best-fit variables for specified depth intervals in core KRSD01.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	6.1	8.09E-03	2.63	0.99
2	6.1	10.1	1.17E-02	3.25	0.98
3	10.3	14.6	1.62E-03	2.94	0.94
4	15.5	20.7	6.57E-03	2.35	0.98
5	21.0	25.2	2.41E-03	2.45	0.94

Table 20. Bulk density, $D_{50,}$ critical shear stress with depth for KRSD01.

Depth (cm)	D_{50} (μm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.00	40.43	1.25	0.19	0.20
6.10	26.53	1.43	0.23	0.24
10.30	41.23	1.49	0.39	0.32
15.50	89.21	1.58	0.17	0.16
21.00	57.83	1.68	0.27	0.32
Mean	**51.05**	**1.48**	**0.25**	**0.25**

Core KRSD04

Core KRSD04 was collected in 1.8 m of water depth. The core consisted of an approximate 2 mm light grey oxic layer overlying light grey sediment down core. Dark grey pockets of material were present from 0 to 6 cm. Gas bubbles are present intermittently down core. The mean grain size of the core was 35.83 µm (silt).

Figure 39 through Figure 42 show the data results and analysis and Table 21 and Table 22 summarize the data.

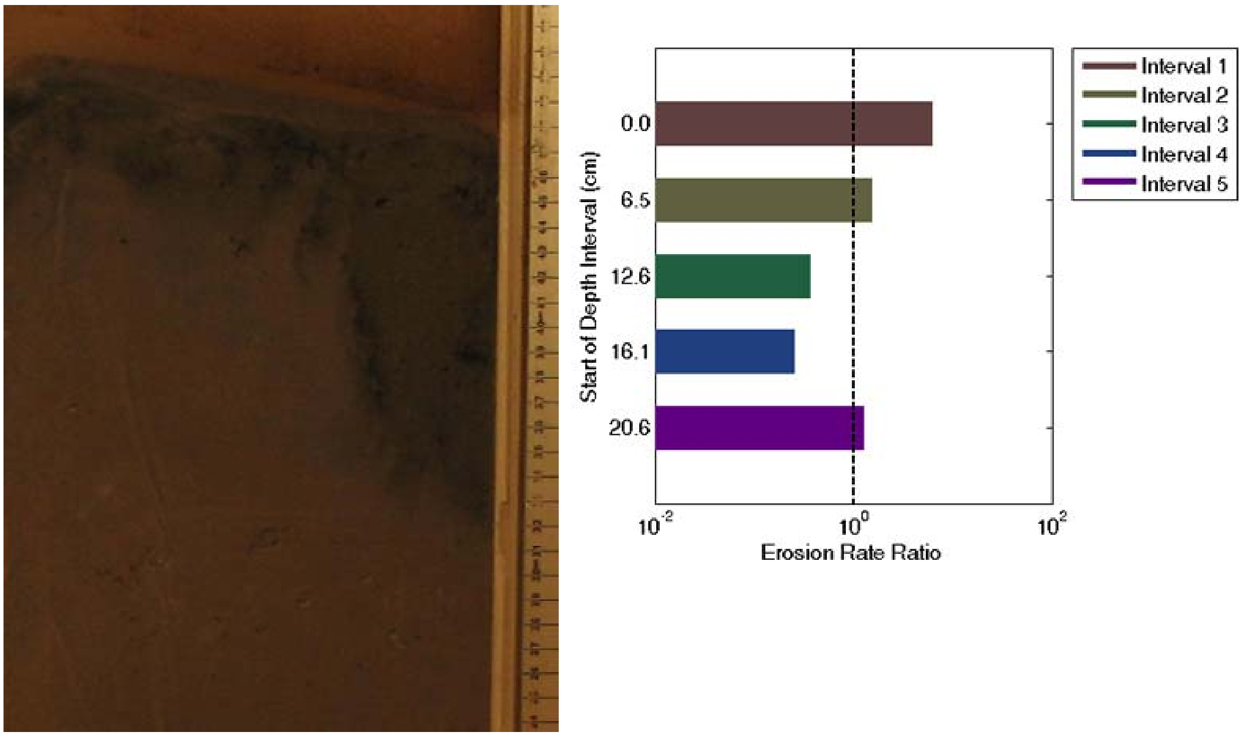


Figure 39. Picture of core KRSD04 aligned with Intra-core erosion rate ratios.

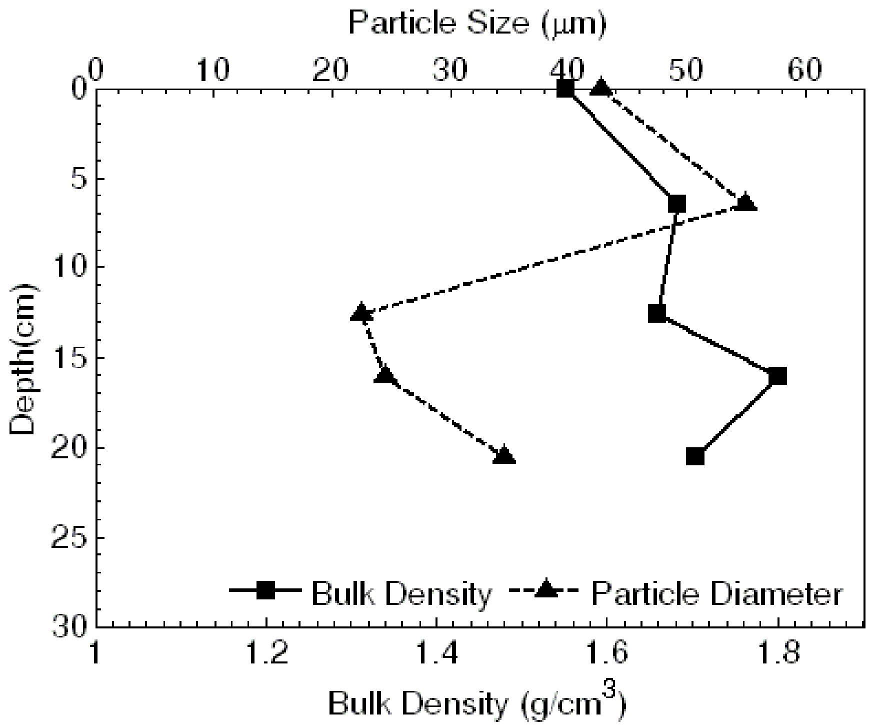


Figure 40. Bulk density and D_{50} with depth for core KRSD04.

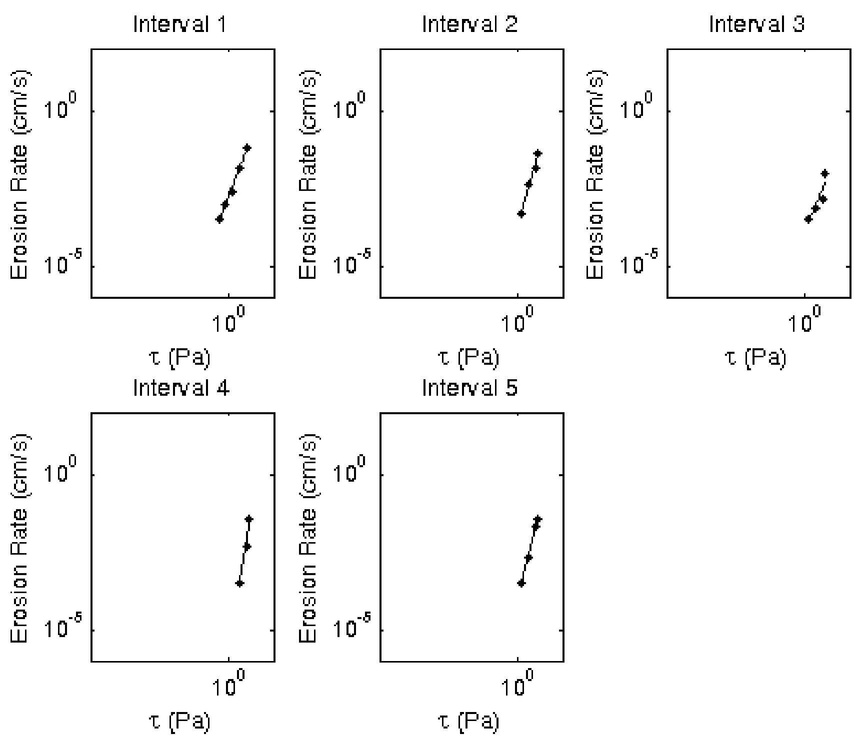


Figure 41. Best fit power law curves for depth intervals in core KRSD04.

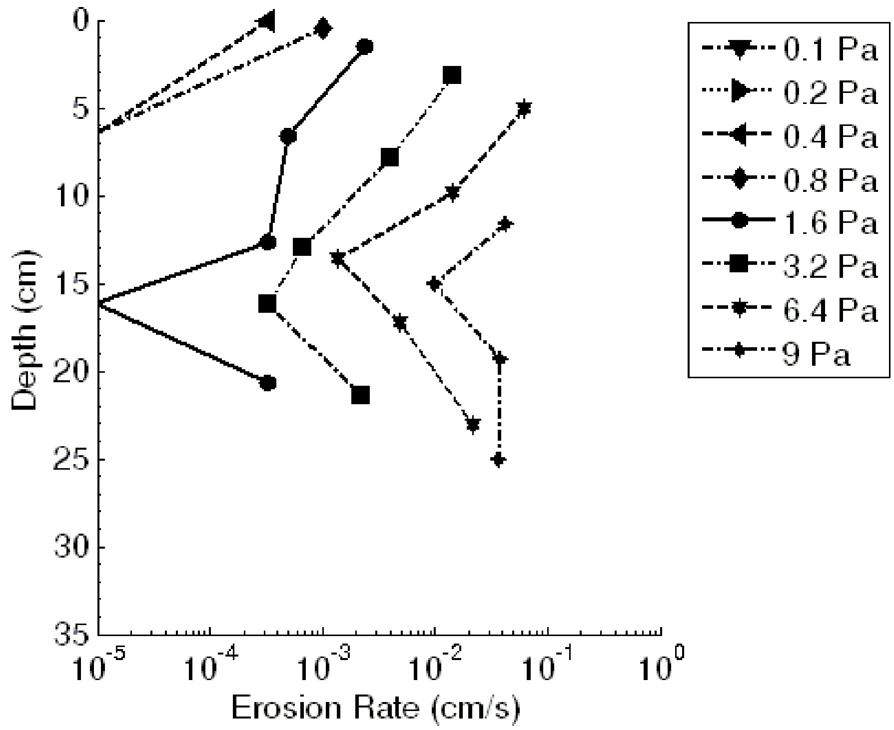


Figure 42. Sedflume erosion rate data for coreKRSD04.

Table 21. Power law best-fit variables for specified depth intervals in core KRSD04.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	6.1	1.52E-03	1.90	0.98
2	6.5	12.6	1.76E-04	2.47	0.99
3	12.6	16.1	1.11E-04	1.73	0.82
4	16.1	20.4	1.65E-06	4.47	0.98
5	20.6	25.9	9.05E-05	2.81	0.99

Table 22. Bulk density, $D_{50,}$ critical shear stress with depth for KRSD04.

Depth (cm)	D_{50} (μm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.00	42.74	1.55	0.24	0.26
6.50	54.94	1.68	0.80	0.96
12.60	22.49	1.66	0.94	1.04
16.10	24.44	1.80	2.50	2.08
20.60	34.51	1.70	1.04	1.04
Mean	**35.83**	**1.68**	**1.10**	**1.08**

Core KRSD05

Core KRSD05 was collected in 3.0 m of water depth. The core consisted of 2-3 mm light grey oxic layer, overlying light grey sediment with pockets of notably coarser grained material down core. At 37 cm a dark grey layer of material was observed. Plant material (roots, leaves, and small sticks) were present from 3 mm below surface to the deepest depth interval. Gas bubbles were observed intermittently from the surface to the end of the core. The mean grain size of the core was 41.96 µm (silt).

Figure 43 through Figure 46 show the data results and analysis and Table 23 and

Table 24 summarize the data.

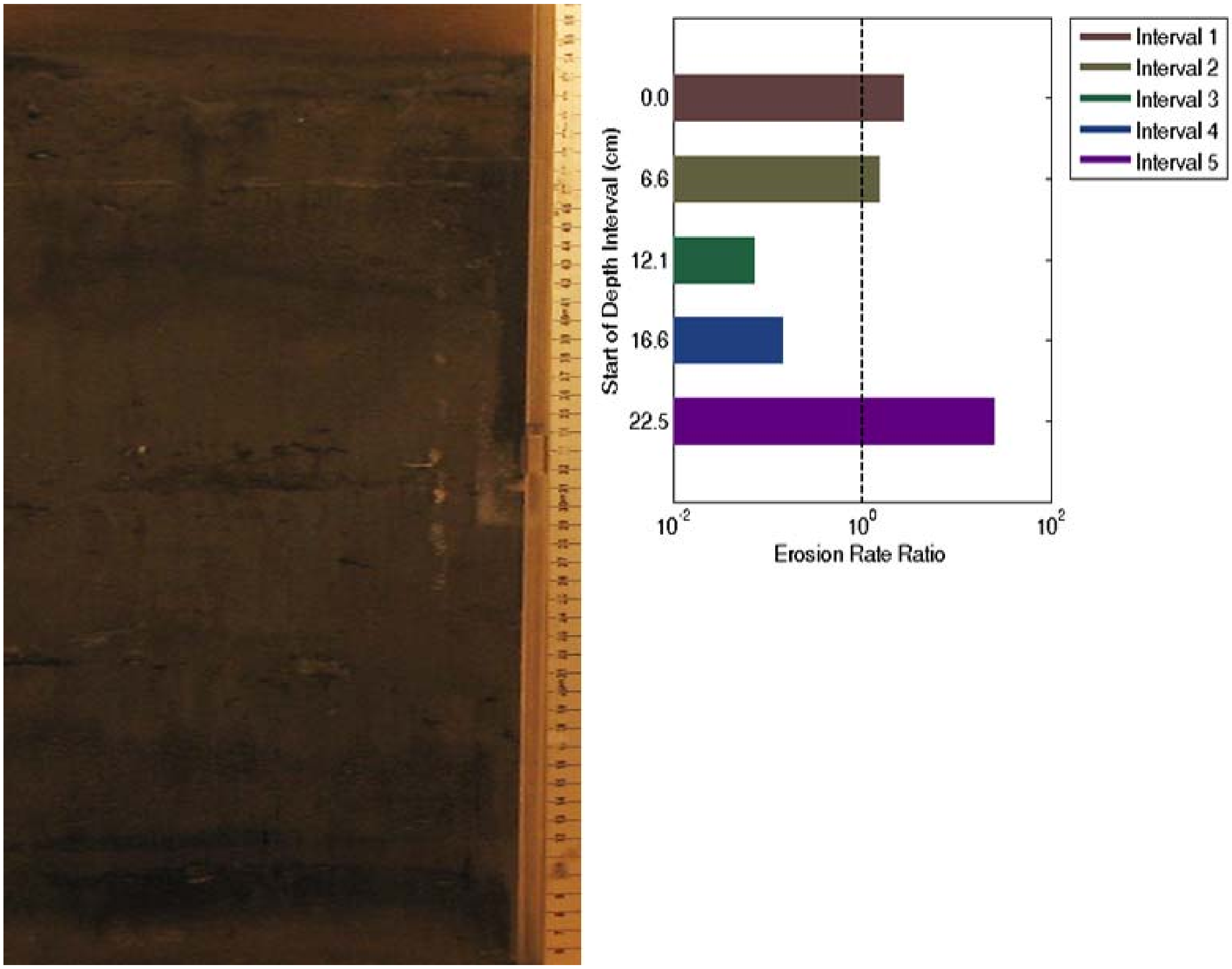


Figure 43. Picture of core KRSD05 aligned with Intra-core erosion rate ratios.

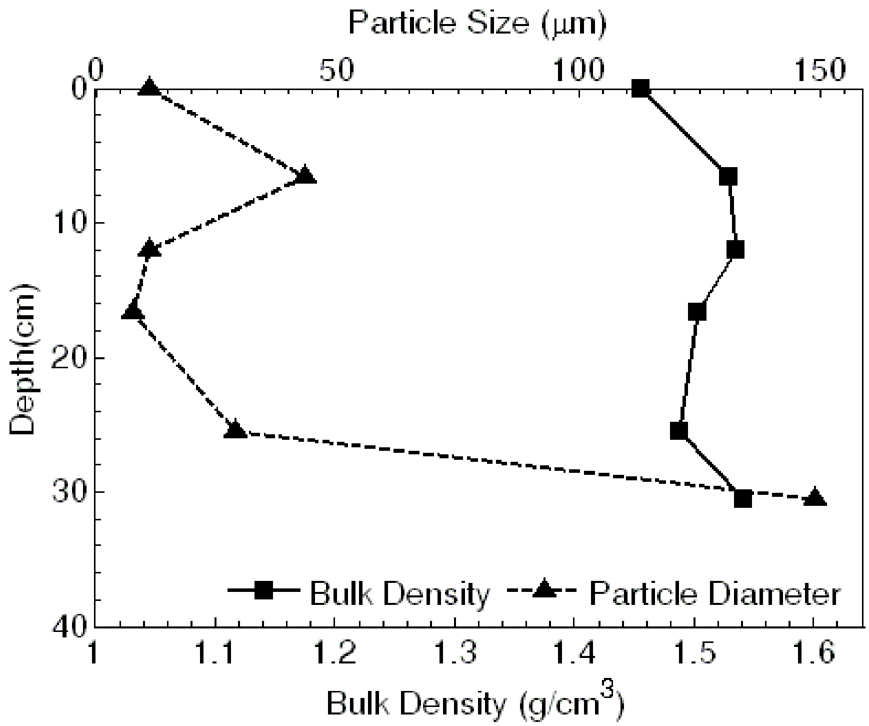


Figure 44. Bulk density and D_{50} with depth for core KRSD05.

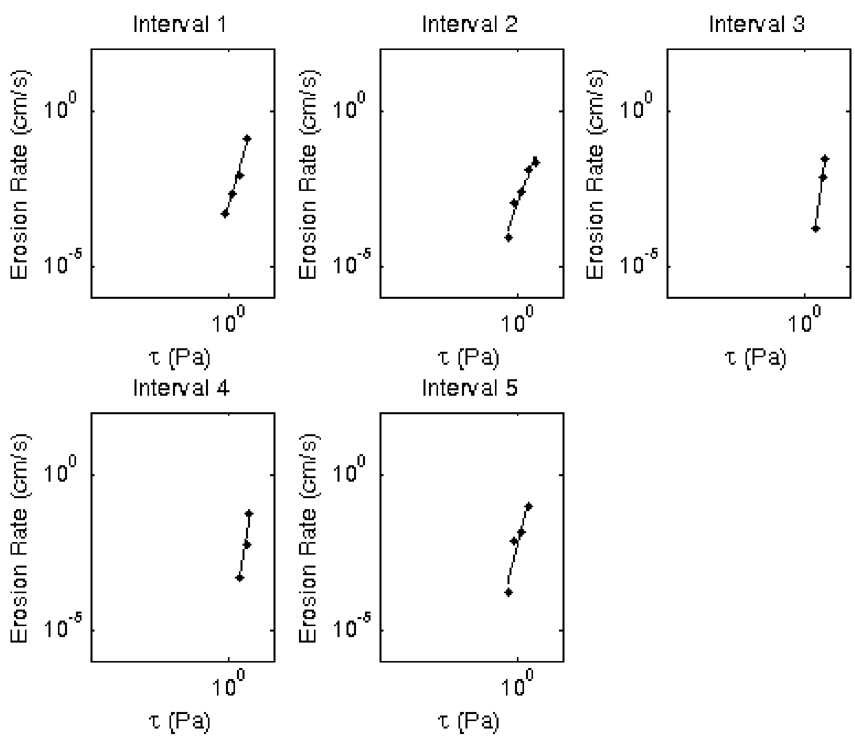


Figure 45. Best fit power law curves for depth intervals in core KRSD05.

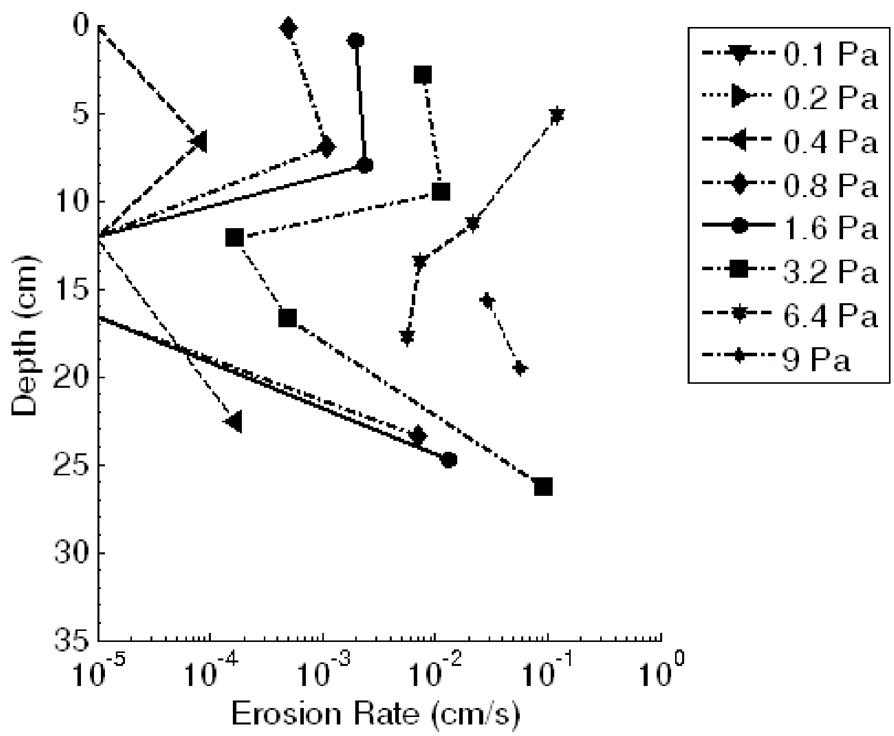


Figure 46. Sedflume erosion rate data for coreKRSD05.

Table 23. Power law best-fit variables for specified depth intervals in core KRSD05.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	6.1	6.80E-04	2.56	0.97
2	6.6	12.1	8.86E-04	1.95	0.95
3	12.1	16.5	4.92E-07	5.06	1.00
4	16.6	20.5	2.46E-06	4.43	0.97
5	22.5	27.1	4.37E-03	2.84	0.92

Table 24. Bulk density, $D_{50,}$ critical shear stress with depth for KRSD05.

Depth (cm)	D_{50} (μm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.0	11.07	1.46	0.47	0.48
6.6	43.33	1.53	0.33	-
12.1	11.20	1.54	2.86	2.56
16.6	7.90	1.50	2.31	1.92
22.5	29.16	1.49	0.26	0.32
30.50	149.07	1.54	-	-
Mean	**41.96**	**1.51**	**1.25**	**1.32**

Core KRSD10

Core KRSD10 was collected in 1.5 m of water depth. The core consisted of an approximate 1 mm thick yellowish orange oxic layer, overlying a 1 cm layer of light grey sediment. Below the light grey sediment, olive grey sediment with pockets of light and dark grey sediment persisted to the end of the core. Plant material (roots, leaves and small sticks) was present at the surface throughout the core to the deepest depth interval. At 6 to 9 cm large sticks, approximately 1 cm diameter, were removed from core. The mean grain size of the core was 85.07 μm (sand).

Figure 47 through Figure 50 show the data results and analysis and Table 25 and Table 26 summarize the data.

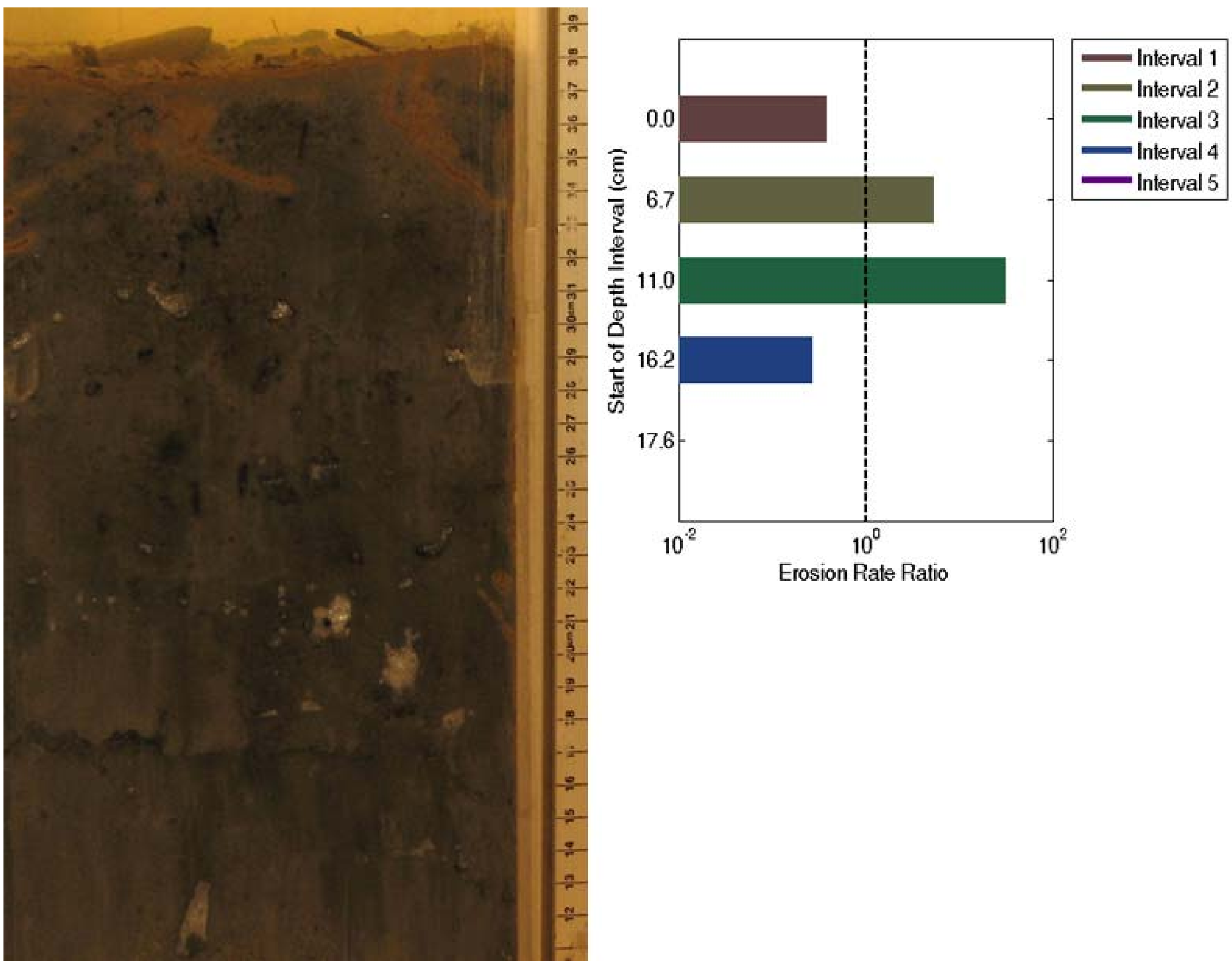


Figure 47. Picture of core KRSD10 aligned with Intra-core erosion rate ratios.

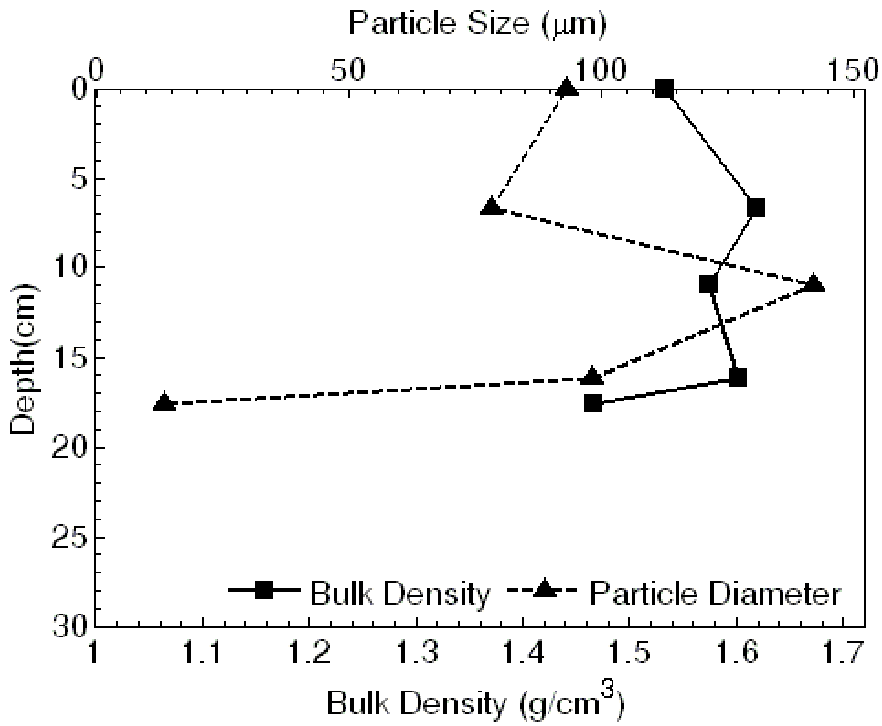


Figure 48. Bulk density and D_{50} with depth for core KRSD10.

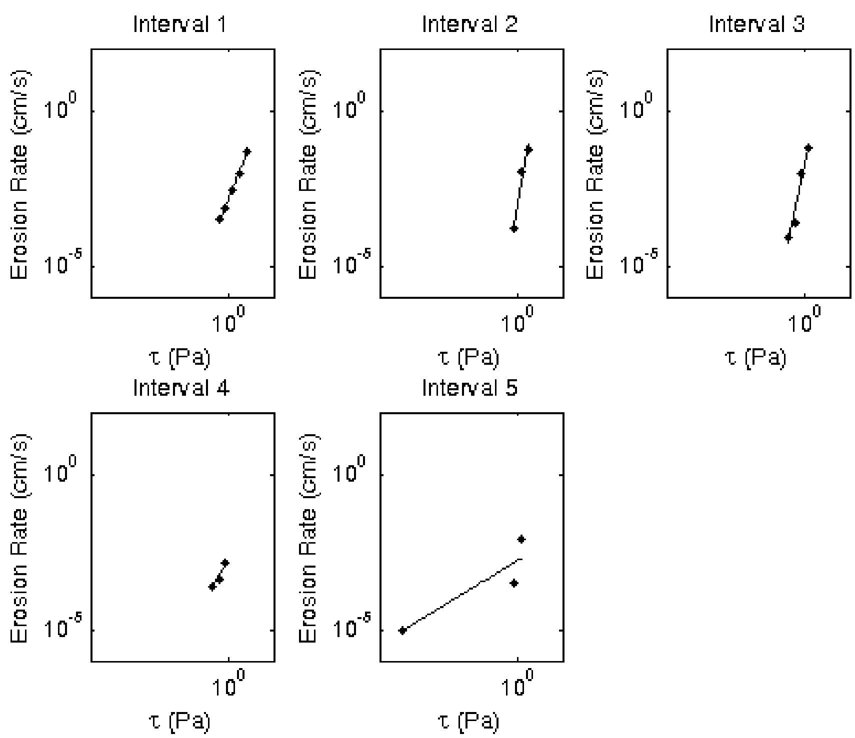


Figure 49. Best fit power law curves for depth intervals in core KRSD10.

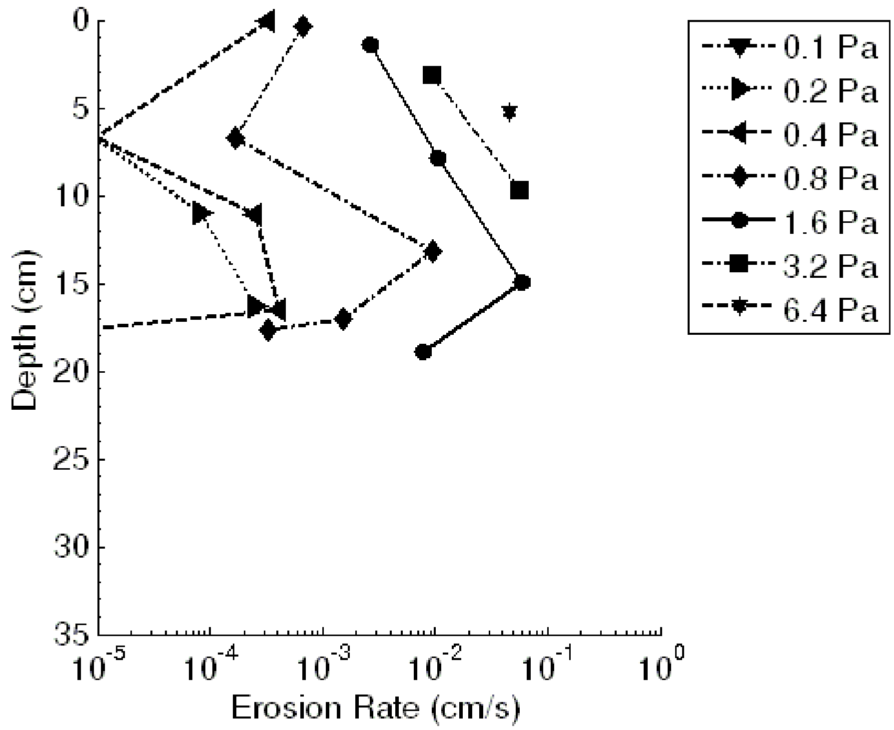


Figure 50. Sedflume erosion rate data for coreKRSD10.

Table 25. Power law best-fit variables for specified depth intervals in core KRSD10.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	6.4	1.30E-03	1.80	0.99
2	6.7	10.5	6.41E-04	4.22	0.95
3	11.0	15.5	1.27E-02	3.37	0.96
4	16.2	17.5	1.76E-03	1.29	0.94
5	17.6	20.0	1.59E-03	0.45	0.82

Table 26. Bulk density, $D_{50,}$ critical shear stress with depth for KRSD10.

Depth (cm)	D_{50} (µm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.00	93.04	1.53	0.24	0.26
6.70	78.29	1.62	0.64	0.64
11.00	141.96	1.57	0.24	0.22
16.20	98.36	1.60	0.11	0.14
17.60	13.72	1.47	-	0.52
Mean	**85.07**	**1.56**	**0.31**	**0.36**

Core KRSD14

Core KRSD14 was collected in 1.8 m of water depth. The core consisted of a 2 mm light brown oxic layer, overlying a light brown coarser grained layer to 3 cm. At 3 cm a layer of coarser grained, olive grey sand persisted to approximately 14 cm where a 1 cm thick dark grey layer was observed. Below the dark grey layer to the end of the core, light grey silt was present. Plant was observed material from the surface to the deepest depth interval. Gas bubbles were present intermittently from the surface to 14 cm. The mean grain size of the core was 47.93 µm (silt).

Figure 51 through Figure 54 show the data results and analysis and Table 27 and Table 28 summarize the data.

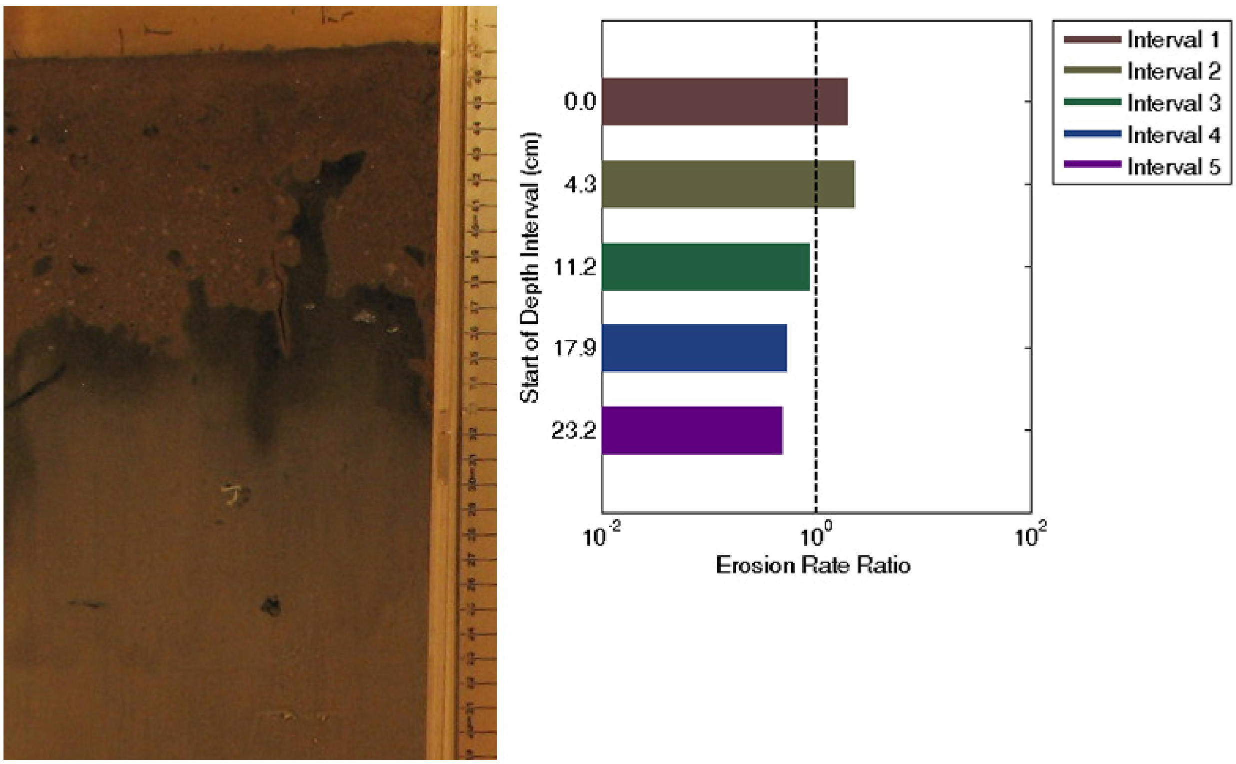


Figure 51. Picture of core KRSD14 aligned with Intra-core erosion rate ratios.

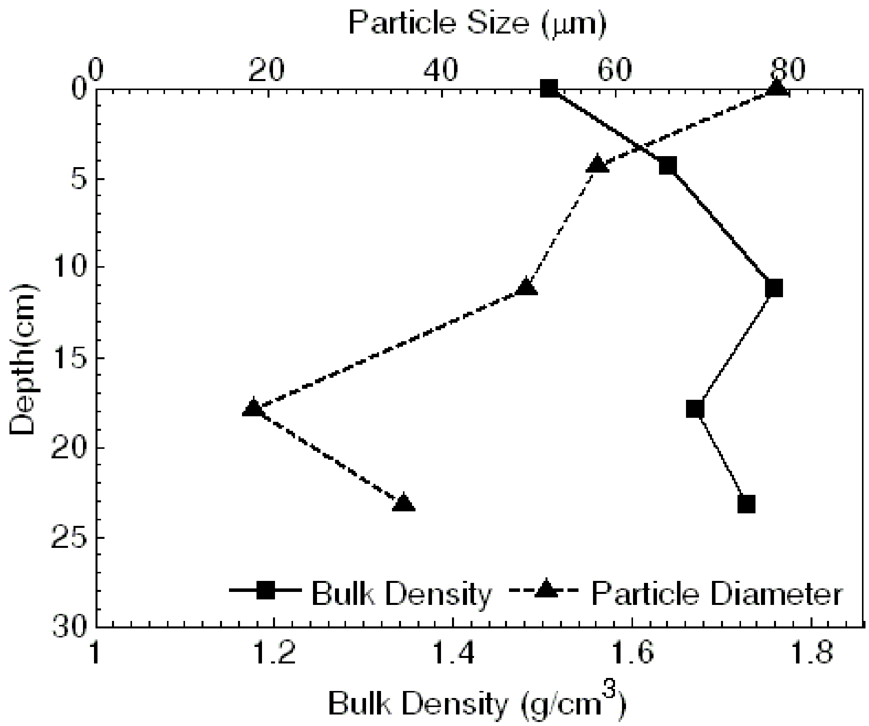


Figure 52. Bulk density and D_{50} with depth for core KRSD14.

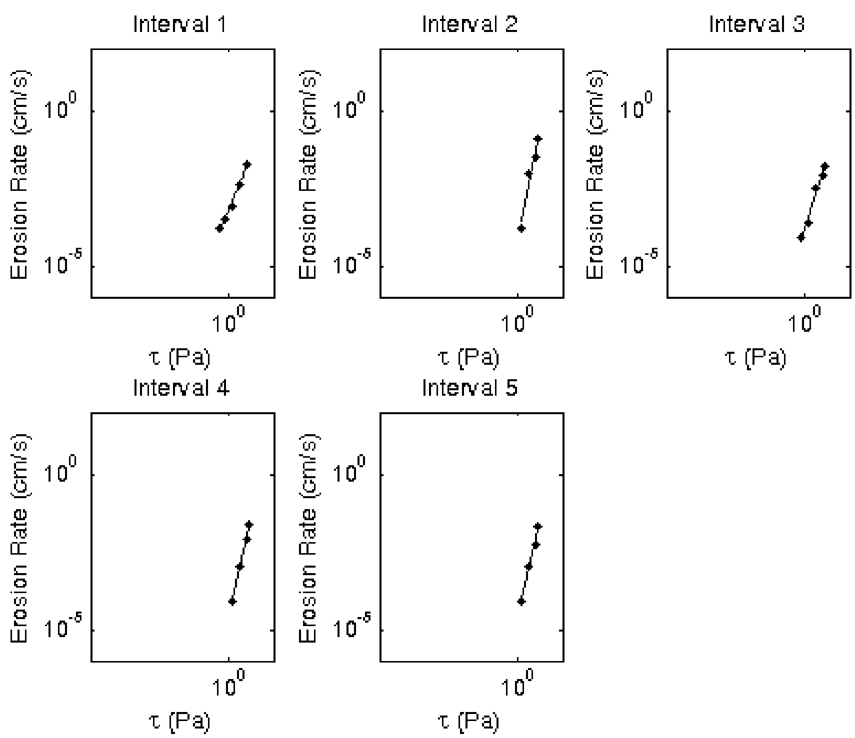


Figure 53. Best fit power law curves for depth intervals in core KRSD14.

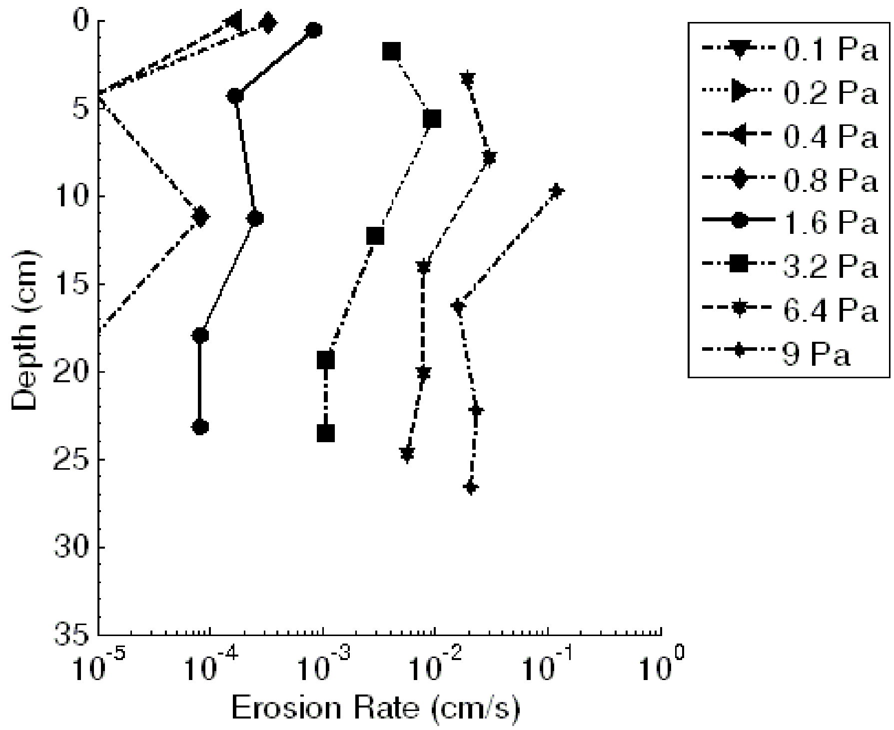


Figure 54. Sedflume erosion rate data for coreKRSD14.

Table 27. Power law best-fit variables for specified depth intervals in core KRSD14.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	3.9	5.75E-04	1.74	0.97
2	4.3	10.7	5.32E-05	3.58	0.94
3	11.2	17.5	1.29E-04	2.25	0.98
4	17.9	23.2	2.07E-05	3.22	1.00
5	23.2	27.6	2.23E-05	3.09	0.99

Table 28. Bulk density, $D_{50,}$ critical shear stress with depth for KRSD14.

Depth (cm)	D_{50} (µm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.00	78.45	1.51	0.37	0.32
4.30	57.87	1.64	1.19	1.28
11.20	49.68	1.76	0.89	0.88
17.90	18.18	1.67	1.63	1.63
23.20	35.46	1.73	1.62	1.63
Mean	**47.93**	**1.66**	**1.14**	**1.15**

Core KRSD20

Core KRSD20 was collected in 4.6 m of water depth. The core consisted of 0 to approximately 3 cm light brown surface layer overlying a layer of dark grey material from a depth of 3 to 8 cm. An olive grey layer was present from 8 cm to approximately 21 cm, where a visibly coarser grained olive grey layer persisted to the end of the core. Plant material (root, leaf, and small sticks) was observed at the surface and persisted to the deepest depth interval. The mean grain size of the core was 69.13 µm (sand).

Figure 55 through Figure 58 show the data results and analysis and Table 29 and Table 30 summarize the data.

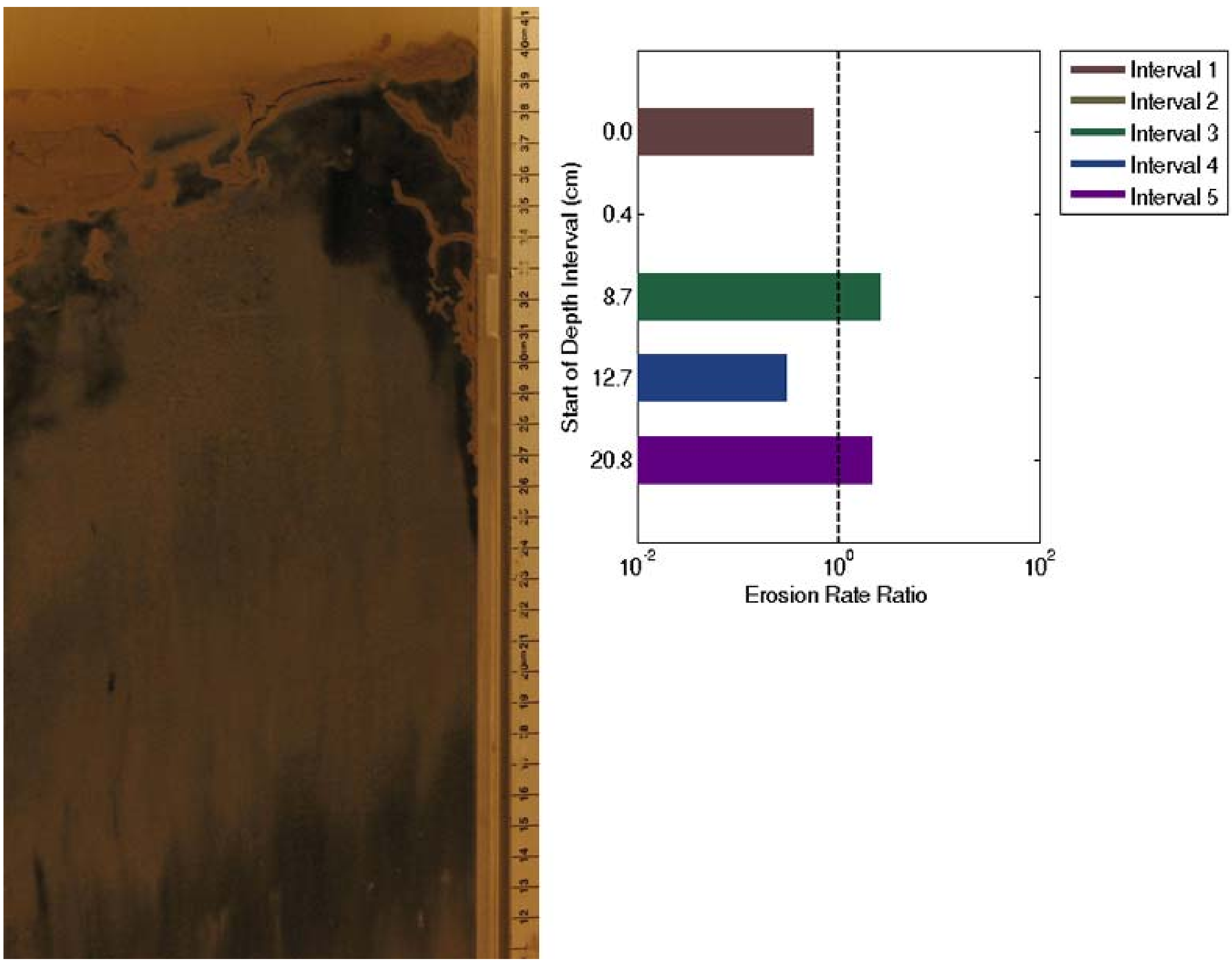


Figure 55. Picture of core KRSD20 aligned with Intra-core erosion rate ratios.

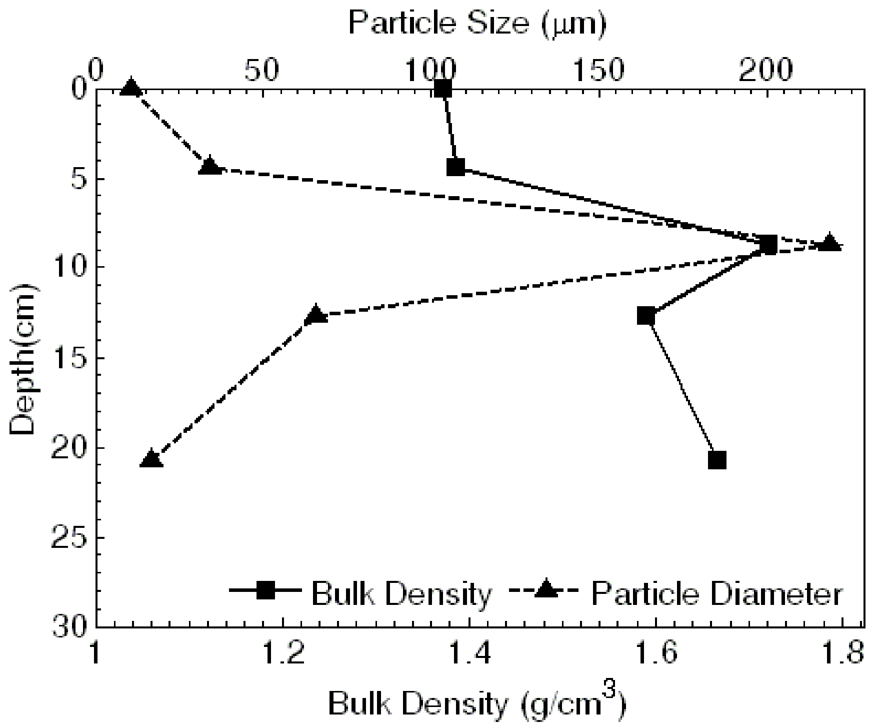


Figure 56. Bulk density and D_{50} with depth for core KRSD20.

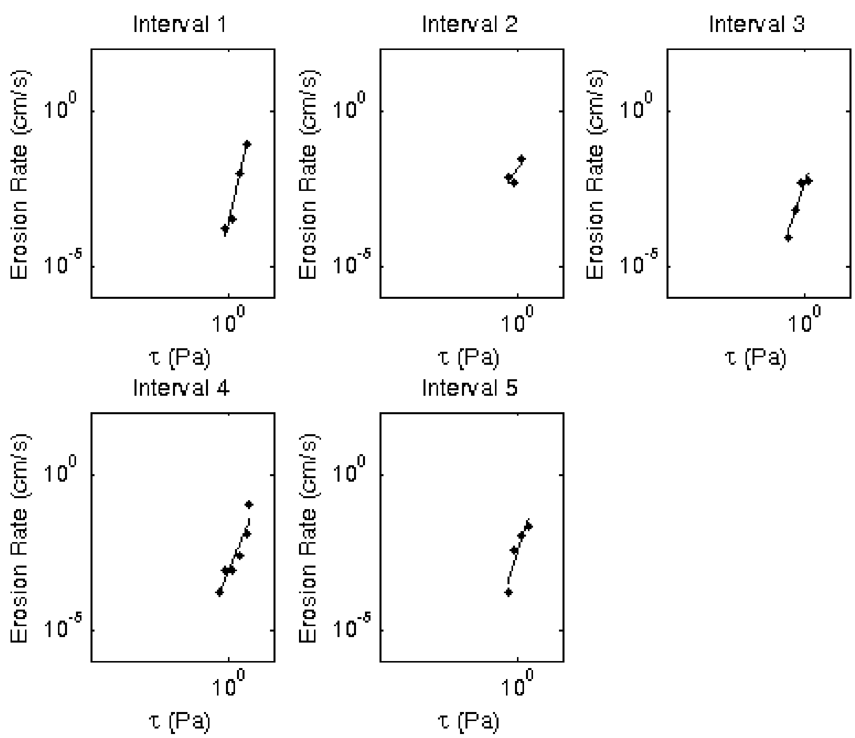


Figure 57. Best fit power law curves for depth intervals in core KRSD20.

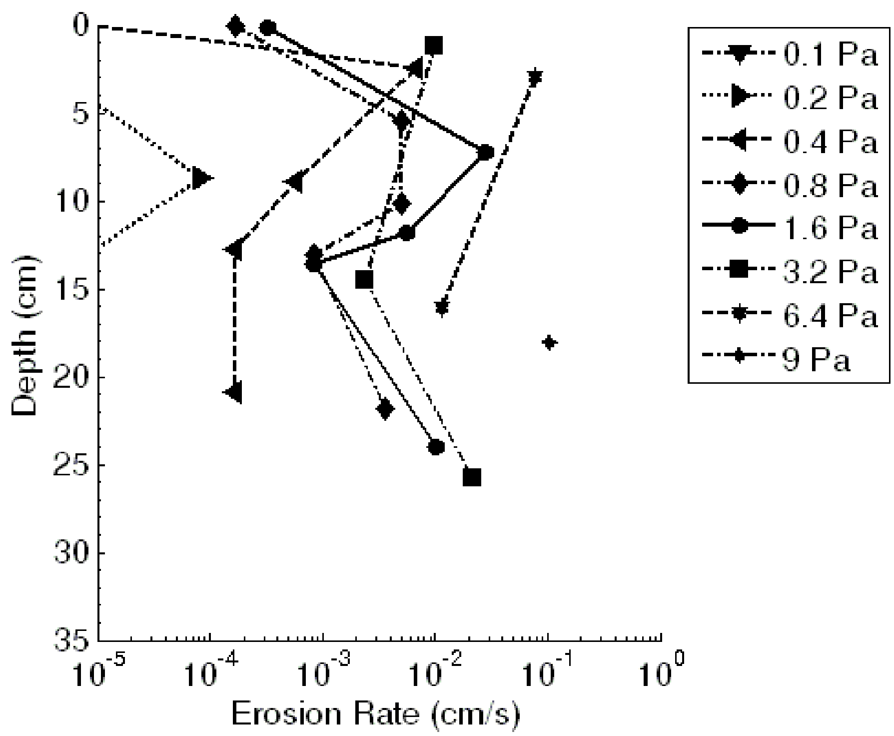


Figure 58. Sedflume erosion rate data for coreKRSD20.

Table 29. Power law best-fit variables for specified depth intervals in core KRSD20.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	3.9	1.95E-04	3.15	0.95
2	0.4	8.1	1.24E-02	1.01	0.60
3	8.7	12.4	3.65E-03	2.14	0.91
4	12.7	19.2	6.83E-04	1.78	0.88
5	20.8	26.4	2.56E-03	2.26	0.89

Table 30. Bulk density, $D_{50,}$ critical shear stress with depth for KRSD20.

Depth (cm)	D_{50} (μm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.00	10.40	1.37	0.81	0.64
4.40	34.11	1.39	-	0.20
8.70	218.58	1.72	0.19	0.21
12.70	65.74	1.59	0.34	0.32
20.80	16.83	1.67	0.24	0.32
Mean	**69.13**	**1.55**	**0.39**	**0.34**

Core KRSD24

Core KRSD24 was collected in 0.6 m of water depth. The core consisted of a 2-3 mm olive grey oxic layer, overlying olive grey silt with pockets of light and dark grey silt down core. Plant material (leaves, roots, and small sticks) was observed at the surface and persisted down core. Gas bubbles were present intermittently to the deepest depth interval. The mean grain size of the core was 69.73 µm (sand).

Figure 59 through Figure 62 show the data results and analysis and Table 31 and Table 32 summarize the data.

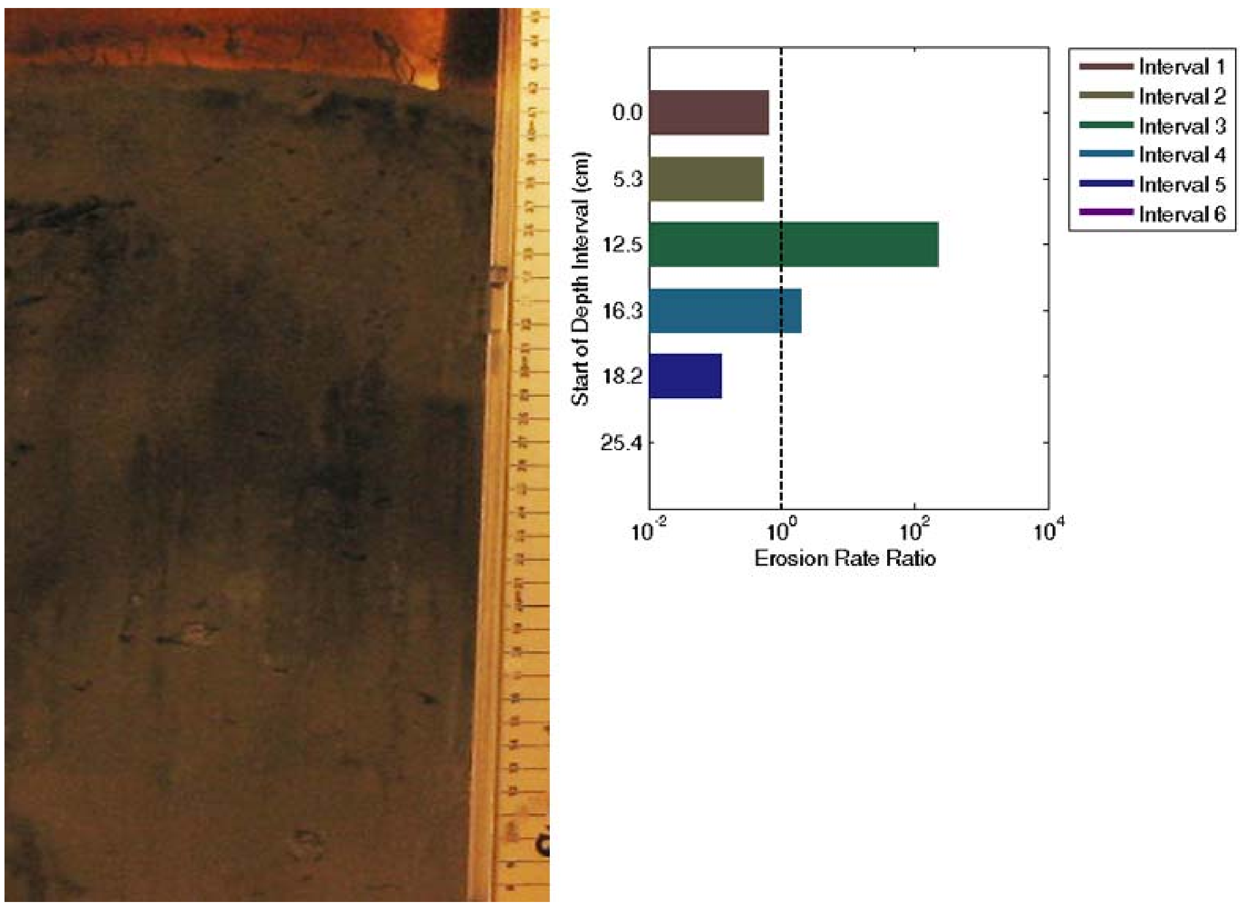


Figure 59. Picture of core KRSD24 aligned with Intra-core erosion rate ratios.

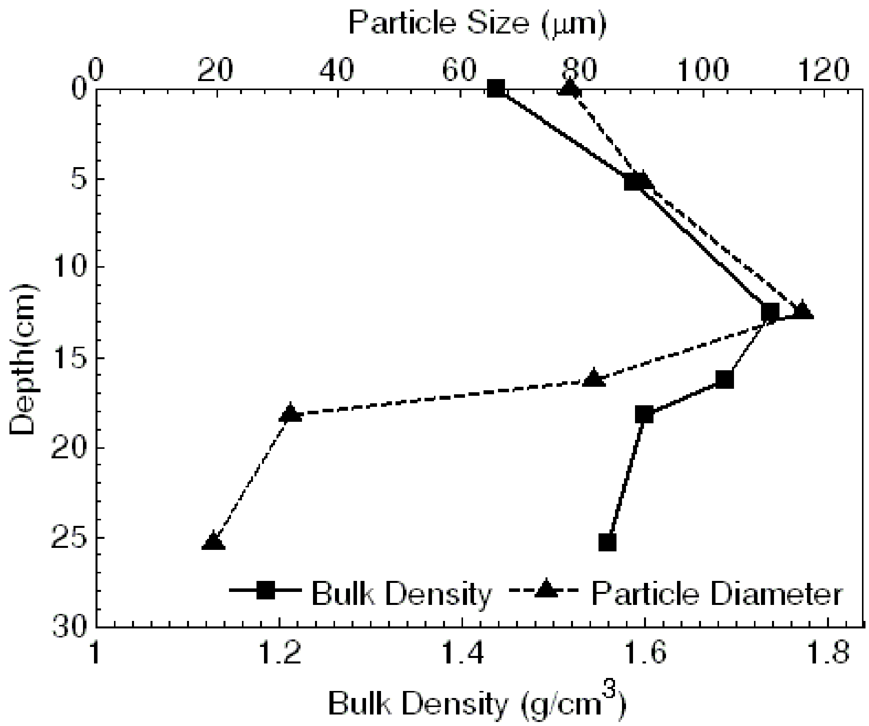


Figure 60. Bulk density and D_{50} with depth for core KRSD24.

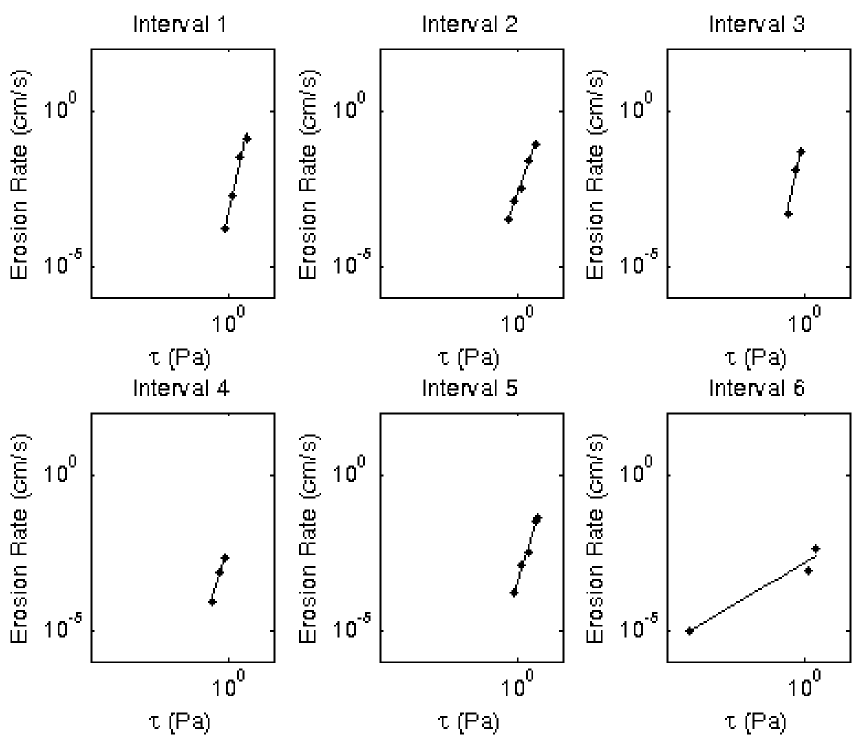


Figure 61. Best fit power law curves for depth intervals in core KRSD24.

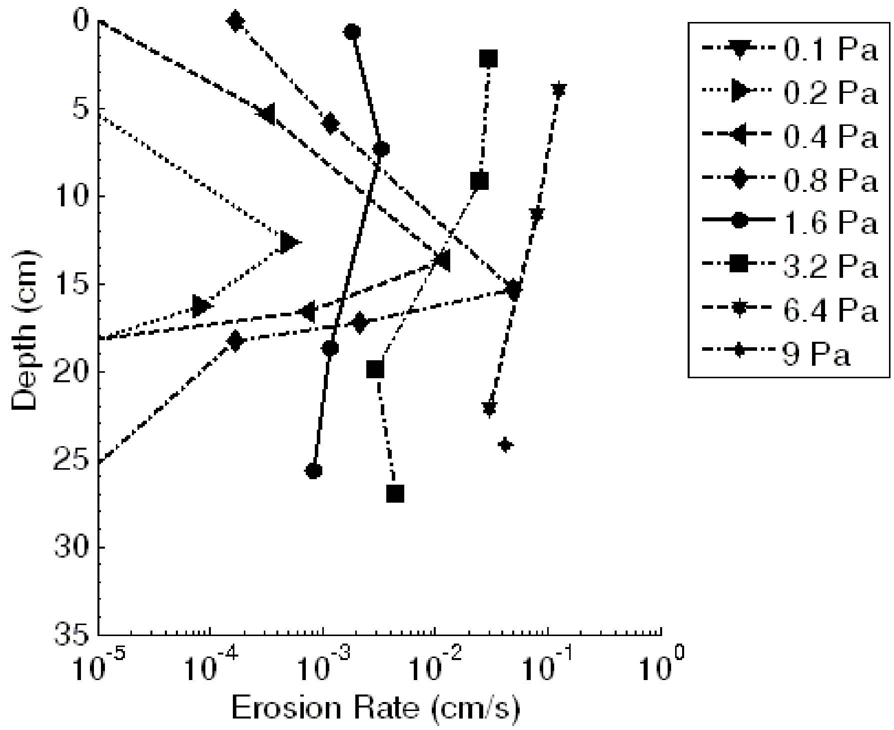


Figure 62. Sedflume erosion rate data for coreKRSD24.

Table 31. Power law best-fit variables for specified depth intervals in core KRSD24.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	4.7	4.03E-04	3.28	0.99
2	5.3	11.9	1.86E-03	2.02	0.99
3	12.5	16.2	1.36E-01	3.30	0.95
4	16.3	17.7	4.39E-03	2.34	0.96
5	18.2	25.1	3.00E-04	2.31	0.98
6	25.4	28.2	1.38E-03	0.43	0.95

Table 32. Bulk density, $D_{50,}$ critical shear stress with depth for KRSD24.

Depth (cm)	D_{50} (μm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.00	78.19	1.44	0.65	0.64
5.30	90.20	1.59	0.24	0.26
12.50	116.49	1.74	0.11	0.12
16.30	81.99	1.69	0.20	0.21
18.20	32.08	1.60	0.62	0.64
25.40	19.45	1.56	-	0.90
Mean	**69.73**	**1.60**	**0.36**	**0.46**

Core KRSD25

Core KRSD25was collected in 2.7 m of water depth. The core consisted of a 2 mm olive grey oxic layer over 16 cm of olive grey coarse grained sediment. Olive grey sediment was present from 16 cm to the end of the core. Plant material was found at the surface and persisted to the deepest depth interval. Gas bubbles were also observed intermittently down core. The mean grain size of the core was 62.57 µm (sand).

Figure 63 through Figure 66 show the data results and analysis and Table 33 and Table 34 summarize the data.

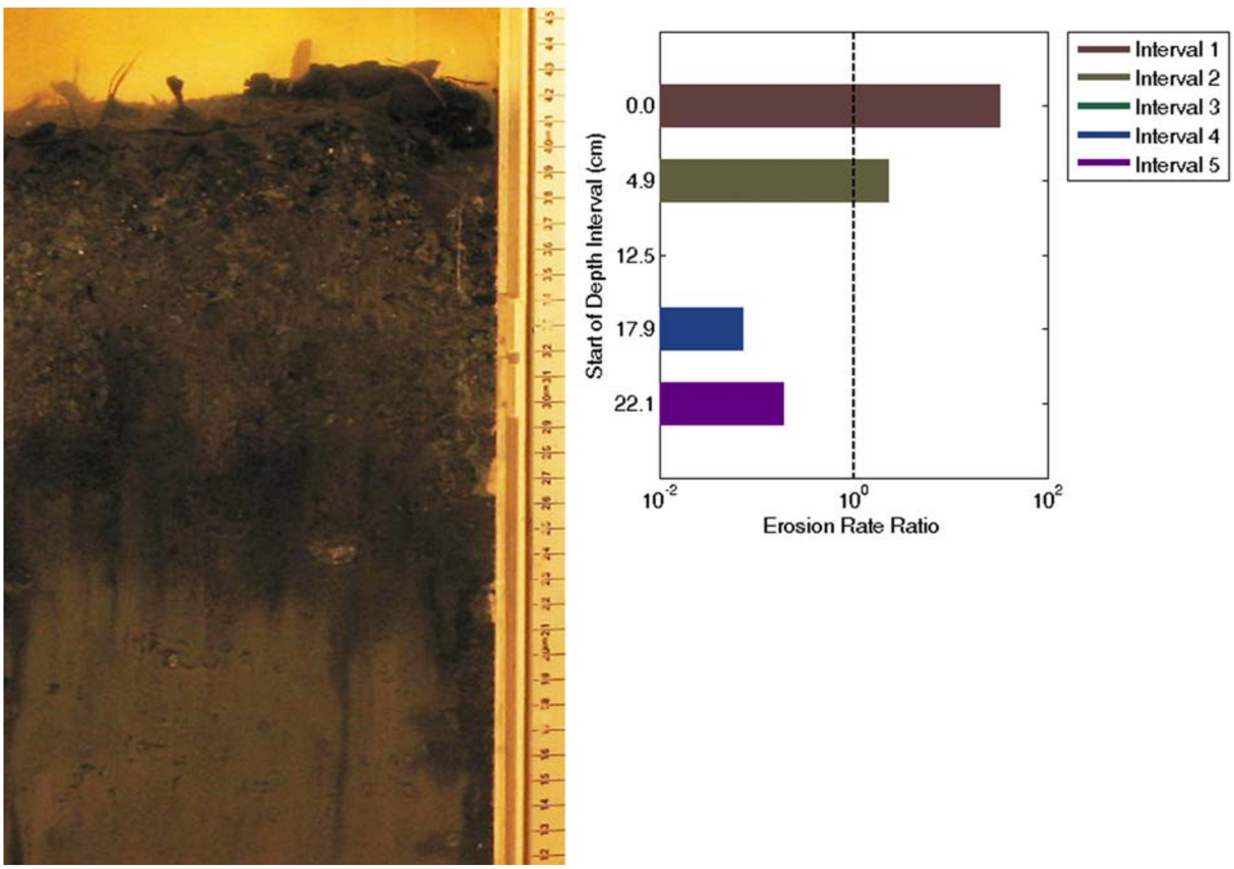


Figure 63. Picture of core KRSD25 aligned with Intra-core erosion rate ratios.

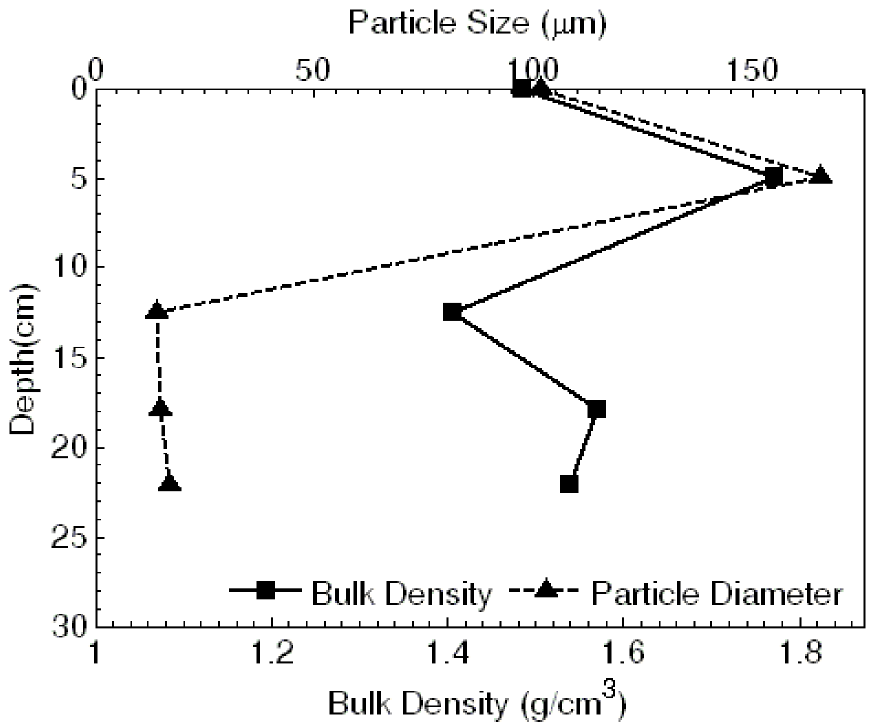


Figure 64. Bulk density and D_{50} with depth for core KRSD25.

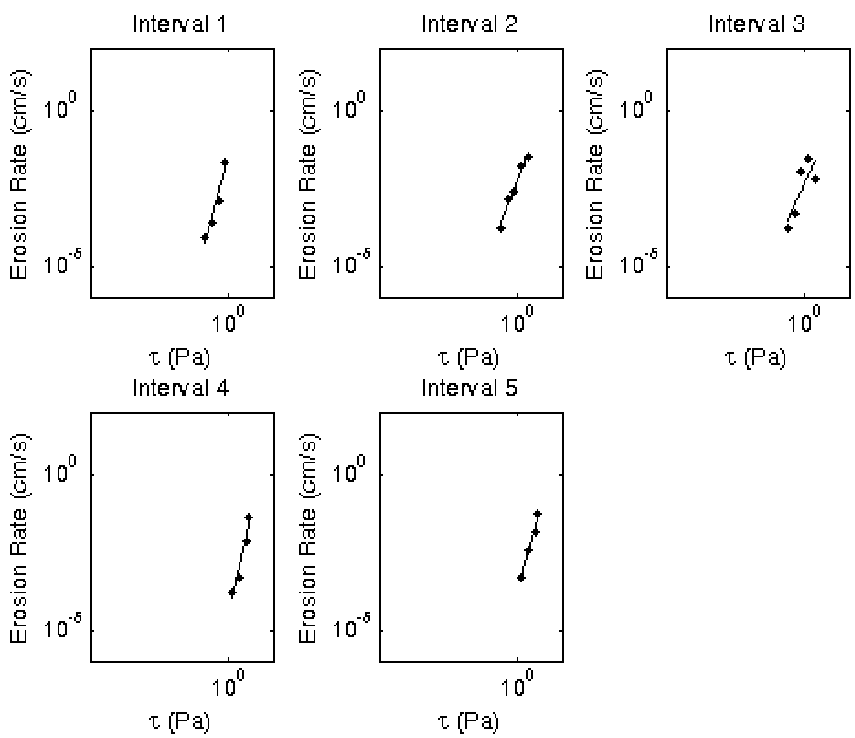


Figure 65. Best fit power law curves for depth intervals in core KRSD25.

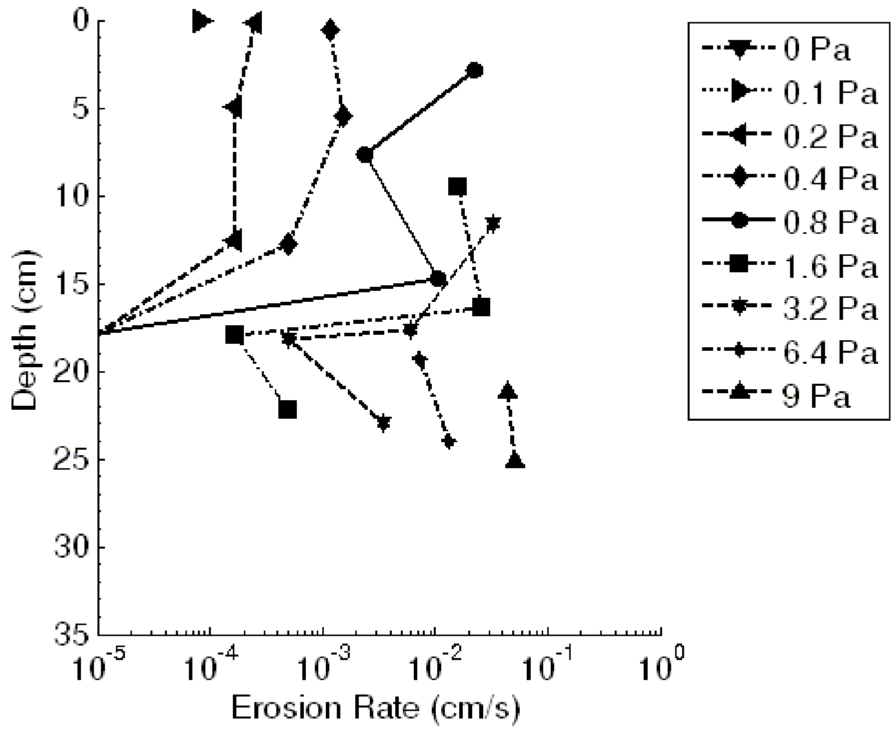


Figure 66. Sedflume erosion rate data for coreKRSD25.

Table 33. Power law best-fit variables for specified depth intervals in core KRSD25.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	3.7	2.39E-02	2.64	0.95
2	4.9	12.5	4.74E-03	1.86	0.96
3	12.5	17.9	3.84E-03	1.60	0.67
4	17.9	22.1	2.33E-05	3.22	0.95
5	22.1	25.8	1.53E-04	2.57	0.99

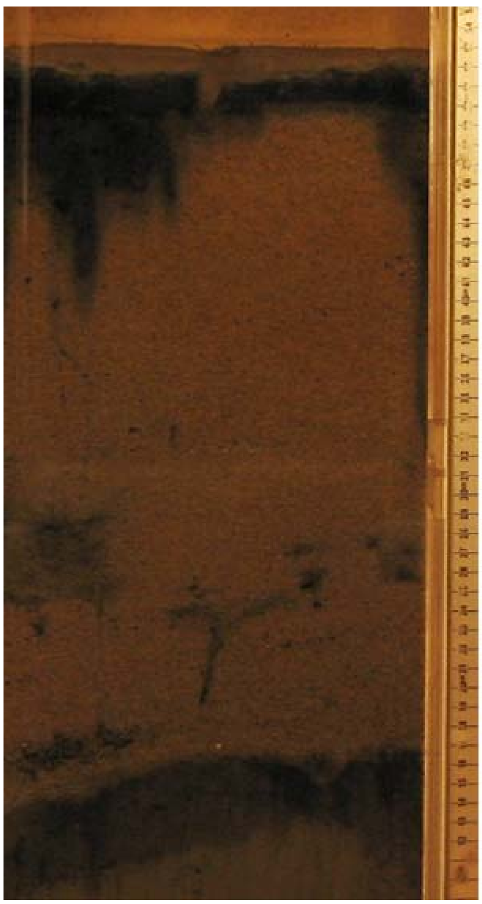
Table 34. Bulk density, $D_{50,}$ critical shear stress with depth for KRSD25.

Depth (cm)	D_{50} (μm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.00	101.76	1.49	0.13	0.11
4.90	165.38	1.77	0.13	0.16
12.50	14.00	1.41	-	0.16
17.90	14.77	1.57	1.57	1.28
22.10	16.96	1.54	0.85	0.96
Mean	**62.57**	**1.55**	**0.67**	**0.53**

Core KRSD28

Core KRSD28 was collected in 1.5 m of water depth. The core consisted of multiple sediment layers. At the surface a 2 mm thick olive grey oxic layer was overlying a 1 cm olive grey sediment layer. Below the olive grey sediment layer, from a core depth of 1 cm to 3-6 cm, a dark grey layer was present. From 3-6 cm to 33 cm a layer of yellowish orange fine to medium sand was observed. The final layer, from 33 cm to the end of the core, was a greenish grey silt/clay layer. Detritus was observed at the surface and at a core depth of 20 cm. The mean grain size of the core was 288.29 µm (sand).

Figure 67 through Figure 70 show the data results and analysis and Table 35 and Table 36 summarize the data.



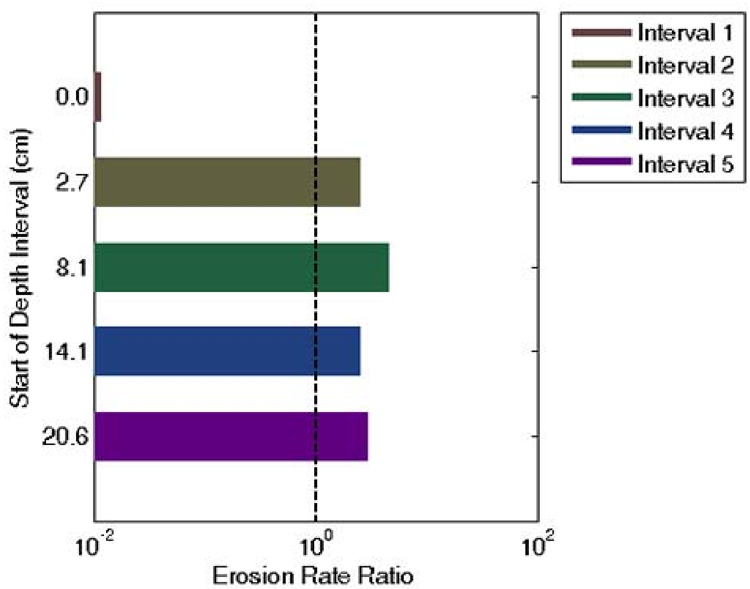


Figure 67. Picture of core KRSD28 aligned with Intra-core erosion rate ratios.

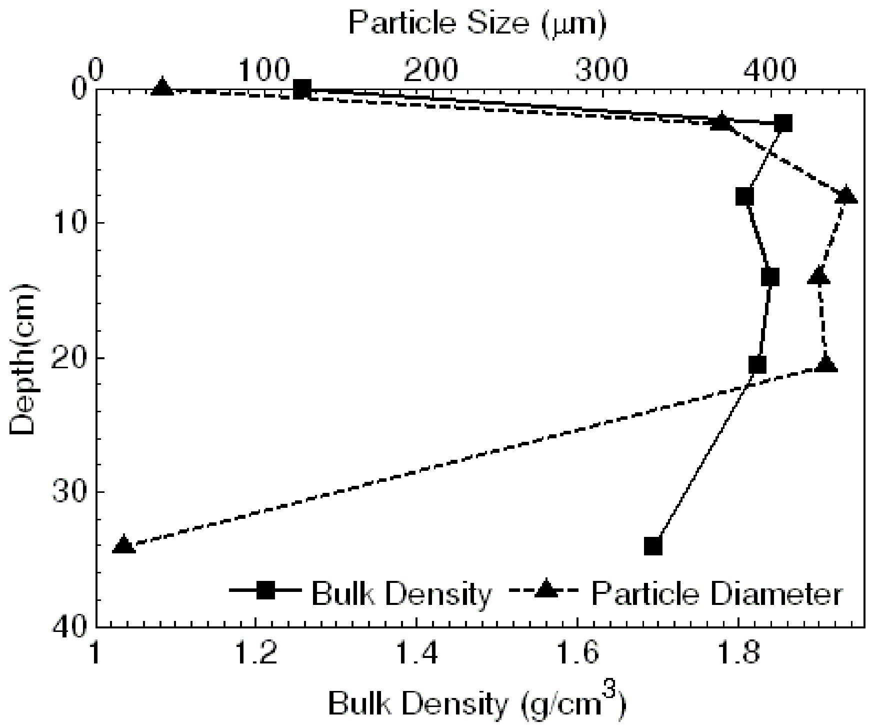


Figure 68. Bulk density and D_{50} with depth for core KRSD28.

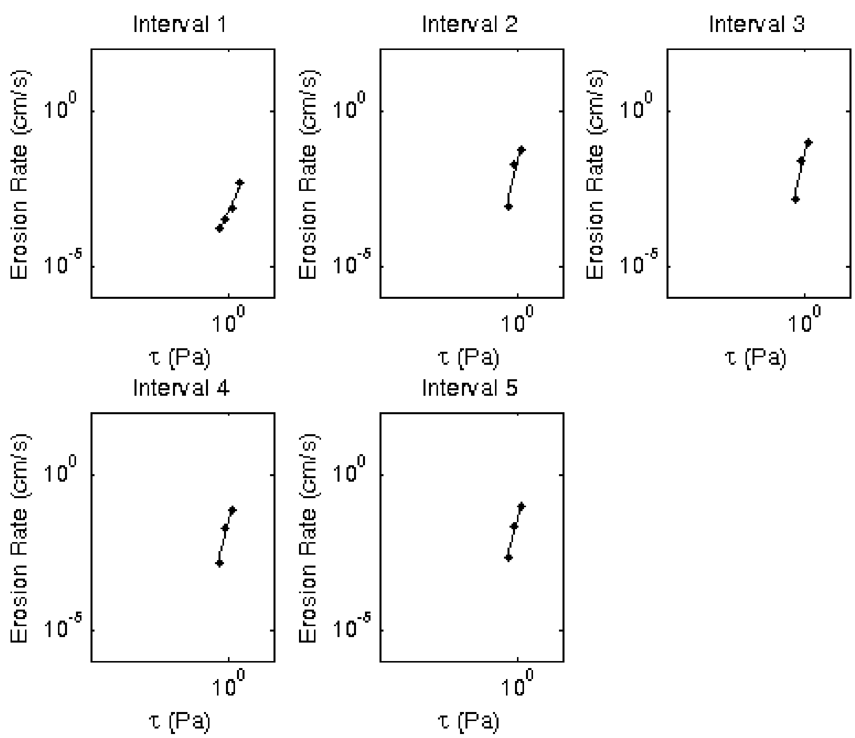


Figure 69. Best fit power law curves for depth intervals in core KRSD28.

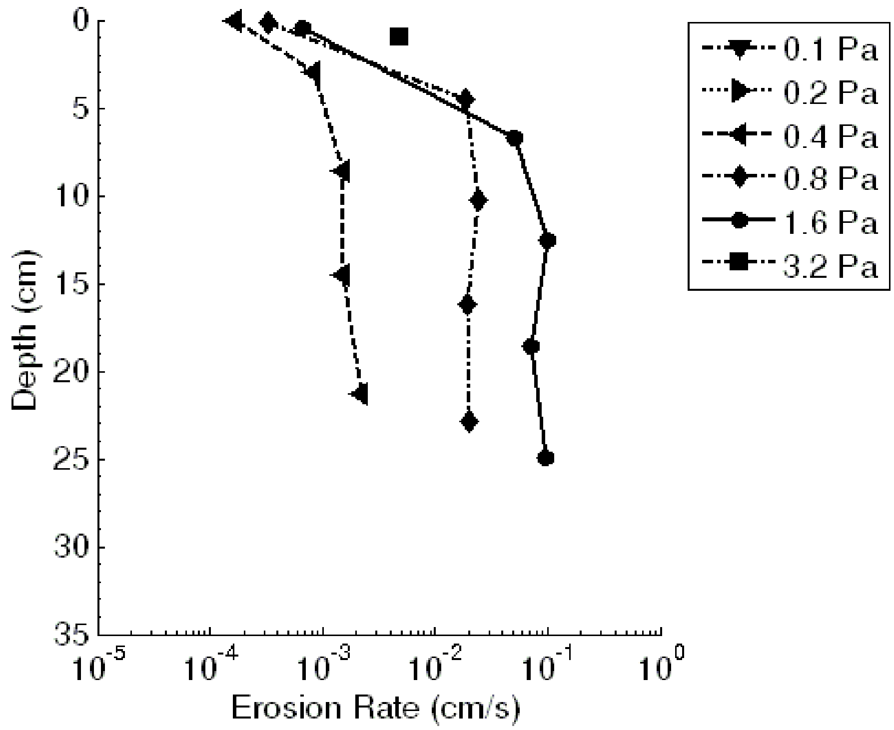


Figure 70. Sedflume erosion rate data for core KRSD28.

Table 35. Power law best-fit variables for specified depth intervals in core KRSD28.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	1.3	5.37E-04	1.56	0.92
2	2.7	7.6	1.79E-02	2.97	0.92
3	8.1	13.5	3.01E-02	3.03	0.97
4	14.1	19.8	2.35E-02	2.78	0.97
5	20.6	26.0	2.94E-02	2.73	0.99

Table 36. Bulk density, D_{50}, critical shear stress with depth for KRSD28.

Depth (cm)	D_{50} (µm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.00	39.06	1.26	0.34	0.32
2.70	370.57	1.85	0.17	0.22
8.10	444.22	1.81	0.15	0.21
14.10	427.98	1.84	0.14	0.21
20.60	431.67	1.82	0.12	0.21
34.10	16.26	1.69	-	-
Mean	**288.29**	**1.71**	**0.19**	**0.24**

Core KRSD48

Core KRSD48 was collected in 0.9 m of water depth. The core consisted of approximately 1 mm light orange oxic layer over an approximate 1 cm thick dark grey layer. Olive grey sediment persisted down core from 1 cm to the end of the core with visible pockets of dark grey sediment and gas bubbles. Detritus (root and leaf material) were also observed at the surface and throughout the core. The mean grain size of the core was 33.13 μm (silt).

Figure 71 through Figure 74 show the data results and analysis and Table 37 and Table 38 summarize the data.

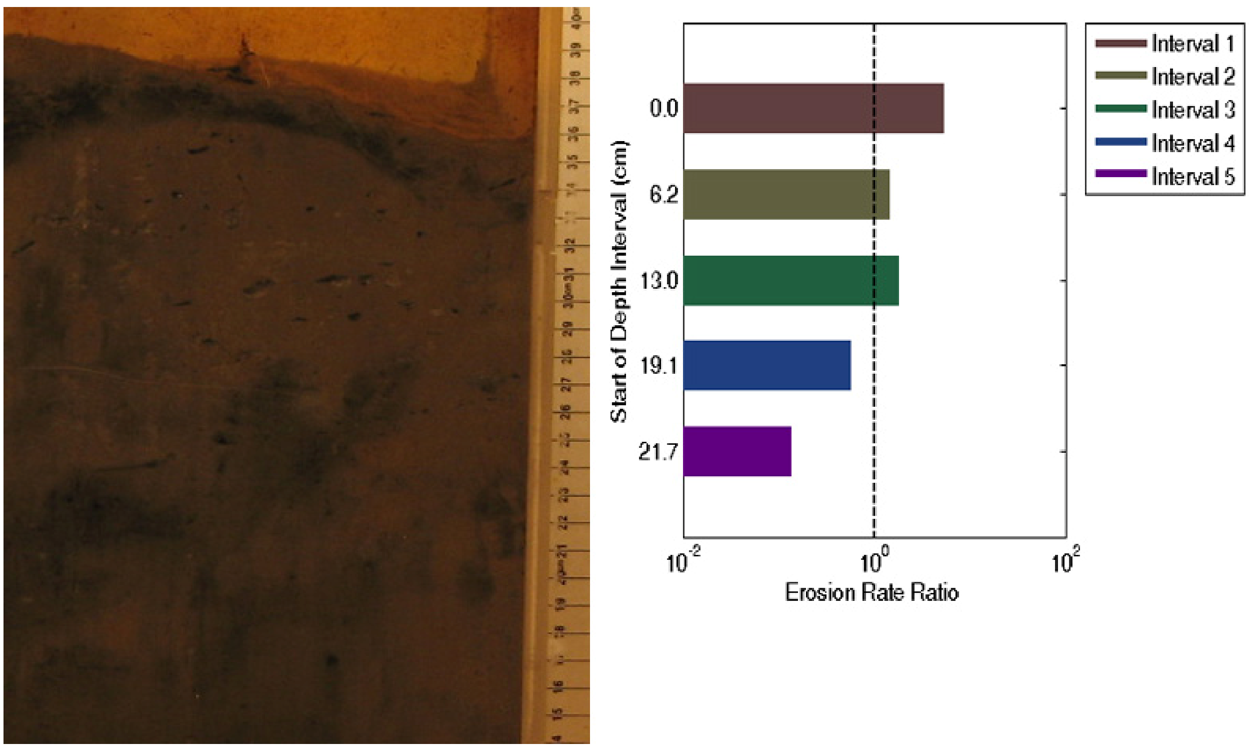


Figure 71. Picture of core KRSD48 aligned with Intra-core erosion rate ratios.

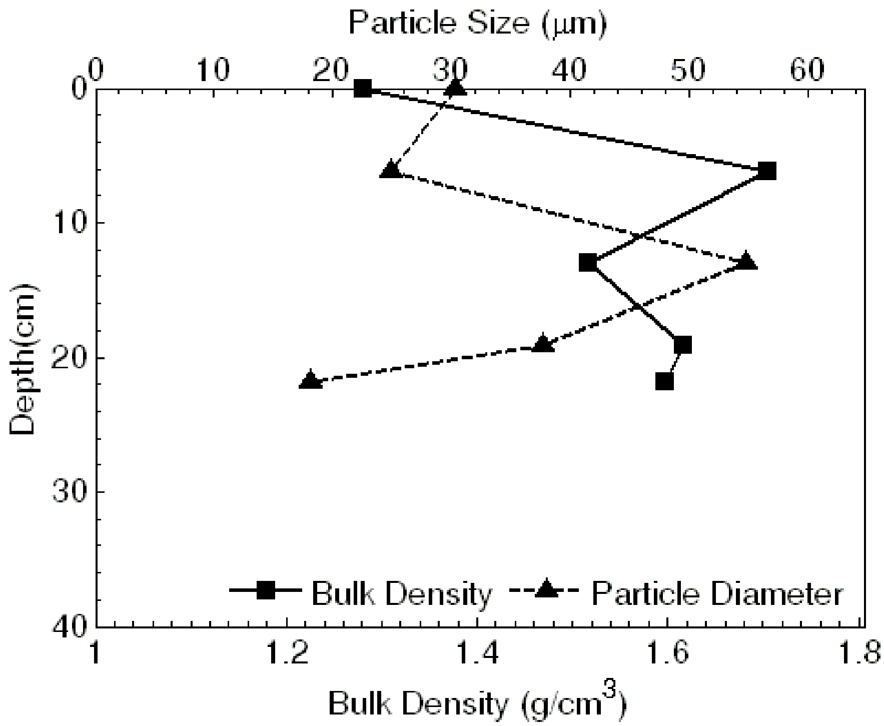


Figure 72. Bulk density and D_{50} with depth for core KRSD48.

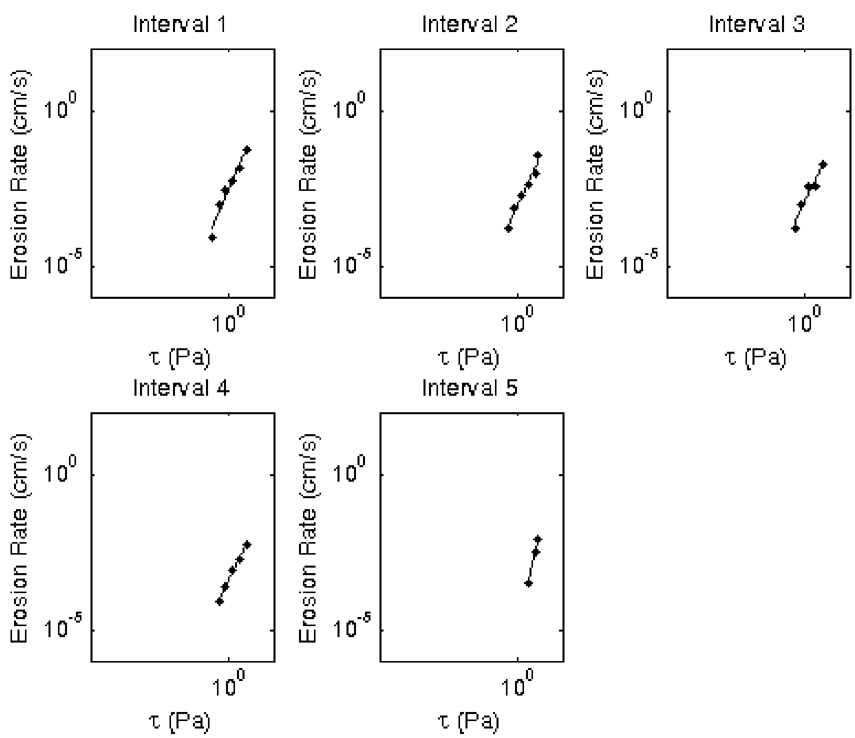


Figure 73. Best fit power law curves for depth intervals in core KRSD48.

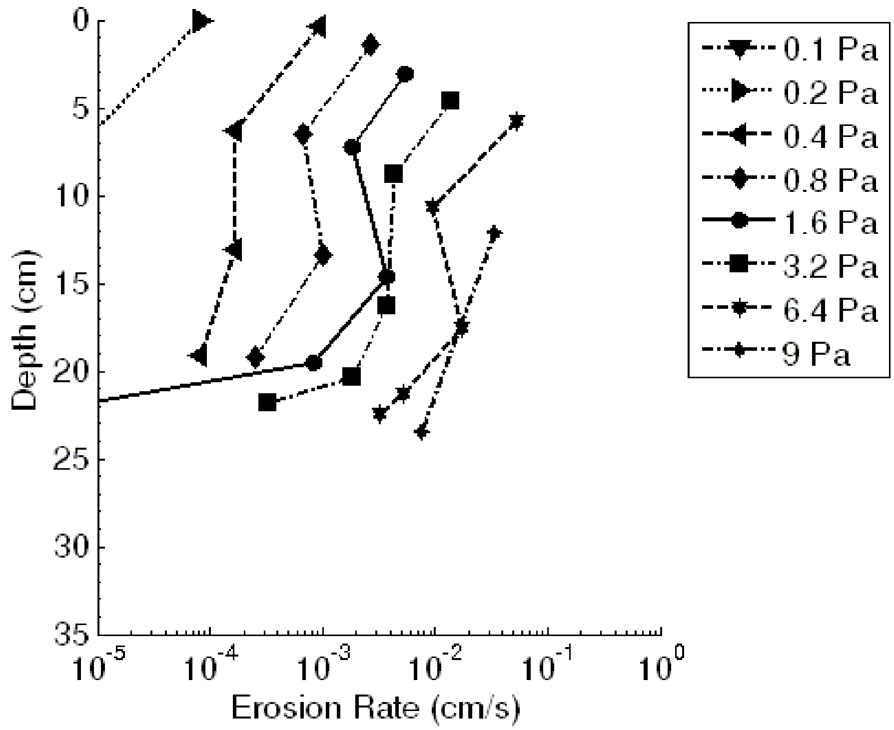


Figure 74. Sedflume erosion rate data for core KRSD48.

Table 37. Power law best-fit variables for specified depth intervals in core KRSD48.

Interval	Depth Start (cm)	Depth Finish (cm)	A	N	r^2
1	0.0	6.2	2.47E-03	1.69	0.96
2	6.2	12.7	7.86E-04	1.56	0.98
3	13.0	18.3	1.02E-03	1.53	0.93
4	19.1	21.7	3.48E-04	1.48	1.00
5	21.7	24.0	9.70E-06	3.07	1.00

Table 38. Bulk density, $D_{50,}$ critical shear stress with depth for KRSD48.

Depth (cm)	D_{50} (μm)	ρ_b (g/cm^3)	Power Law τ_{cr} (Pa)	Linear Interpolation τ_{cr} (Pa)
0.00	30.23	1.28	0.15	0.20
6.20	24.87	1.71	0.27	0.32
13.00	54.74	1.52	0.22	0.32
19.10	37.76	1.62	0.43	0.44
219.70	18.05	1.60	2.14	2.08
Mean	**33.13**	**1.54**	**0.64**	**0.67**

Summary

Sea Engineering, Inc. (SEI) conducted a Sedflume analysis on eighteen cores obtained from the Kanawha River, West Virginia. These cores were collected offshore in areas from 0.6 to 6.7 m of water depth. The primary goal of this work was to characterize the stability of the sediments within Kanawha River. The Sedflume analysis determines sediment erosion rates, critical shear stress, particle size and wet bulk density at depth intervals down the length of each core.

A summary spatial comparison of the erosion rate ratios relative to the average of the Kanawha River site as a whole is presented in Figure 75a, Figure 76, Figure 77. All cores are not represented in a single figure as a result of the large data set. The colored bars represent the different intervals within each core as compare to the entire site. The dashed line denotes the site wide average erosion rate ratio of 1. Ratios above this line denote intervals that are more susceptible to erosion than ratios below this line.

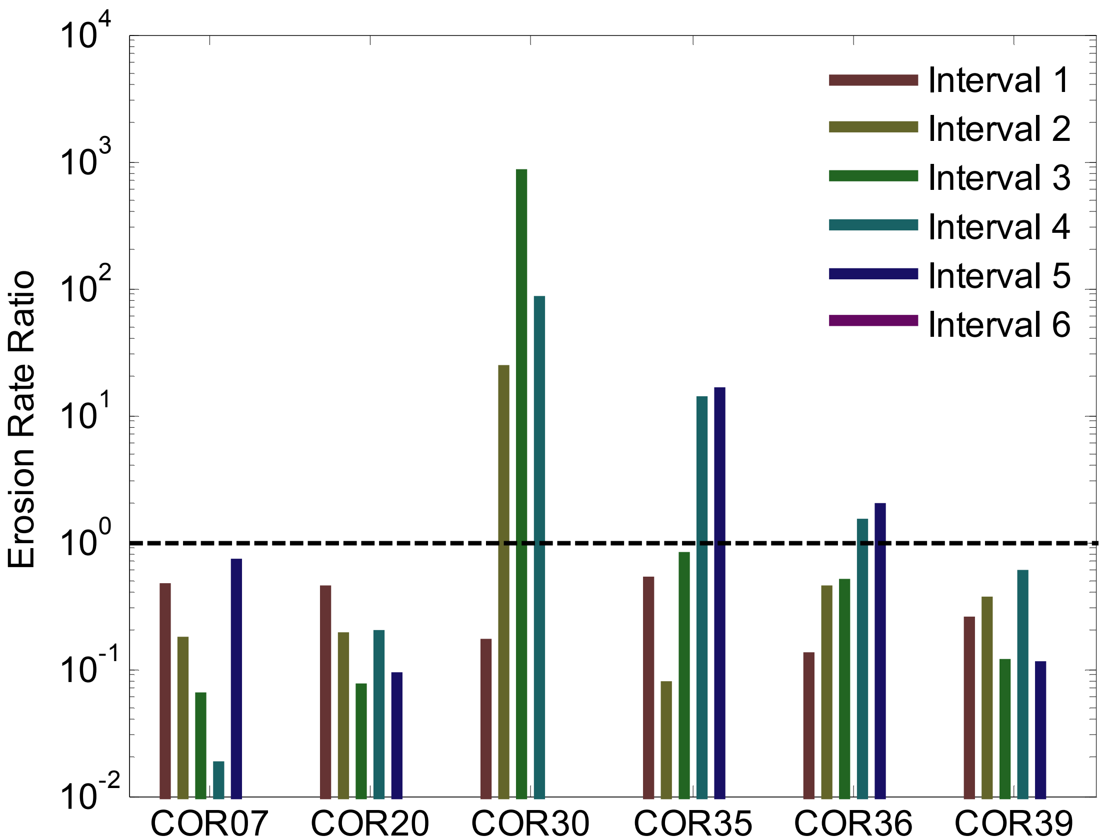


Figure 75a. 1 of 3 images illustrating the spatial comparison of site-wide erosion rate ratios from Kanawha River.

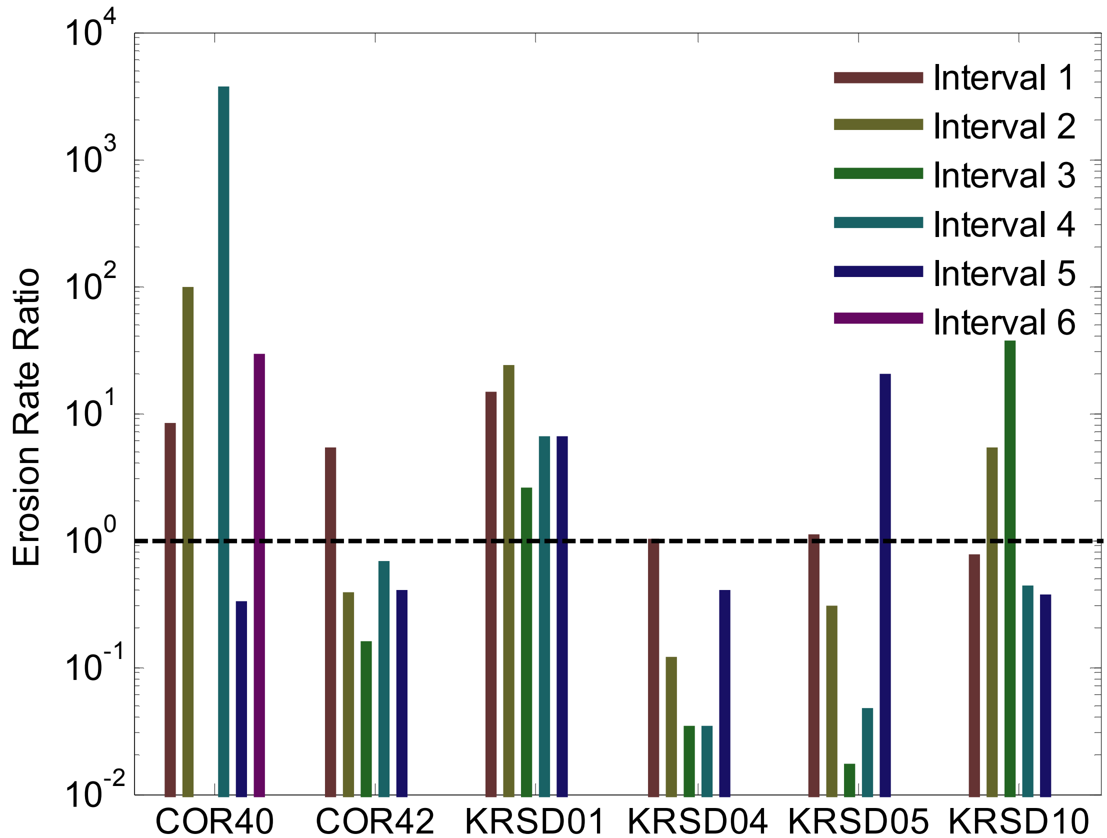


Figure 76. 2 of 3 images illustrating the spatial comparison of site-wide erosion rate ratios from Kanawha River.

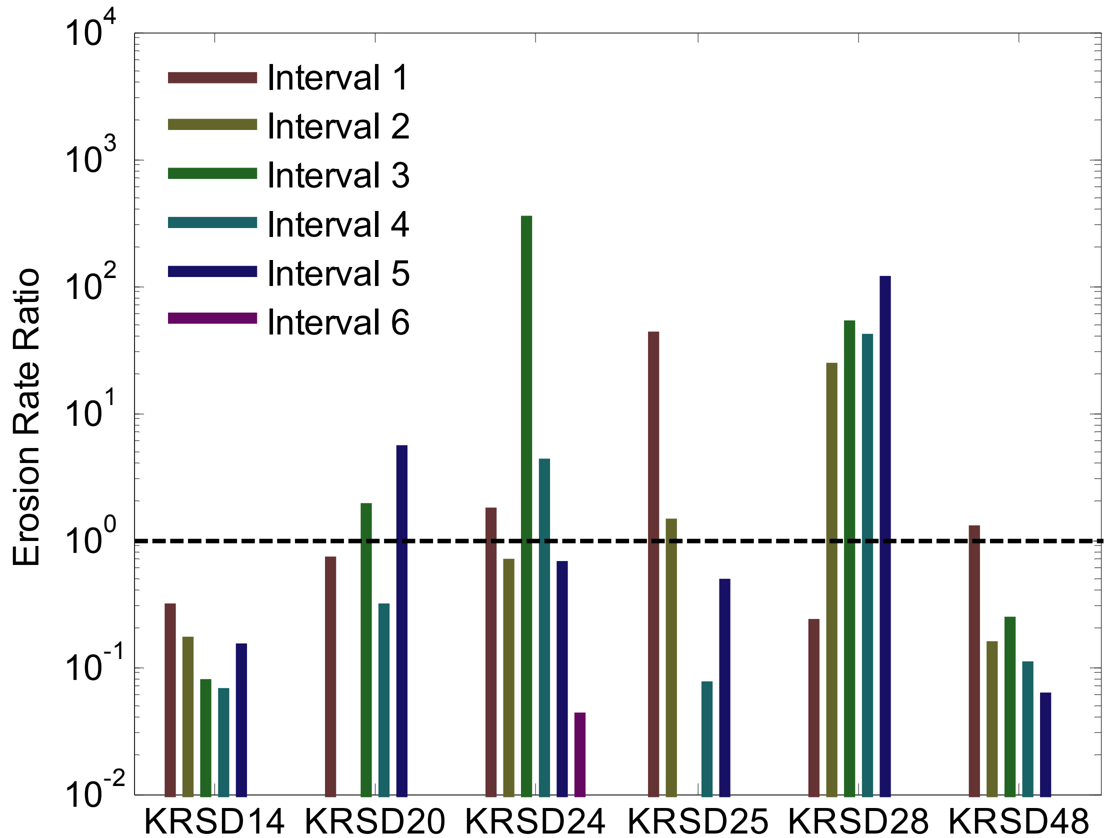


Figure 77. 3 of 3 images illustrating the spatial comparison of site-wide erosion rate ratios from Kanawha River.

References

Hakanson, L., and M. Jansson, 2002, Principles of Lake Sedimentology. Blackburn Press, Caldwell, New Jersey, USA.

Jepsen, R., J. Roberts, and W. Lick, 1997, Effects of bulk density on sediment erosion rates, Water, Air and Soil Pollution, 99:21-31.

McNeil, J., C. Taylor, and W. Lick, 1996, Measurements of erosion of undisturbed bottom sediments with depth, J. Hydr. Engr., 122(6):316-324.

Roberts, J., R. Jepsen, D. Gotthard, and W. Lick, 1998, Effects of particle size and bulk density on erosion of quartz particles, J. Hydr. Engrg., 124(12):1261 1267.

Appendix A – Particle Size Distributions

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

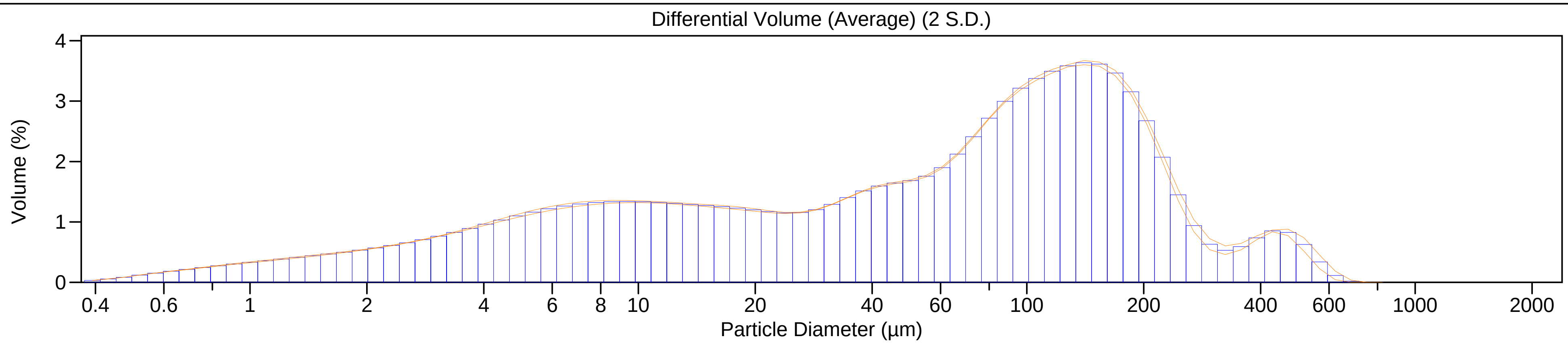
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR07_1_613.$av
COR07_1_613.$av
File ID: COR07
Sample ID: 1
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR07_1_611.$ls
C:\LS13320\Projects\WestVirgina\COR07_1_612.$ls
C:\LS13320\Projects\WestVirgina\COR07_1_613.$ls

Volume Statistics (Arithmetic) COR07_1_613.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	93.44 µm	S.D.:	104.9 µm
Median:	63.98 µm	Variance:	10998 µm^2
Mean/Median ratio:	1.460	C.V.:	112%
Mode:	140.1 µm	Skewness:	1.936 Right skewed
		Kurtosis:	4.657 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.820 µm	12.02 µm	63.98 µm	138.3 µm	211.3 µm



AR101201

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR07_2_616.$av
COR07_2_616.$av
File ID: COR07
Sample ID: 2
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR07_2_614.$ls
C:\LS13320\Projects\WestVirgina\COR07_2_615.$ls
C:\LS13320\Projects\WestVirgina\COR07_2_616.$ls

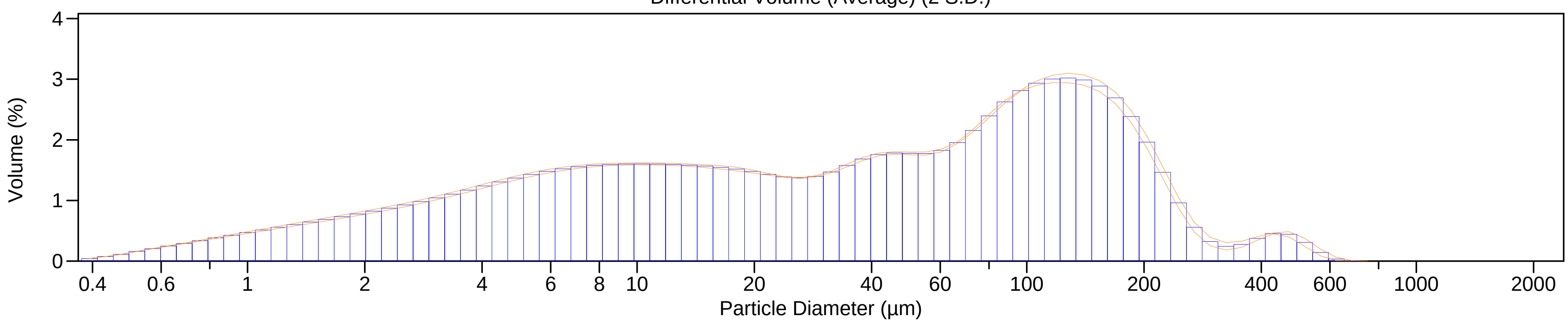
Volume Statistics (Arithmetic) COR07_2_616.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	70.50 µm	S.D.:	86.85 µm
Median:	36.25 µm	Variance:	7543 µm^2
Mean/Median ratio:	1.945	C.V.:	123%
Mode:	127.7 µm	Skewness:	2.222 Right skewed
		Kurtosis:	6.879 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.690 µm	7.838 µm	36.25 µm	109.4 µm	176.5 µm

Differential Volume (Average) (2 S.D.)



AR101202

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name:	**C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR07_3_619.$av**
	COR07_3_619.$av
File ID:	**COR07**
Sample ID:	**3**
Operator:	**ANDES**
Optical model:	**Fraunhofer.rf780z**
LS 13 320 SW	**Aqueous Liquid Module**

Run length: **60 seconds**

Pump speed: **80**

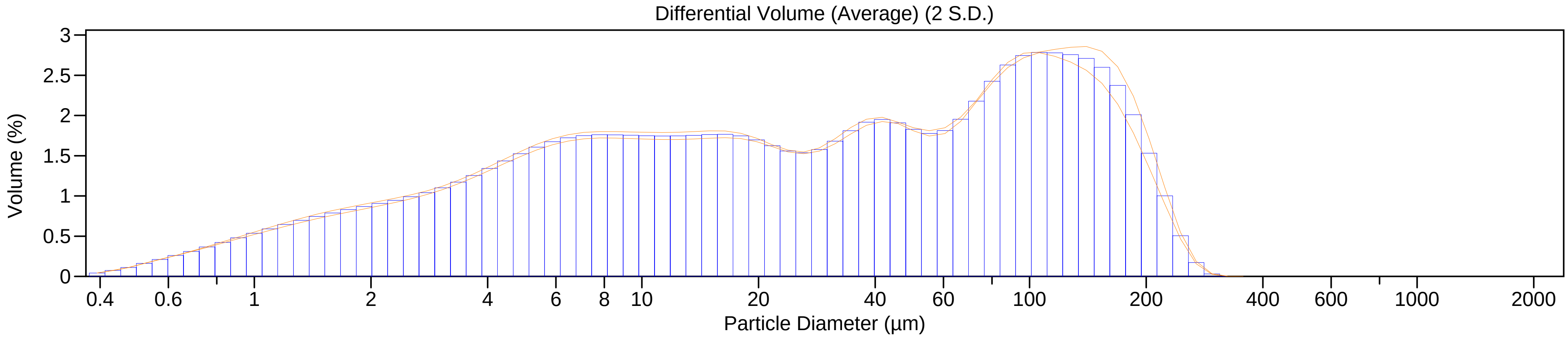
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR07_3_617.$ls
C:\LS13320\Projects\WestVirgina\COR07_3_618.$ls
C:\LS13320\Projects\WestVirgina\COR07_3_619.$ls

Volume Statistics (Arithmetic) COR07_3_619.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	53.73 µm	S.D.:	59.66 µm
Median:	26.51 µm	Variance:	3559 µm^2
Mean/Median ratio:	2.026	C.V.:	111%
Mode:	105.9 µm	Skewness:	1.224 Right skewed
		Kurtosis:	0.625 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.427 µm	6.819 µm	26.51 µm	88.98 µm	148.1 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR07_4_622.$av
COR07_4_622.$av
File ID: COR07
Sample ID: 4
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR07_4_620.$ls
C:\LS13320\Projects\WestVirgina\COR07_4_621.$ls
C:\LS13320\Projects\WestVirgina\COR07_4_622.$ls

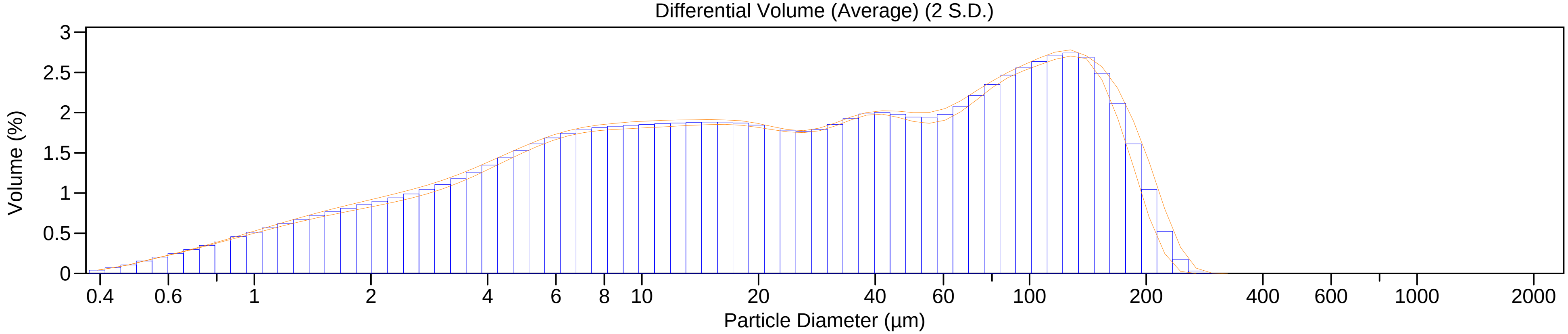
Volume Statistics (Arithmetic) COR07_4_622.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	49.27 µm	S.D.:	54.59 µm
Median:	24.43 µm	Variance:	2980 µm^2
Mean/Median ratio:	2.017	C.V.:	111%
Mode:	127.7 µm	Skewness:	1.246 Right skewed
		Kurtosis:	0.648 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.497 µm	6.901 µm	24.43 µm	80.04 µm	137.1 µm

Differential Volume (Average) (2 S.D.)



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name:	C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR07_5_625.$av
	COR07_5_625.$av
File ID:	COR07
Sample ID:	5
Operator:	ANDES
Optical model:	Fraunhofer.rf780z
LS 13 320 SW	Aqueous Liquid Module
	Run length: 60 seconds
Pump speed:	80

Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR07_5_623.$ls
C:\LS13320\Projects\WestVirgina\COR07_5_624.$ls
C:\LS13320\Projects\WestVirgina\COR07_5_625.$ls

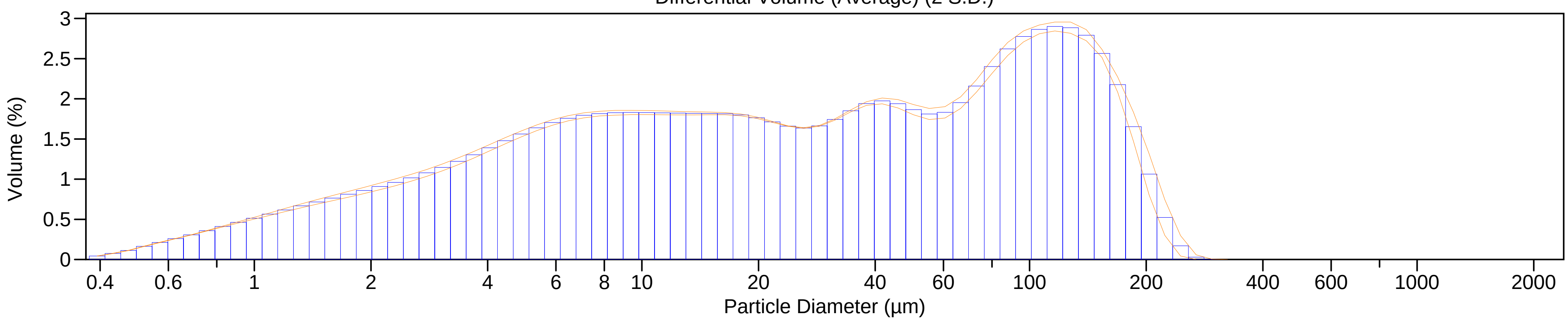
Volume Statistics (Arithmetic) COR07_5_625.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	50.17 µm	S.D.:	55.19 µm
Median:	24.67 µm	Variance:	3046 µm^2
Mean/Median ratio:	2.034	C.V.:	110%
Mode:	116.3 µm	Skewness:	1.190 Right skewed
		Kurtosis:	0.469 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.473 µm	6.731 µm	24.67 µm	83.95 µm	138.3 µm

Differential Volume (Average) (2 S.D.)



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR20_1_448.$av
COR20_1_448.$av
File ID: COR20
Sample ID: 1
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR20_1_446.$ls
C:\LS13320\Projects\WestVirgina\COR20_1_447.$ls
C:\LS13320\Projects\WestVirgina\COR20_1_448.$ls

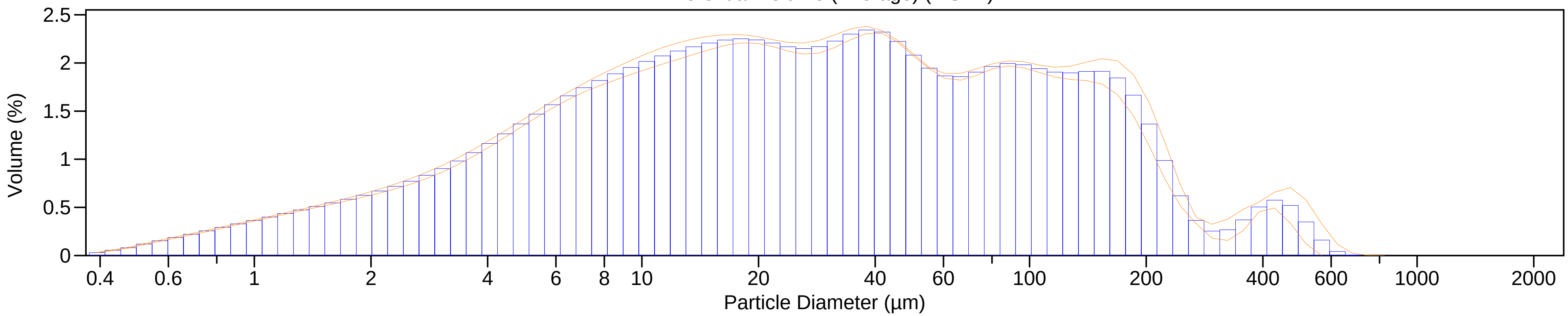
Volume Statistics (Arithmetic) COR20_1_448.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	60.38 µm	S.D.:	86.45 µm
Median:	25.86 µm	Variance:	7473 μm^2
Mean/Median ratio:	2.335	C.V.:	143%
Mode:	37.97 µm	Skewness:	2.824 Right skewed
		Kurtosis:	9.813 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.345 µm	8.711 µm	25.86 µm	77.99 µm	160.5 µm

Differential Volume (Average) (2 S.D.)



AR101206

Kanawha River

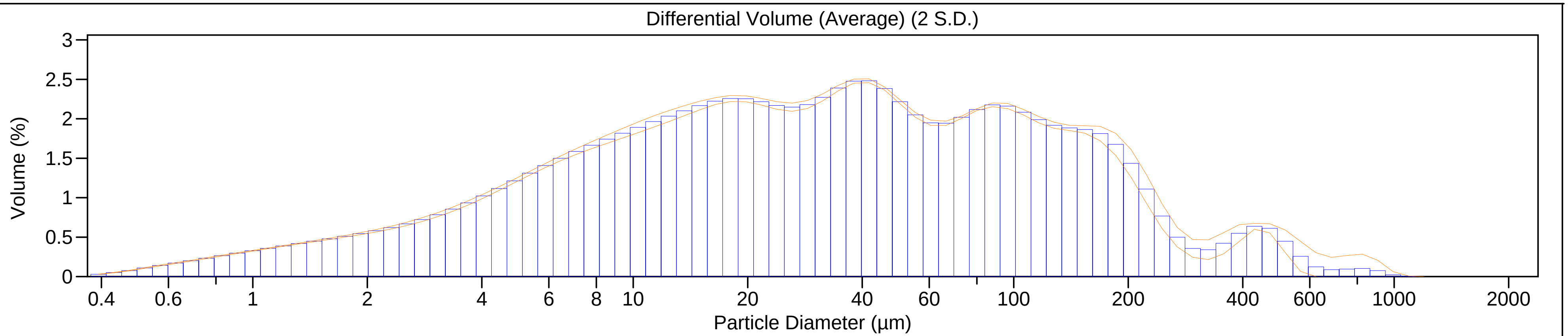
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR20_2_442.$av
COR20_2_442.$av
File ID: COR20
Sample ID: 2
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR20_2_440.$ls
C:\LS13320\Projects\WestVirgina\COR20_2_441.$ls
C:\LS13320\Projects\WestVirgina\COR20_2_442.$ls

Volume Statistics (Arithmetic) COR20_2_442.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	68.68 µm	S.D.:	103.7 µm
Median:	29.83 µm	Variance:	10749 µm^2
Mean/Median ratio:	2.302	C.V.:	151%
Mode:	41.68 µm	Skewness:	3.363 Right skewed
		Kurtosis:	15.31 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.785 µm	10.03 µm	29.83 µm	85.80 µm	173.6 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

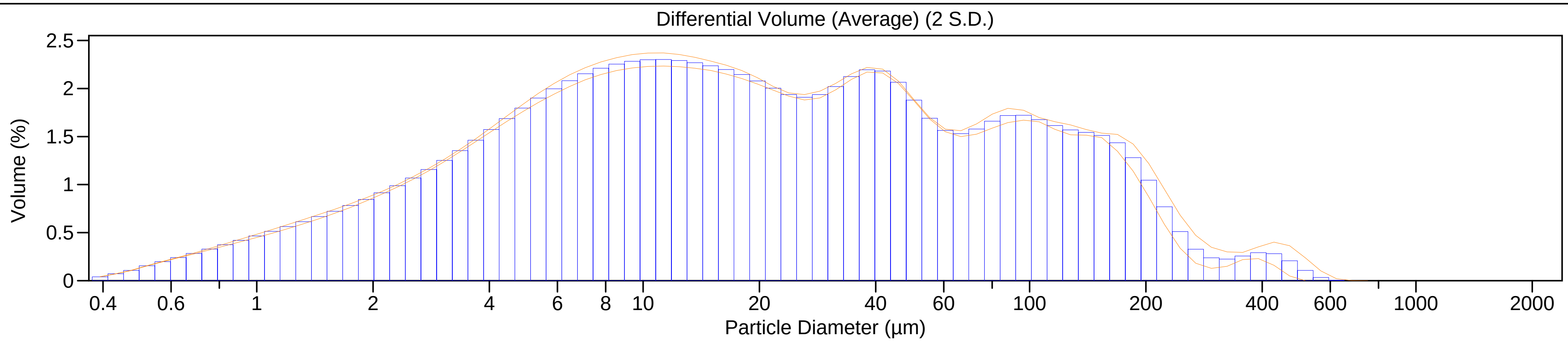
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR20_3_430.$av
COR20_3_430.$av
File ID: COR20
Sample ID: 3
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR20_3_428.$ls
C:\LS13320\Projects\WestVirgina\COR20_3_429.$ls
C:\LS13320\Projects\WestVirgina\COR20_3_430.$ls

Volume Statistics (Arithmetic) COR20_3_430.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	47.10 µm	S.D.:	69.93 µm
Median:	17.87 µm	Variance:	4891 µm^2
Mean/Median ratio:	2.636	C.V.:	148%
Mode:	11.29 µm	Skewness:	2.919 Right skewed
		Kurtosis:	11.23 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.579 µm	6.290 µm	17.87 µm	56.87 µm	134.3 µm



Kanawha River

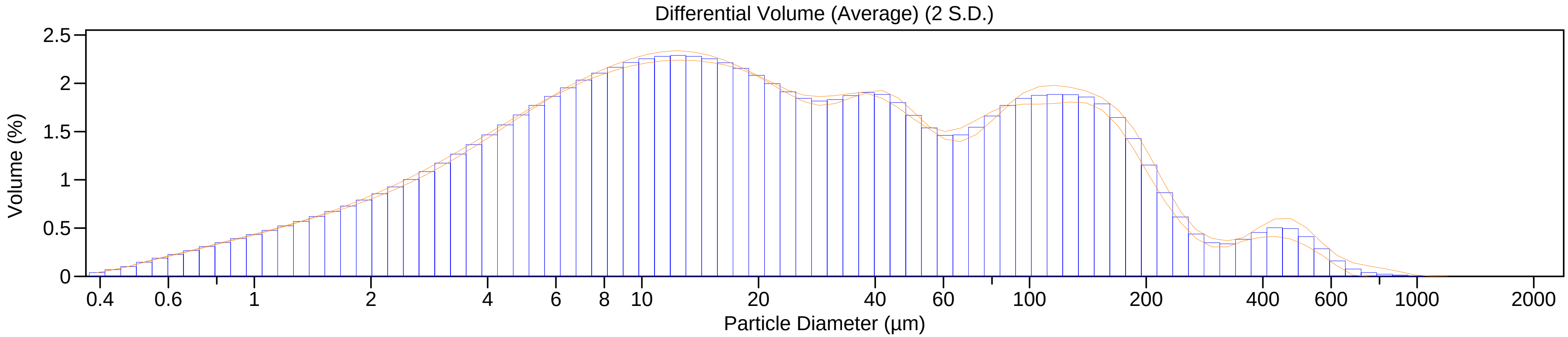
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR20_4_451.$av
COR20_4_451.$av
File ID: COR20
Sample ID: 4
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR20_4_449.$ls
C:\LS13320\Projects\WestVirgina\COR20_4_450.$ls
C:\LS13320\Projects\WestVirgina\COR20_4_451.$ls

Volume Statistics (Arithmetic) COR20_4_451.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	58.94 µm	S.D.:	94.75 µm
Median:	19.64 µm	Variance:	8978 µm^2
Mean/Median ratio:	3.002	C.V.:	161%
Mode:	12.40 µm	Skewness:	3.220 Right skewed
		Kurtosis:	13.24 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.734 µm	6.800 µm	19.64 µm	73.12 µm	158.7 µm



Kanawha River

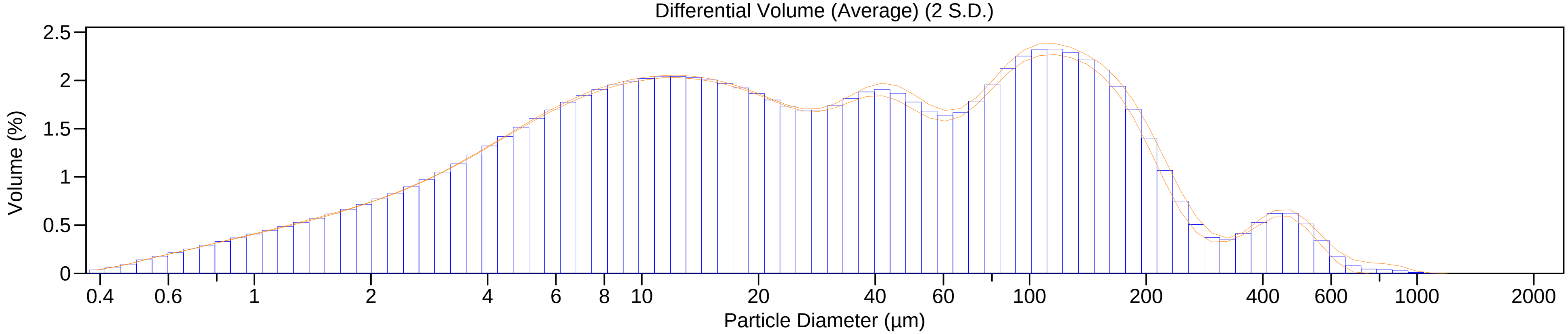
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR20_5_421.$av
COR20_5_421.$av
File ID: COR20
Sample ID: 5
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR20_5_419.$ls
C:\LS13320\Projects\WestVirgina\COR20_5_420.$ls
C:\LS13320\Projects\WestVirgina\COR20_5_421.$ls

Volume Statistics (Arithmetic) COR20_5_421.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	67.68 µm	S.D.:	101.6 µm
Median:	25.29 µm	Variance:	10315 µm^2
Mean/Median ratio:	2.677	C.V.:	150%
Mode:	116.3 µm	Skewness:	2.994 Right skewed
		Kurtosis:	11.67 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.949 µm	7.618 µm	25.29 µm	92.15 µm	173.3 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name:	**C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR30_1_730.$av**
	COR30_1_730.$av
File ID:	**COR30**
Sample ID:	**1**
Operator:	**ANDES**
Optical model:	**Fraunhofer.rf780z**
LS 13 320 SW	**Aqueous Liquid Module**

Run length: **60 seconds**

Pump speed: **80**

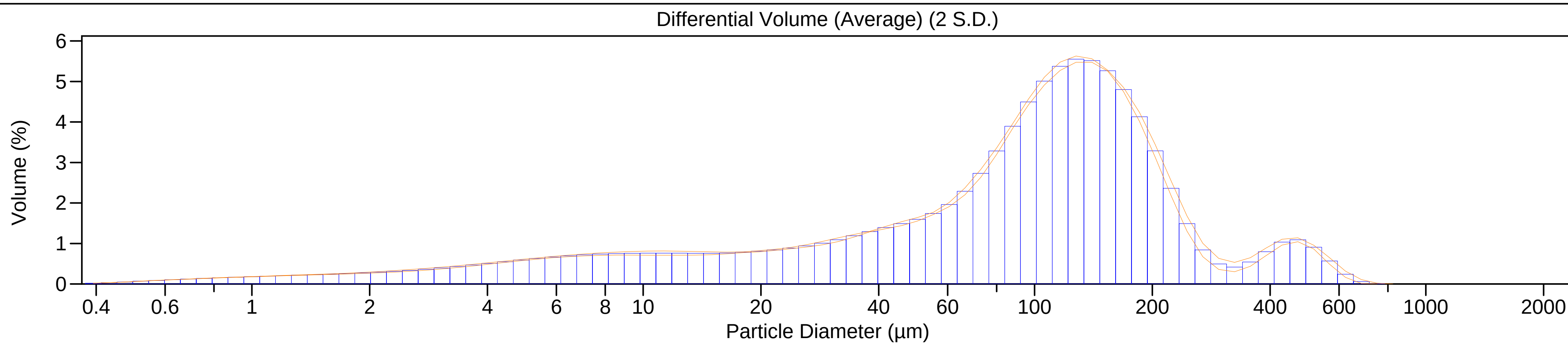
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR30_1_728.$ls
C:\LS13320\Projects\WestVirgina\COR30_1_729.$ls
C:\LS13320\Projects\WestVirgina\COR30_1_730.$ls

Volume Statistics (Arithmetic) COR30_1_730.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	117.2 µm	S.D.:	108.3 µm
Median:	100.7 µm	Variance:	11733 µm^2
Mean/Median ratio:	1.164	C.V.:	92.4%
Mode:	127.7 µm	Skewness:	1.935 Right skewed
		Kurtosis:	4.929 Leptokurtic

<10%	<25%	<50%	<75%	<90%
7.732 µm	38.86 µm	100.7 µm	155.9 µm	220.8 µm



AR101211

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

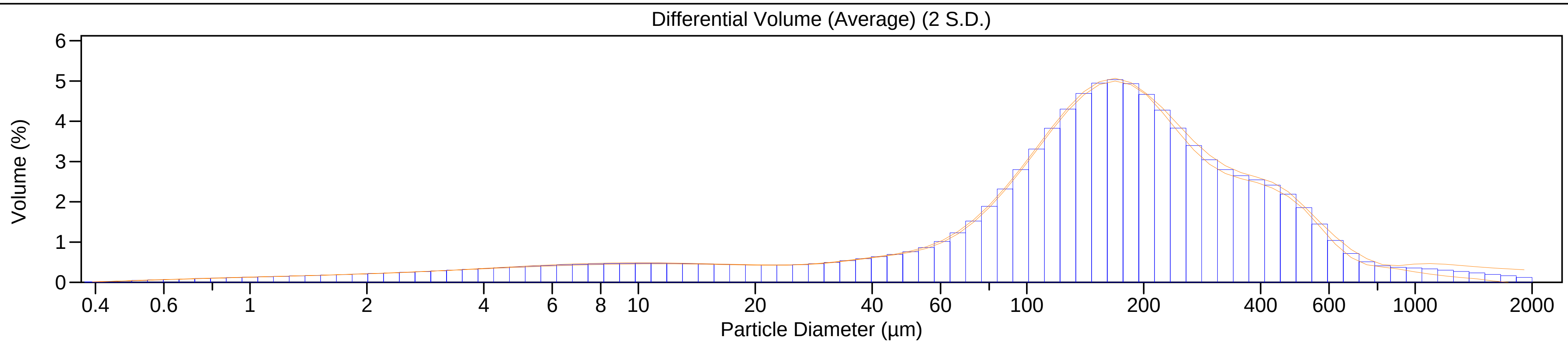
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR30_2_733.$av
COR30_2_733.$av
File ID: COR30
Sample ID: 2
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR30_2_731.$ls
C:\LS13320\Projects\WestVirgina\COR30_2_732.$ls
C:\LS13320\Projects\WestVirgina\COR30_2_733.$ls

Volume Statistics (Arithmetic) COR30_2_733.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	219.0 µm	S.D.:	228.5 µm
Median:	161.6 µm	Variance:	52195 µm^2
Mean/Median ratio:	1.356	C.V.:	104%
Mode:	168.9 µm	Skewness:	2.978 Right skewed
		Kurtosis:	13.15 Leptokurtic

<10%	<25%	<50%	<75%	<90%
14.51 µm	88.56 µm	161.6 µm	274.5 µm	460.3 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

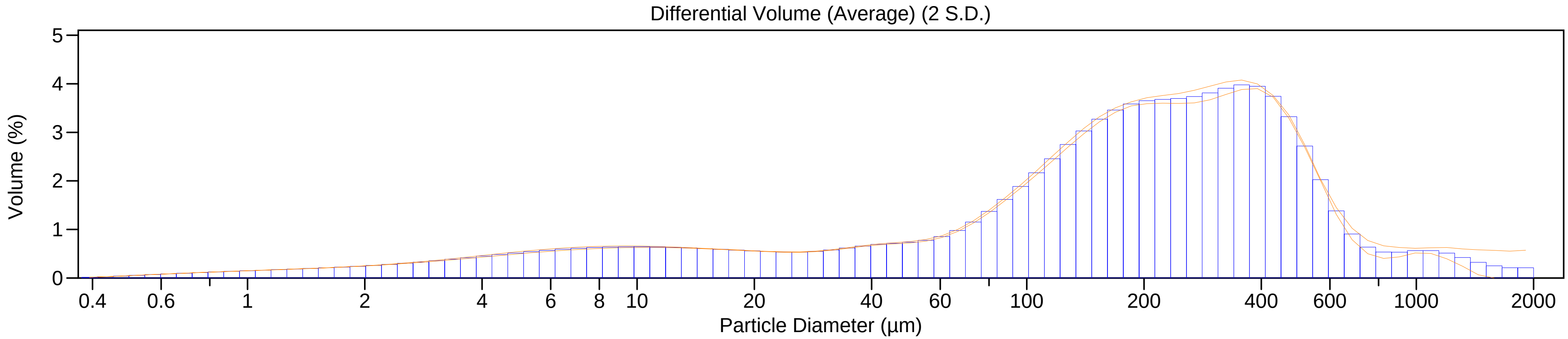
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR30_3_736.$av
COR30_3_736.$av
File ID: COR30
Sample ID: 3
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR30_3_734.$ls
C:\LS13320\Projects\WestVirgina\COR30_3_735.$ls
C:\LS13320\Projects\WestVirgina\COR30_3_736.$ls

Volume Statistics (Arithmetic) COR30_3_736.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	254.8 µm	S.D.:	265.4 µm
Median:	190.7 µm	Variance:	70427 µm^2
Mean/Median ratio:	1.336	C.V.:	104%
Mode:	356.1 µm	Skewness:	2.424 Right skewed
		Kurtosis:	8.651 Leptokurtic

<10%	<25%	<50%	<75%	<90%
9.361 µm	75.68 µm	190.7 µm	354.9 µm	525.5 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

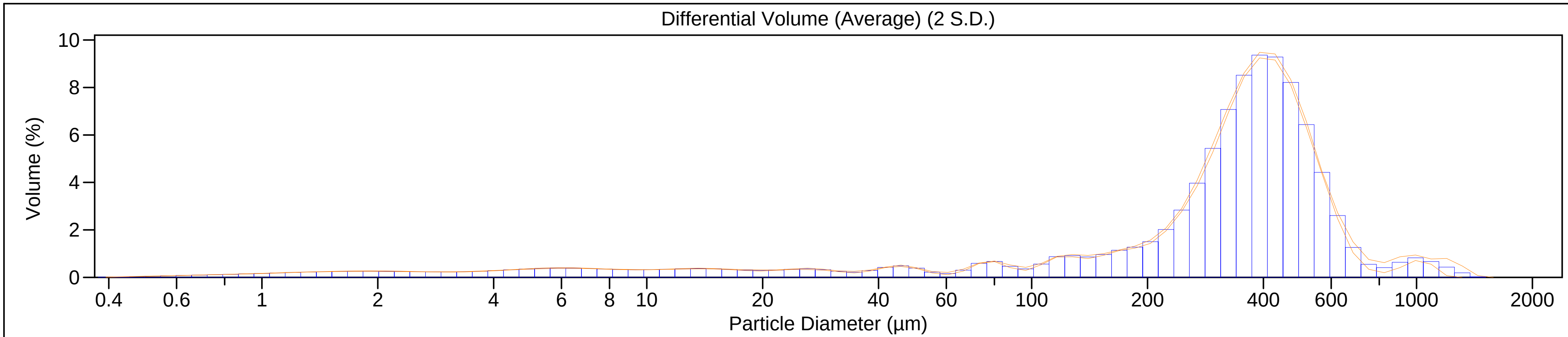
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR30_4_739.$av
COR30_4_739.$av
File ID: COR30
Sample ID: 4
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR30_4_737.$ls
C:\LS13320\Projects\WestVirgina\COR30_4_738.$ls
C:\LS13320\Projects\WestVirgina\COR30_4_739.$ls

Volume Statistics (Arithmetic) COR30_4_739.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	343.7 µm	S.D.:	217.4 µm
Median:	355.0 µm	Variance:	47260 µm^2
Mean/Median ratio:	0.968	C.V.:	63.2%
Mode:	391.0 µm	Skewness:	0.754 Right skewed
		Kurtosis:	2.109 Leptokurtic

<10%	<25%	<50%	<75%	<90%
17.61 µm	215.3 µm	355.0 µm	458.7 µm	566.3 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name:	**C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR35_1_544.$av**
	COR35_1_544.$av
File ID:	**COR35**
Sample ID:	**1**
Operator:	**ANDES**
Optical model:	**Fraunhofer.rf780z**
LS 13 320 SW	**Aqueous Liquid Module**

Run length: **60 seconds**

Pump speed: **80**

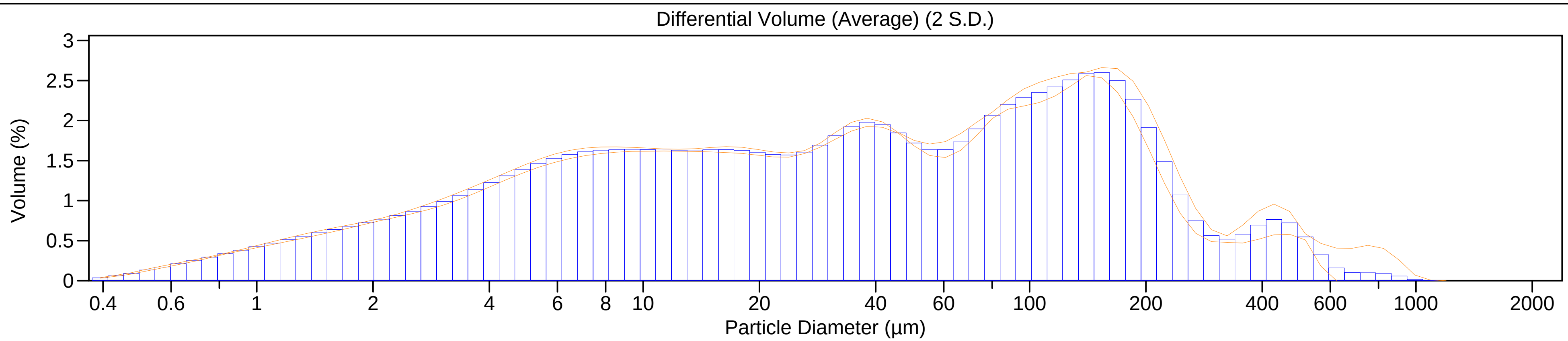
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR35_1_542.$ls
C:\LS13320\Projects\WestVirgina\COR35_1_543.$ls
C:\LS13320\Projects\WestVirgina\COR35_1_544.$ls

Volume Statistics (Arithmetic) COR35_1_544.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	79.27 µm	S.D.:	111.3 µm
Median:	33.95 µm	Variance:	12391 μm^2
Mean/Median ratio:	2.335	C.V.:	140%
Mode:	153.8 µm	Skewness:	2.729 Right skewed
		Kurtosis:	10.05 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.936 µm	8.210 µm	33.95 µm	112.5 µm	198.8 µm



Kanawha River

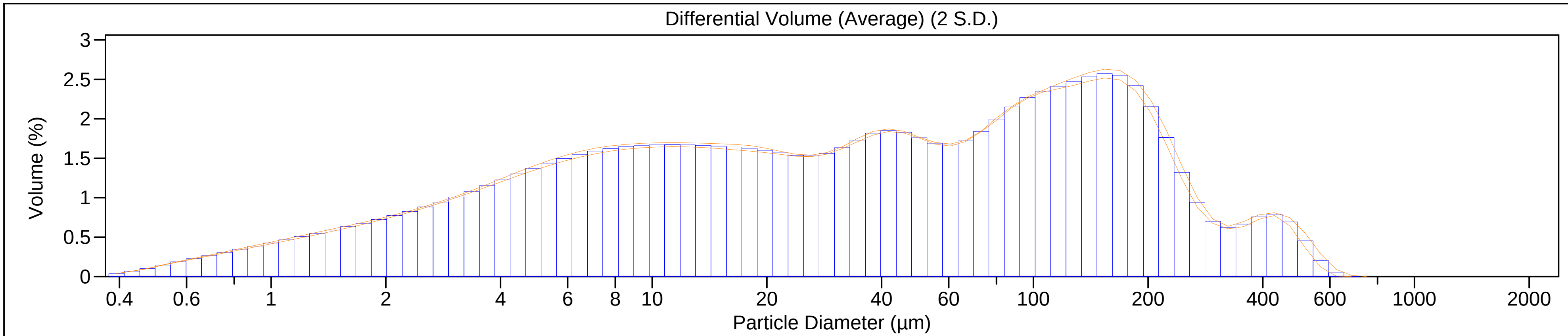
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR35_2_547.$av
COR35_2_547.$av
File ID: COR35
Sample ID: 2
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR35_2_545.$ls
C:\LS13320\Projects\WestVirgina\COR35_2_546.$ls
C:\LS13320\Projects\WestVirgina\COR35_2_547.$ls

Volume Statistics (Arithmetic) COR35_2_547.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	77.90 µm	S.D.:	101.2 µm
Median:	34.42 µm	Variance:	10235 μm^2
Mean/Median ratio:	2.263	C.V.:	130%
Mode:	153.8 µm	Skewness:	2.083 Right skewed
		Kurtosis:	4.909 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.902 µm	8.190 µm	34.42 µm	115.9 µm	204.1 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

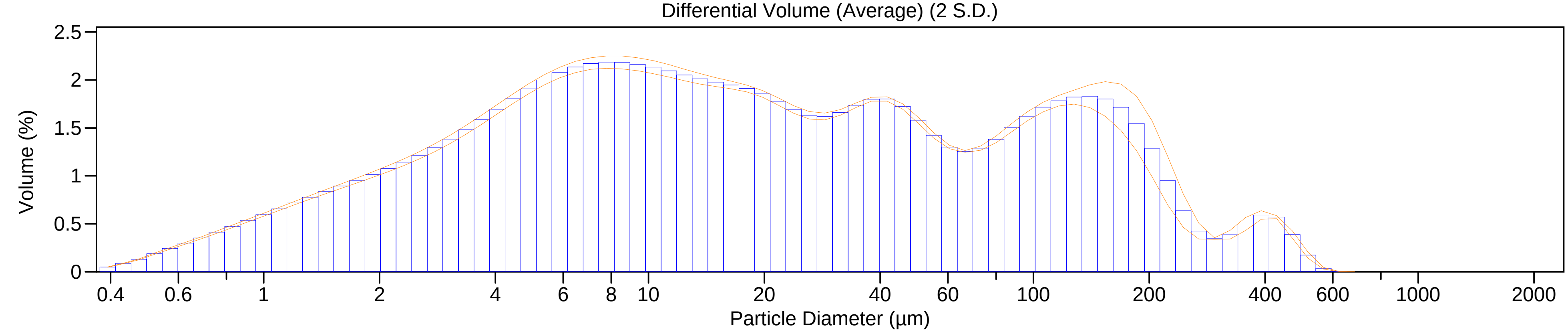
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR35_3_550.$av
COR35_3_550.$av
File ID: COR35
Sample ID: 3
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR35_3_548.$ls
C:\LS13320\Projects\WestVirgina\COR35_3_549.$ls
C:\LS13320\Projects\WestVirgina\COR35_3_550.$ls

Volume Statistics (Arithmetic) COR35_3_550.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	53.69 µm	S.D.:	83.25 µm
Median:	16.45 µm	Variance:	6931 µm^2
Mean/Median ratio:	3.264	C.V.:	155%
Mode:	7.776 µm	Skewness:	2.650 Right skewed
		Kurtosis:	8.189 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.155 µm	5.411 µm	16.45 µm	66.16 µm	157.6 µm



AR101217

Kanawha River

File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR35_4_553.$av
COR35_4_553.$av
File ID: COR35
Sample ID: 4
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR35_4_551.$ls
C:\LS13320\Projects\WestVirgina\COR35_4_552.$ls
C:\LS13320\Projects\WestVirgina\COR35_4_553.$ls

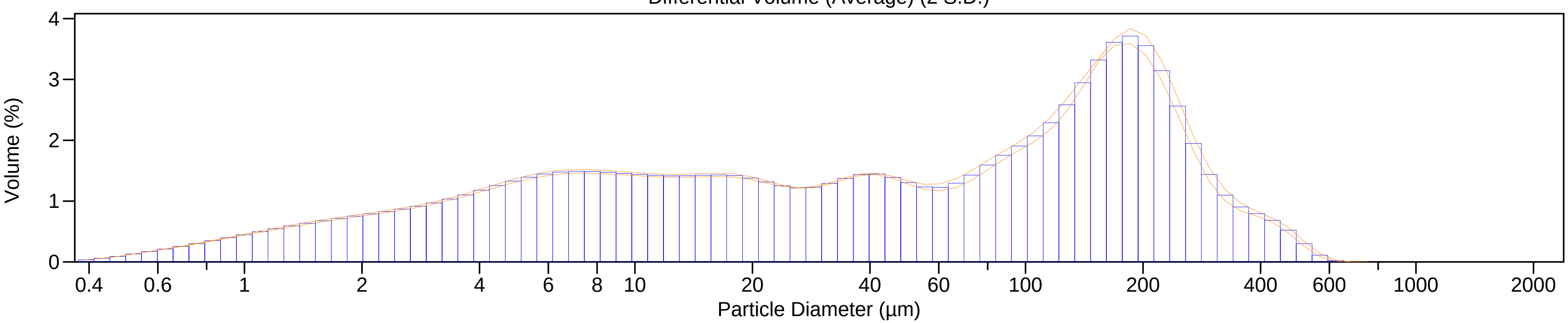
Volume Statistics (Arithmetic) COR35_4_553.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	93.39 µm	S.D.:	105.7 µm
Median:	45.94 µm	Variance:	11175 µm^2
Mean/Median ratio:	2.033	C.V.:	113%
Mode:	185.4 µm	Skewness:	1.386 Right skewed
		Kurtosis:	1.802 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.845 µm	8.459 µm	45.94 µm	158.6 µm	237.5 µm

Differential Volume (Average) (2 S.D.)



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

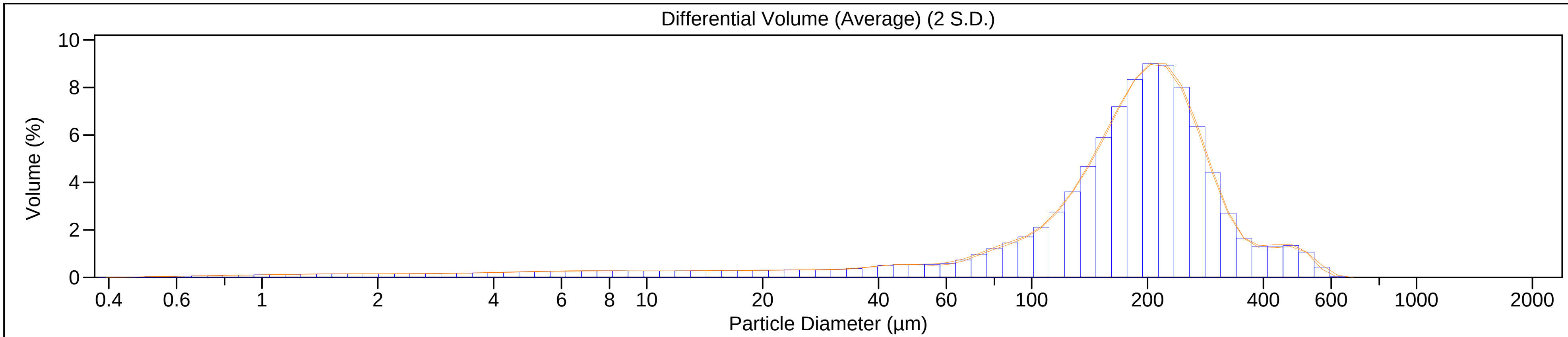
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR35_5_556.$av
COR35_5_556.$av
File ID: COR35
Sample ID: 5
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR35_5_554.$ls
C:\LS13320\Projects\WestVirgina\COR35_5_555.$ls
C:\LS13320\Projects\WestVirgina\COR35_5_556.$ls

Volume Statistics (Arithmetic) COR35_5_556.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	189.1 µm	S.D.:	107.0 µm
Median:	187.1 µm	Variance:	11439 µm^2
Mean/Median ratio:	1.010	C.V.:	56.6%
Mode:	203.5 µm	Skewness:	0.610 Right skewed
		Kurtosis:	1.058 Leptokurtic

<10%	<25%	<50%	<75%	<90%
39.39 µm	126.0 µm	187.1 µm	244.4 µm	308.8 µm



Kanawha River

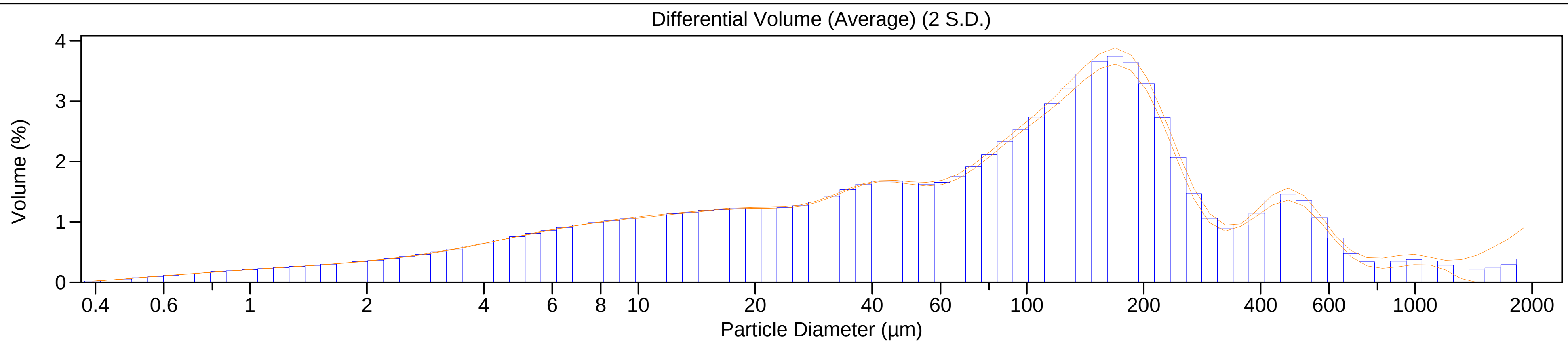
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR35_6_568.$av
COR35_6_568.$av
File ID: COR35
Sample ID: 6
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR35_6_566.$ls
C:\LS13320\Projects\WestVirgina\COR35_6_567.$ls
C:\LS13320\Projects\WestVirgina\COR35_6_568.$ls

Volume Statistics (Arithmetic) COR35_6_568.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	162.6 µm	S.D.:	251.7 µm
Median:	89.82 µm	Variance:	63357 µm^2
Mean/Median ratio:	1.811	C.V.:	155%
Mode:	168.9 µm	Skewness:	3.768 Right skewed
		Kurtosis:	18.05 Leptokurtic

<10%	<25%	<50%	<75%	<90%
5.941 µm	21.35 µm	89.82 µm	186.8 µm	403.8 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

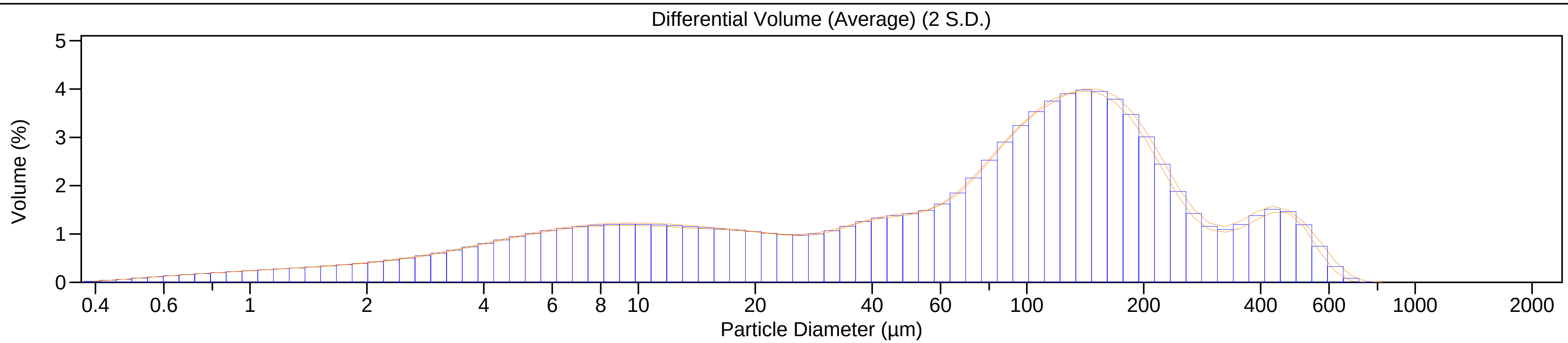
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR36_1_742.$av
COR36_1_742.$av
File ID: COR36
Sample ID: 1
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR36_1_740.$ls
C:\LS13320\Projects\WestVirgina\COR36_1_741.$ls
C:\LS13320\Projects\WestVirgina\COR36_1_742.$ls

Volume Statistics (Arithmetic) COR36_1_742.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	119.3 µm	S.D.:	127.4 µm
Median:	88.02 µm	Variance:	16231 µm^2
Mean/Median ratio:	1.356	C.V.:	107%
Mode:	140.1 µm	Skewness:	1.634 Right skewed
		Kurtosis:	2.640 Leptokurtic

<10%	<25%	<50%	<75%	<90%
4.974 µm	16.96 µm	88.02 µm	166.1 µm	286.0 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

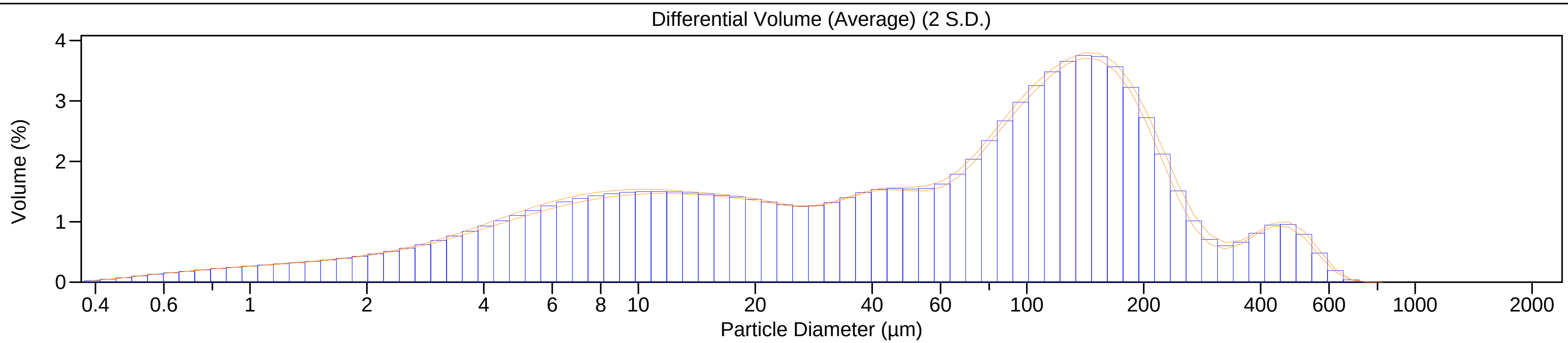
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR36_2_745.$av
COR36_2_745.$av
File ID: COR36
Sample ID: 2
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR36_2_743.$ls
C:\LS13320\Projects\WestVirgina\COR36_2_744.$ls
C:\LS13320\Projects\WestVirgina\COR36_2_745.$ls

Volume Statistics (Arithmetic) COR36_2_745.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	97.53 µm	S.D.:	111.6 µm
Median:	63.60 µm	Variance:	12451 µm^2
Mean/Median ratio:	1.534	C.V.:	114%
Mode:	140.1 µm	Skewness:	1.932 Right skewed
		Kurtosis:	4.405 Leptokurtic

<10%	<25%	<50%	<75%	<90%
4.447 µm	12.48 µm	63.60 µm	143.7 µm	221.5 µm



AR101222

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name:	**C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR36_3_748.$av**
	COR36_3_748.$av
File ID:	**COR36**
Sample ID:	**3**
Operator:	**ANDES**
Optical model:	**Fraunhofer.rf780z**
LS 13 320 SW	**Aqueous Liquid Module**

Run length: **60 seconds**

Pump speed: **80**

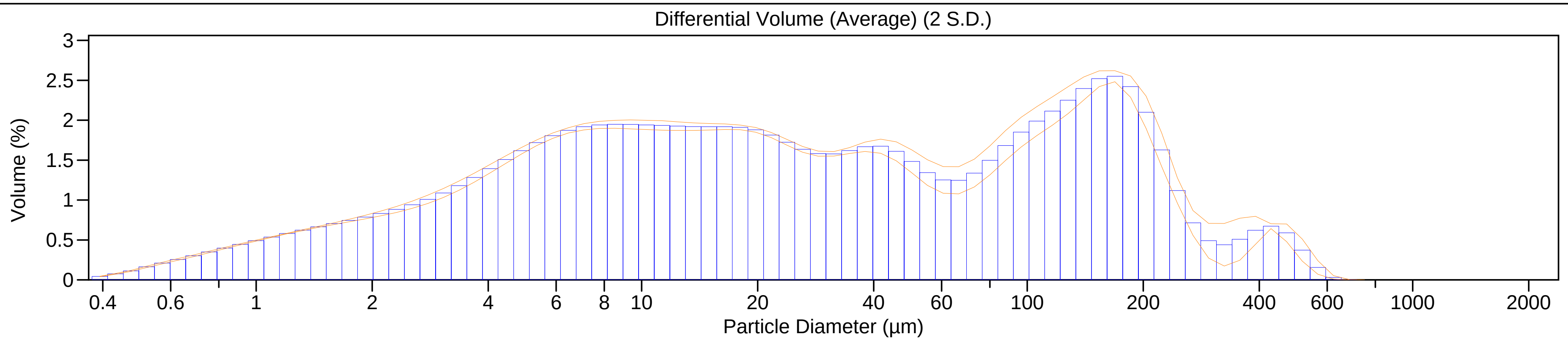
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR36_3_746.$ls
C:\LS13320\Projects\WestVirgina\COR36_3_747.$ls
C:\LS13320\Projects\WestVirgina\COR36_3_748.$ls

Volume Statistics (Arithmetic) COR36_3_748.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	68.86 µm	S.D.:	95.67 µm
Median:	23.34 µm	Variance:	9153 µm^2
Mean/Median ratio:	2.951	C.V.:	139%
Mode:	168.9 µm	Skewness:	2.229 Right skewed
		Kurtosis:	5.788 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.625 µm	6.894 µm	23.34 µm	104.5 µm	190.3 µm



Kanawha River

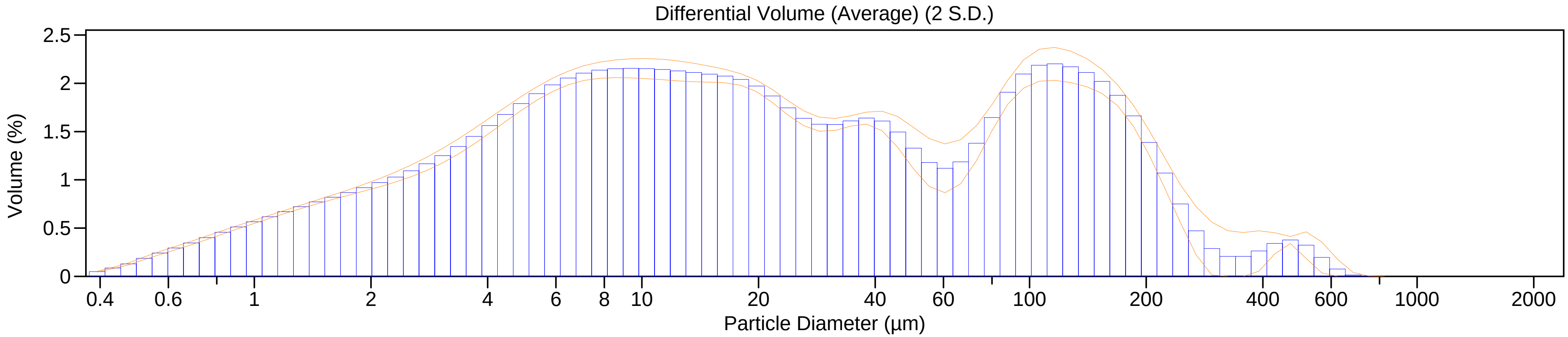
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR36_4_754.$av
COR36_4_754.$av
File ID: COR36
Sample ID: 4
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR36_4_752.$ls
C:\LS13320\Projects\WestVirgina\COR36_4_753.$ls
C:\LS13320\Projects\WestVirgina\COR36_4_754.$ls

Volume Statistics (Arithmetic) COR36_4_754.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	55.79 µm	S.D.:	83.98 µm
Median:	17.86 µm	Variance:	7052 $µm^2$
Mean/Median ratio:	3.124	C.V.:	151%
Mode:	116.3 µm	Skewness:	2.848 Right skewed
		Kurtosis:	10.78 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.285 µm	5.918 µm	17.86 µm	80.32 µm	157.7 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

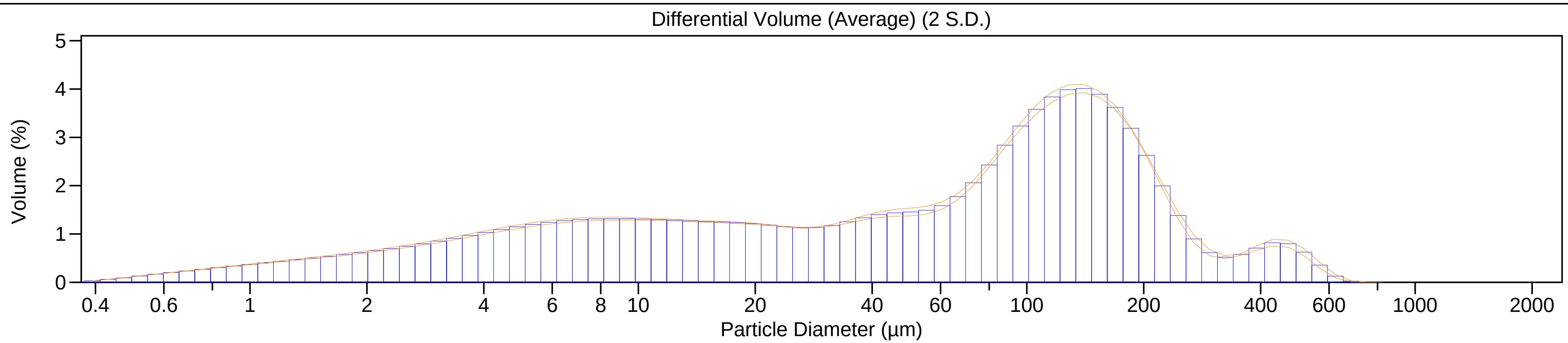
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR36_5_757.$av
COR36_5_757.$av
File ID: COR36
Sample ID: 5
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR36_5_755.$ls
C:\LS13320\Projects\WestVirgina\COR36_5_756.$ls
C:\LS13320\Projects\WestVirgina\COR36_5_757.$ls

Volume Statistics (Arithmetic) COR36_5_757.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	93.40 µm	S.D.:	105.1 µm
Median:	65.29 µm	Variance:	11037 µm^2
Mean/Median ratio:	1.431	C.V.:	112%
Mode:	140.1 µm	Skewness:	1.926 Right skewed
		Kurtosis:	4.718 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.379 µm	10.84 µm	65.29 µm	139.6 µm	209.3 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name:	**C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR39_1_526.$av**		
	COR39_1_526.$av		
File ID:	**COR39**		
Sample ID:	**1**		
Operator:	**ANDES**		
Optical model:	**Fraunhofer.rf780z**		
LS 13 320 SW	**Aqueous Liquid Module**		
		Run length:	**60 seconds**
Pump speed:	**80**		

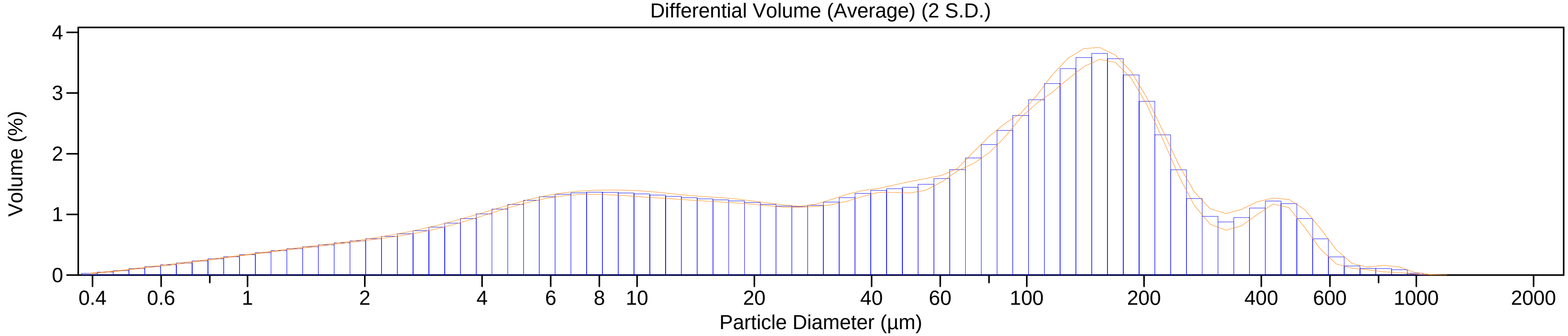
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR39_1_524.$ls
C:\LS13320\Projects\WestVirgina\COR39_1_525.$ls
C:\LS13320\Projects\WestVirgina\COR39_1_526.$ls

Volume Statistics (Arithmetic) COR39_1_526.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	108.3 µm	S.D.:	129.8 µm
Median:	67.57 µm	Variance:	16845 µm^2
Mean/Median ratio:	1.602	C.V.:	120%
Mode:	153.8 µm	Skewness:	2.094 Right skewed
		Kurtosis:	5.718 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.719 µm	11.36 µm	67.57 µm	155.9 µm	255.2 µm



Kanawha River

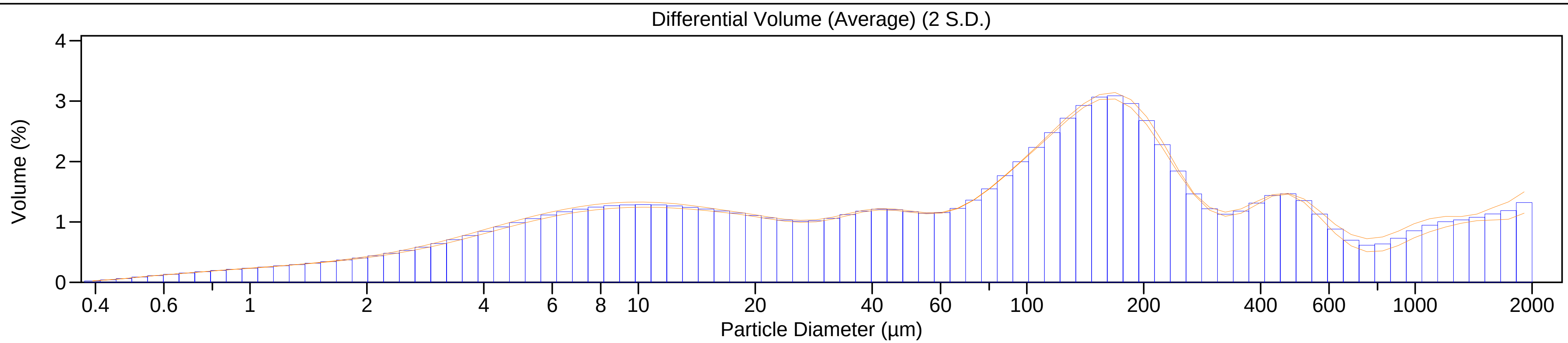
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR39_2_529.$av
COR39_2_529.$av
File ID: COR39
Sample ID: 2
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR39_2_527.$ls
C:\LS13320\Projects\WestVirgina\COR39_2_528.$ls
C:\LS13320\Projects\WestVirgina\COR39_2_529.$ls

Volume Statistics (Arithmetic) COR39_2_529.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	254.8 µm	S.D.:	413.2 µm
Median:	101.4 µm	Variance:	170.7e3 µm^2
Mean/Median ratio:	2.512	C.V.:	162%
Mode:	168.9 µm	Skewness:	2.444 Right skewed
		Kurtosis:	5.439 Leptokurtic

<10%	<25%	<50%	<75%	<90%
4.839 µm	15.39 µm	101.4 µm	242.1 µm	777.6 µm



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Kanawha River

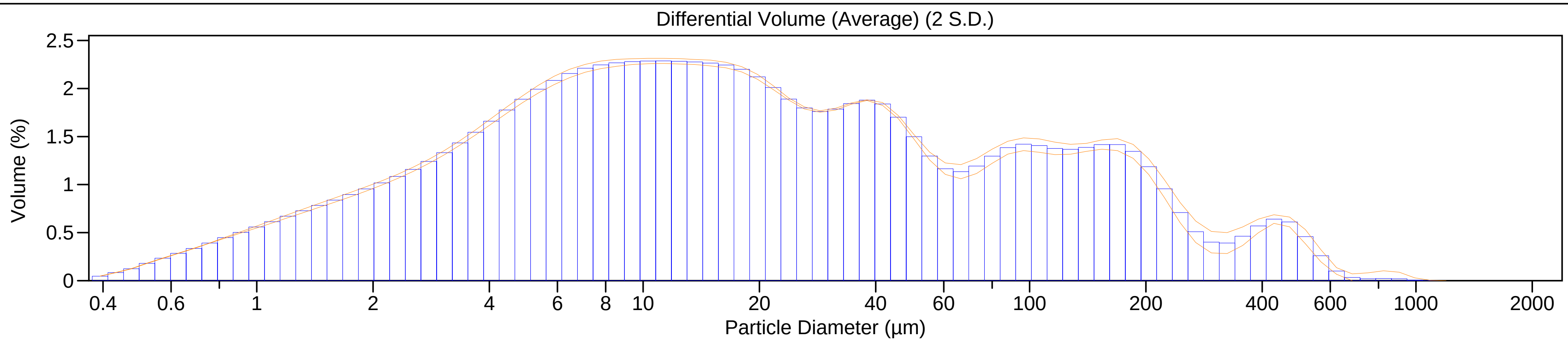
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR39_3_532.$av
COR39_3_532.$av
File ID: COR39
Sample ID: 3
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR39_3_530.$ls
C:\LS13320\Projects\WestVirgina\COR39_3_531.$ls
C:\LS13320\Projects\WestVirgina\COR39_3_532.$ls

Volume Statistics (Arithmetic) COR39_3_532.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	55.83 µm	S.D.:	96.72 µm
Median:	16.02 µm	Variance:	9354 µm^2
Mean/Median ratio:	3.485	C.V.:	173%
Mode:	11.29 µm	Skewness:	3.164 Right skewed
		Kurtosis:	12.19 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.268 µm	5.660 µm	16.02 µm	56.48 µm	162.6 µm



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Kanawha River

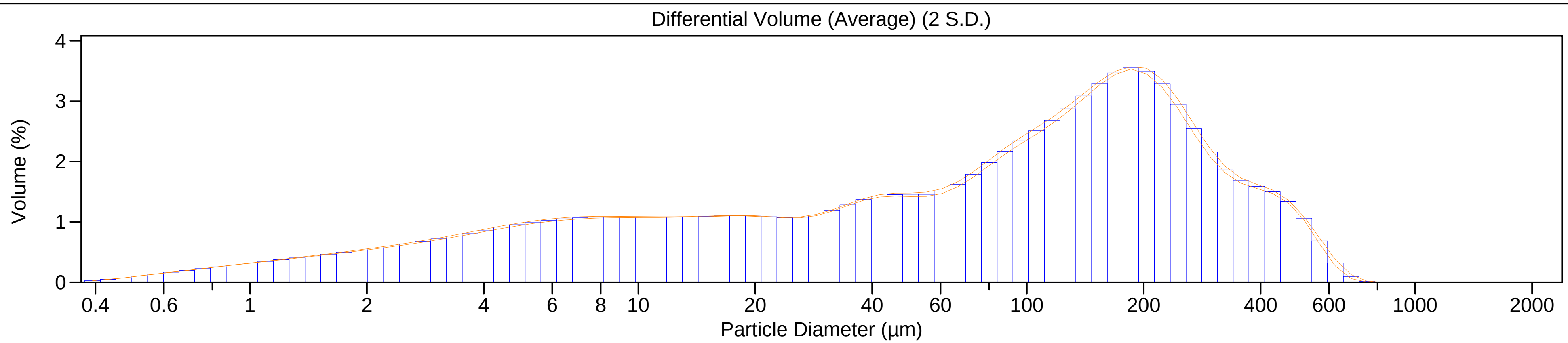
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR39_4_535.$av
COR39_4_535.$av
File ID: COR39
Sample ID: 4
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR39_4_533.$ls
C:\LS13320\Projects\WestVirgina\COR39_4_534.$ls
C:\LS13320\Projects\WestVirgina\COR39_4_535.$ls

Volume Statistics (Arithmetic) COR39_4_535.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	125.8 µm	S.D.:	132.5 µm
Median:	86.05 µm	Variance:	17545 µm^2
Mean/Median ratio:	1.462	C.V.:	105%
Mode:	185.4 µm	Skewness:	1.353 Right skewed
		Kurtosis:	1.556 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.997 µm	15.35 µm	86.05 µm	192.2 µm	312.2 µm



AR101229

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name:	**C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR39_5_538.$av**
	COR39_5_538.$av
File ID:	**COR39**
Sample ID:	**5**
Operator:	**ANDES**
Optical model:	**Fraunhofer.rf780z**
LS 13 320 SW	**Aqueous Liquid Module**
Run length:	**60 seconds**
Pump speed:	**80**

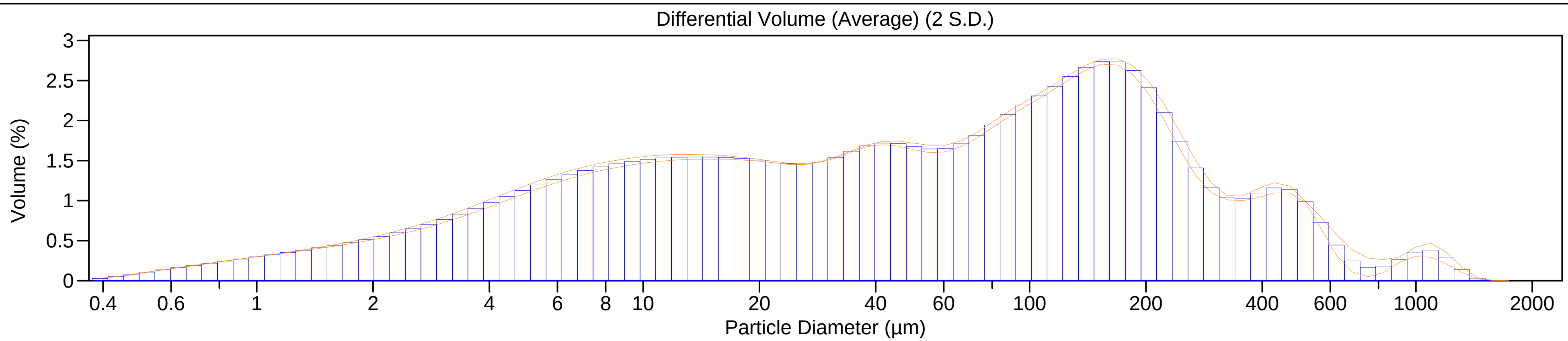
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR39_5_536.$ls
C:\LS13320\Projects\WestVirgina\COR39_5_537.$ls
C:\LS13320\Projects\WestVirgina\COR39_5_538.$ls

Volume Statistics (Arithmetic) COR39_5_538.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	119.1 µm	S.D.:	178.8 µm
Median:	51.40 µm	Variance:	31964 µm^2
Mean/Median ratio:	2.317	C.V.:	150%
Mode:	153.8 µm	Skewness:	3.175 Right skewed
		Kurtosis:	13.17 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.988 µm	11.55 µm	51.40 µm	155.1 µm	301.7 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

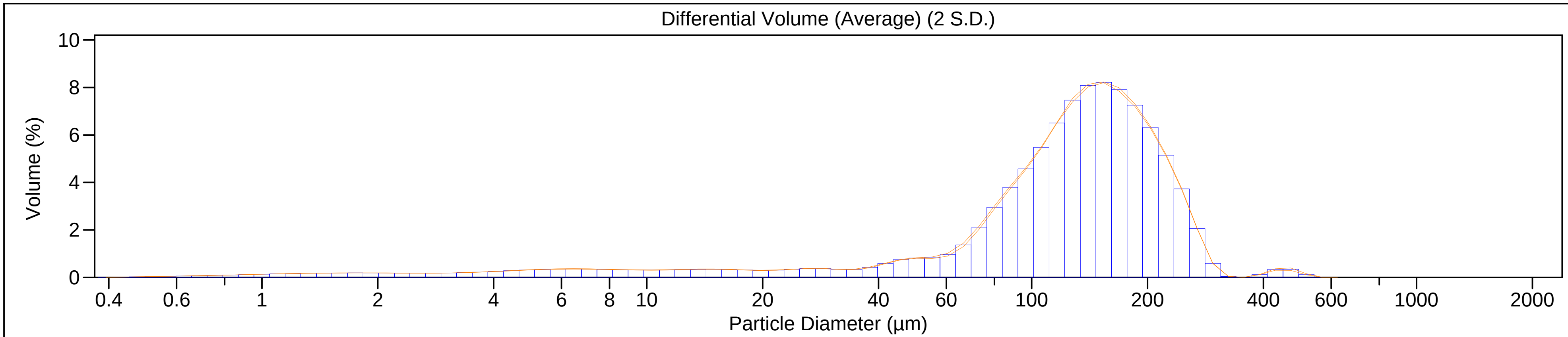
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR40_1_589.$av
COR40_1_589.$av
File ID: COR40
Sample ID: 1
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR40_1_587.$ls
C:\LS13320\Projects\WestVirgina\COR40_1_588.$ls
C:\LS13320\Projects\WestVirgina\COR40_1_589.$ls

Volume Statistics (Arithmetic) COR40_1_589.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	134.8 µm	S.D.:	73.88 µm
Median:	134.2 µm	Variance:	5458 μm^2
Mean/Median ratio:	1.004	C.V.:	54.8%
Mode:	153.8 µm	Skewness:	0.616 Right skewed
		Kurtosis:	2.294 Leptokurtic

<10%	<25%	<50%	<75%	<90%
26.73 µm	90.62 µm	134.2 µm	179.5 µm	223.4 µm



AR101231

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

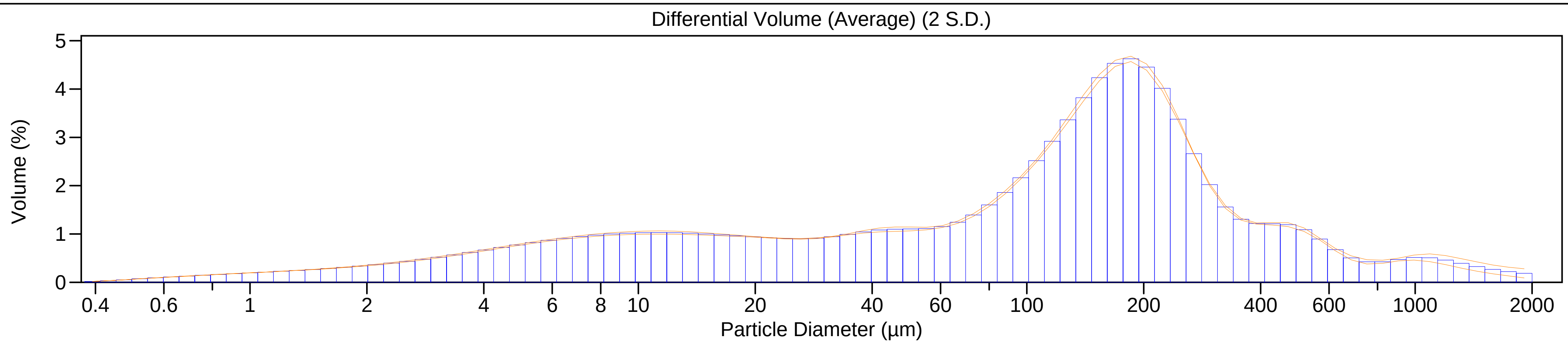
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR40_2_592.$av
COR40_2_592.$av
File ID: COR40
Sample ID: 2
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR40_2_590.$ls
C:\LS13320\Projects\WestVirgina\COR40_2_591.$ls
C:\LS13320\Projects\WestVirgina\COR40_2_592.$ls

Volume Statistics (Arithmetic) COR40_2_592.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	183.7 µm	S.D.:	252.9 µm
Median:	125.3 µm	Variance:	63974 µm^2
Mean/Median ratio:	1.467	C.V.:	138%
Mode:	185.4 µm	Skewness:	3.309 Right skewed
		Kurtosis:	13.79 Leptokurtic

<10%	<25%	<50%	<75%	<90%
5.960 µm	24.99 µm	125.3 µm	218.1 µm	402.7 µm



Kanawha River

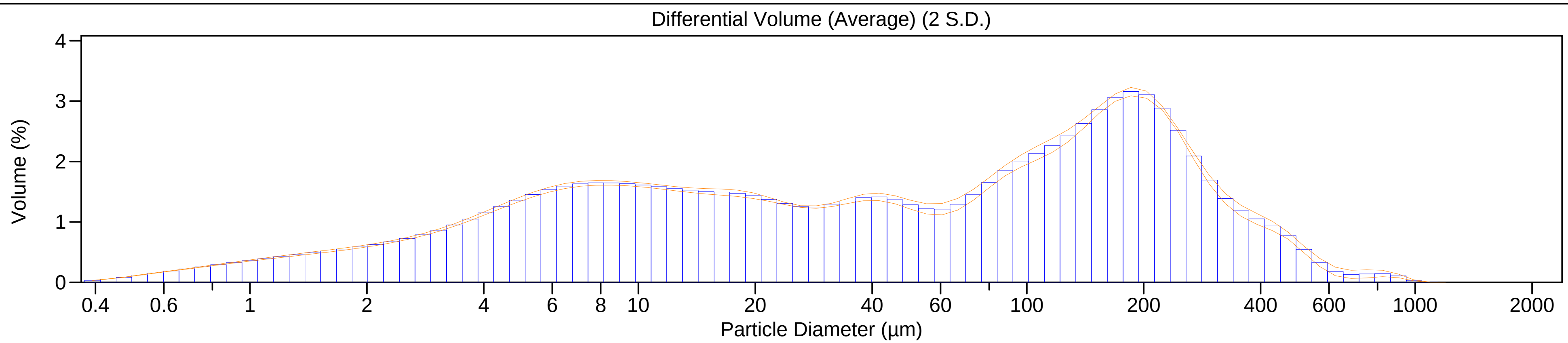
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR40_3_595.$av
COR40_3_595.$av
File ID: COR40
Sample ID: 3
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR40_3_593.$ls
C:\LS13320\Projects\WestVirgina\COR40_3_594.$ls
C:\LS13320\Projects\WestVirgina\COR40_3_595.$ls

Volume Statistics (Arithmetic) COR40_3_595.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	103.2 µm	S.D.:	128.1 µm
Median:	47.11 µm	Variance:	16400 µm^2
Mean/Median ratio:	2.190	C.V.:	124%
Mode:	185.4 µm	Skewness:	2.045 Right skewed
		Kurtosis:	5.998 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.474 µm	9.237 µm	47.11 µm	163.5 µm	265.7 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

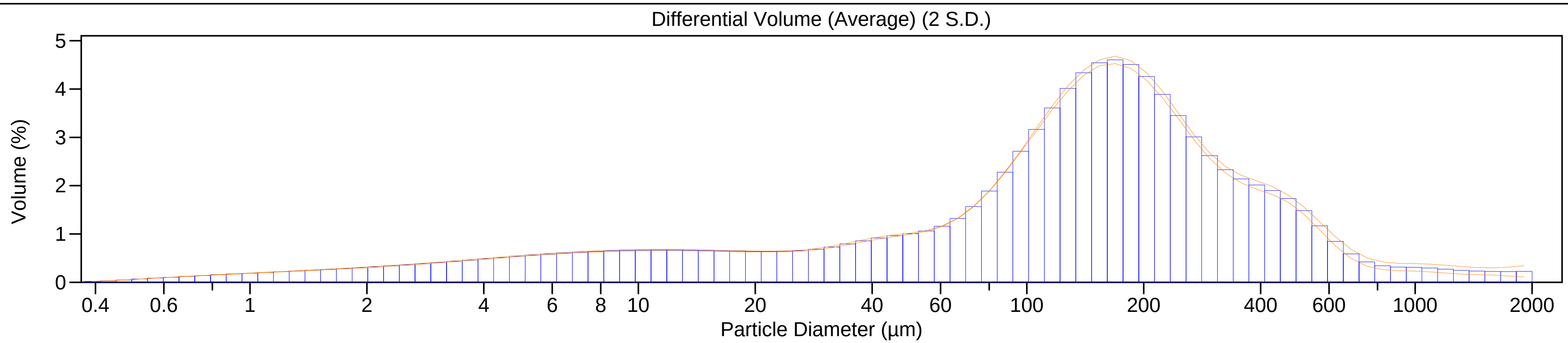
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR40_4_598.$av
COR40_4_598.$av
File ID: COR40
Sample ID: 4
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR40_4_596.$ls
C:\LS13320\Projects\WestVirgina\COR40_4_597.$ls
C:\LS13320\Projects\WestVirgina\COR40_4_598.$ls

Volume Statistics (Arithmetic) COR40_4_598.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	196.9 µm	S.D.:	235.9 µm
Median:	141.4 µm	Variance:	55639 µm^2
Mean/Median ratio:	1.392	C.V.:	120%
Mode:	168.9 µm	Skewness:	3.372 Right skewed
		Kurtosis:	16.08 Leptokurtic

<10%	<25%	<50%	<75%	<90%
7.924 µm	54.26 µm	141.4 µm	243.4 µm	427.4 µm



AR101234

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name:	**C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR40_5_601.$av**
	COR40_5_601.$av
File ID:	**COR40**
Sample ID:	**5**
Operator:	**ANDES**
Optical model:	**Fraunhofer.rf780z**
LS 13 320 SW	**Aqueous Liquid Module**

Run length: **60 seconds**

Pump speed: **80**

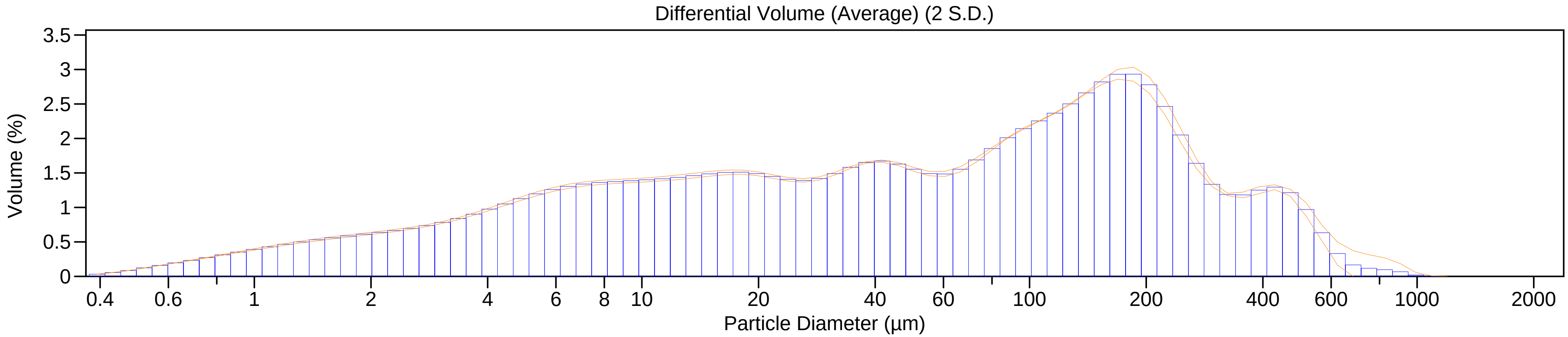
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR40_5_599.$ls
C:\LS13320\Projects\WestVirgina\COR40_5_600.$ls
C:\LS13320\Projects\WestVirgina\COR40_5_601.$ls

Volume Statistics (Arithmetic) COR40_5_601.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	107.3 µm	S.D.:	134.1 µm
Median:	51.11 µm	Variance:	17988 µm^2
Mean/Median ratio:	2.098	C.V.:	125%
Mode:	185.4 µm	Skewness:	1.961 Right skewed
		Kurtosis:	4.566 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.424 µm	10.83 µm	51.11 µm	159.5 µm	280.1 µm



LS Particle Size Analyzer

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24 Sep 2009

Kanawha River

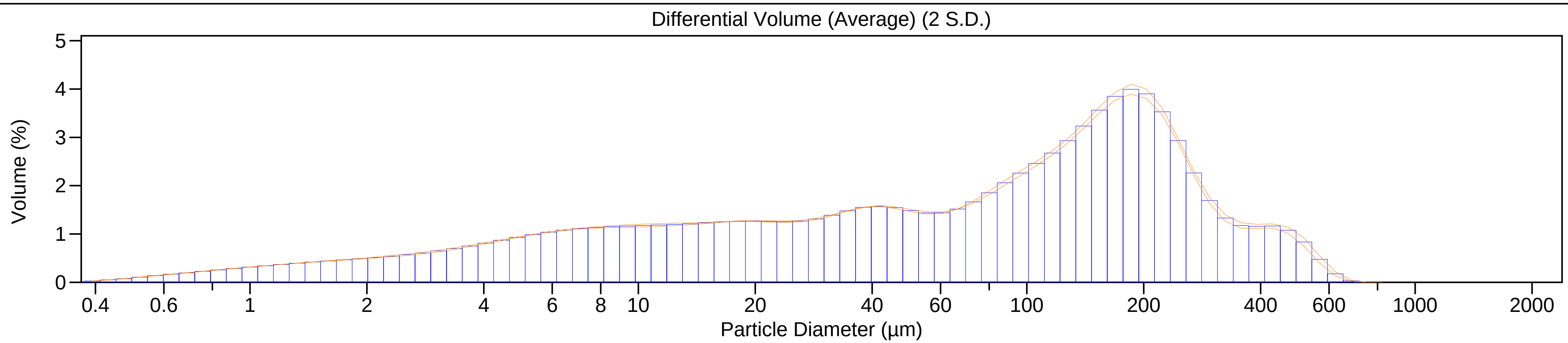
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR40_6_607.$av
COR40_6_607.$av
File ID: COR40
Sample ID: 6
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR40_6_605.$ls
C:\LS13320\Projects\WestVirgina\COR40_6_606.$ls
C:\LS13320\Projects\WestVirgina\COR40_6_607.$ls

Volume Statistics (Arithmetic) COR40_6_607.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	115.5 µm	S.D.:	121.4 µm
Median:	78.99 µm	Variance:	14738 µm^2
Mean/Median ratio:	1.463	C.V.:	105%
Mode:	185.4 µm	Skewness:	1.414 Right skewed
		Kurtosis:	1.974 Leptokurtic

<10%	<25%	<50%	<75%	<90%
4.281 µm	15.21 µm	78.99 µm	180.2 µm	272.3 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

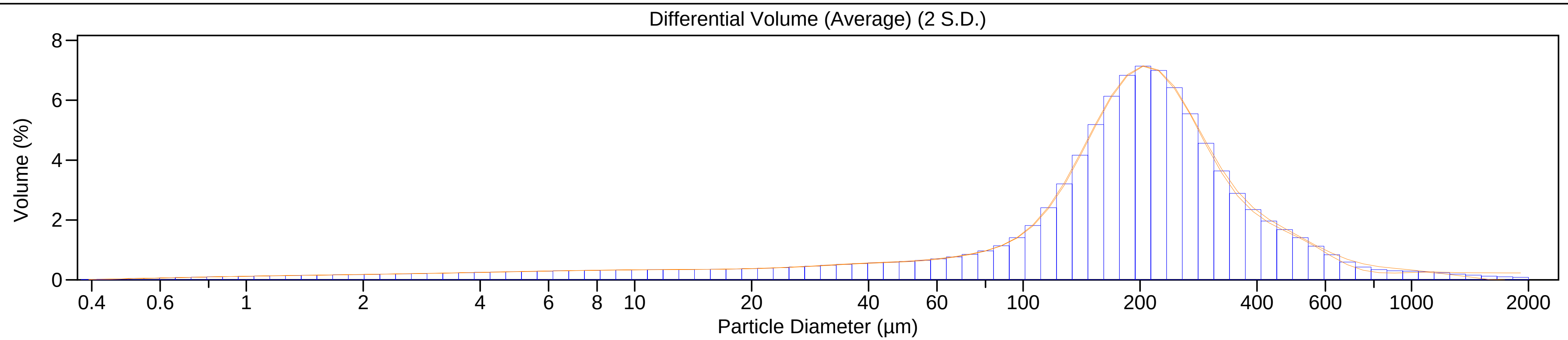
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR40_7_610.$av
COR40_7_610.$av
File ID: COR40
Sample ID: 7
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR40_7_608.$ls
C:\LS13320\Projects\WestVirgina\COR40_7_609.$ls
C:\LS13320\Projects\WestVirgina\COR40_7_610.$ls

Volume Statistics (Arithmetic) COR40_7_610.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	225.7 µm	S.D.:	198.8 µm
Median:	193.4 µm	Variance:	39508 µm^2
Mean/Median ratio:	1.167	C.V.:	88.1%
Mode:	203.5 µm	Skewness:	3.111 Right skewed
		Kurtosis:	16.07 Leptokurtic

<10%	<25%	<50%	<75%	<90%
25.74 µm	122.6 µm	193.4 µm	275.6 µm	412.5 µm



AR101237

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

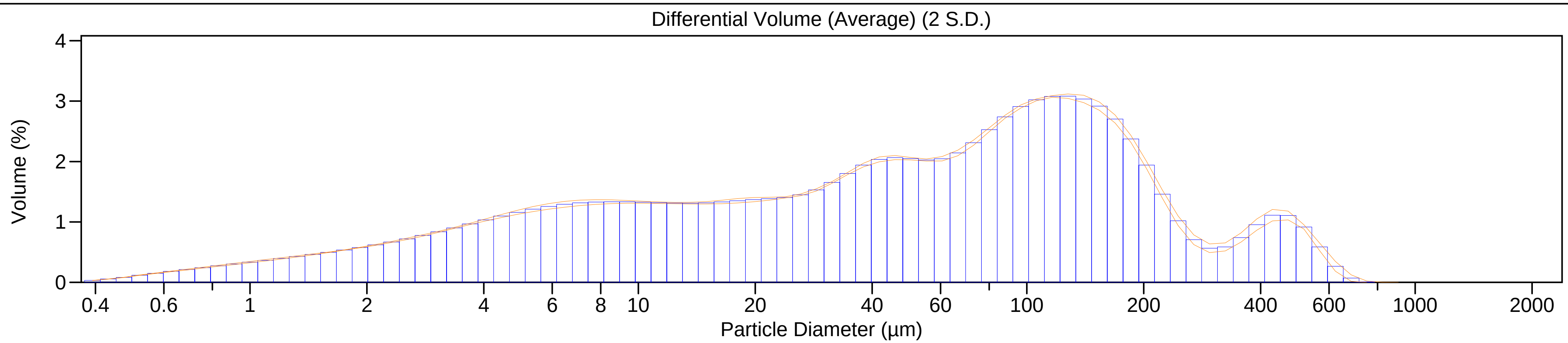
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR42_1_574.$av
COR42_1_574.$av
File ID: COR42
Sample ID: 1
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR42_1_572.$ls
C:\LS13320\Projects\WestVirgina\COR42_1_573.$ls
C:\LS13320\Projects\WestVirgina\COR42_1_574.$ls

Volume Statistics (Arithmetic) COR42_1_574.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	91.70 µm	S.D.:	115.9 µm
Median:	50.24 µm	Variance:	13422 µm^2
Mean/Median ratio:	1.825	C.V.:	126%
Mode:	127.7 µm	Skewness:	2.190 Right skewed
		Kurtosis:	5.200 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.604 µm	11.24 µm	50.24 µm	126.3 µm	214.7 µm



AR101238

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

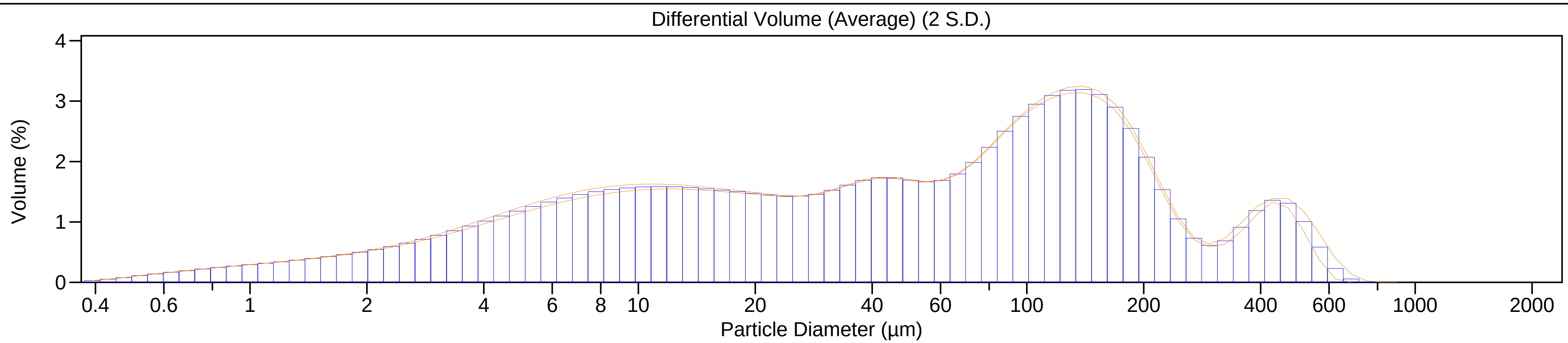
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR42_2_577.$av
COR42_2_577.$av
File ID: COR42
Sample ID: 2
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR42_2_575.$ls
C:\LS13320\Projects\WestVirgina\COR42_2_576.$ls
C:\LS13320\Projects\WestVirgina\COR42_2_577.$ls

Volume Statistics (Arithmetic) COR42_2_577.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	95.74 µm	S.D.:	120.3 µm
Median:	49.65 µm	Variance:	14482 µm^2
Mean/Median ratio:	1.928	C.V.:	126%
Mode:	140.1 µm	Skewness:	2.021 Right skewed
		Kurtosis:	4.151 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.992 µm	11.07 µm	49.65 µm	134.1 µm	230.4 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

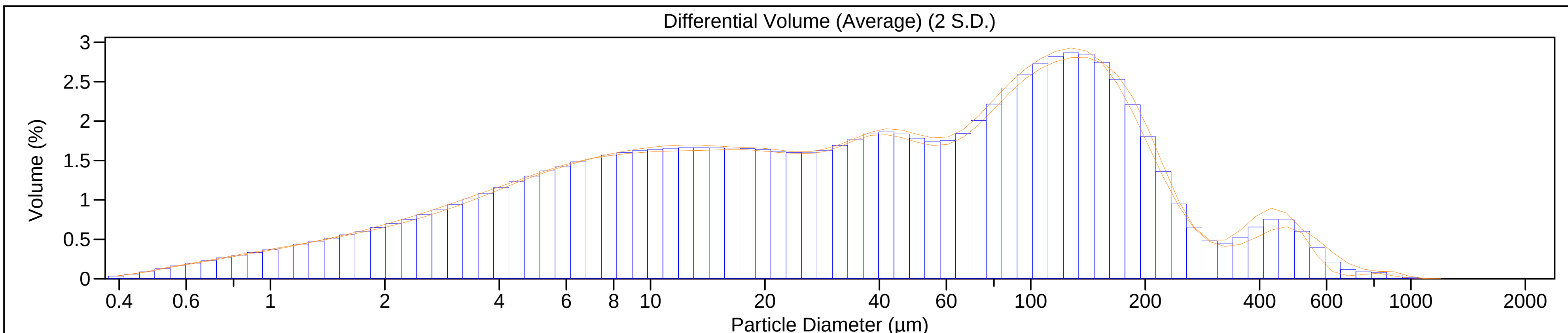
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR42_3_580.$av
COR42_3_580.$av
File ID: COR42
Sample ID: 3
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR42_3_578.$ls
C:\LS13320\Projects\WestVirgina\COR42_3_579.$ls
C:\LS13320\Projects\WestVirgina\COR42_3_580.$ls

Volume Statistics (Arithmetic) COR42_3_580.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	81.03 µm	S.D.:	111.8 µm
Median:	37.37 µm	Variance:	12508 µm^2
Mean/Median ratio:	2.169	C.V.:	138%
Mode:	127.7 µm	Skewness:	2.778 Right skewed
		Kurtosis:	10.36 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.240 µm	9.129 µm	37.37 µm	114.7 µm	193.8 µm



Kanawha River

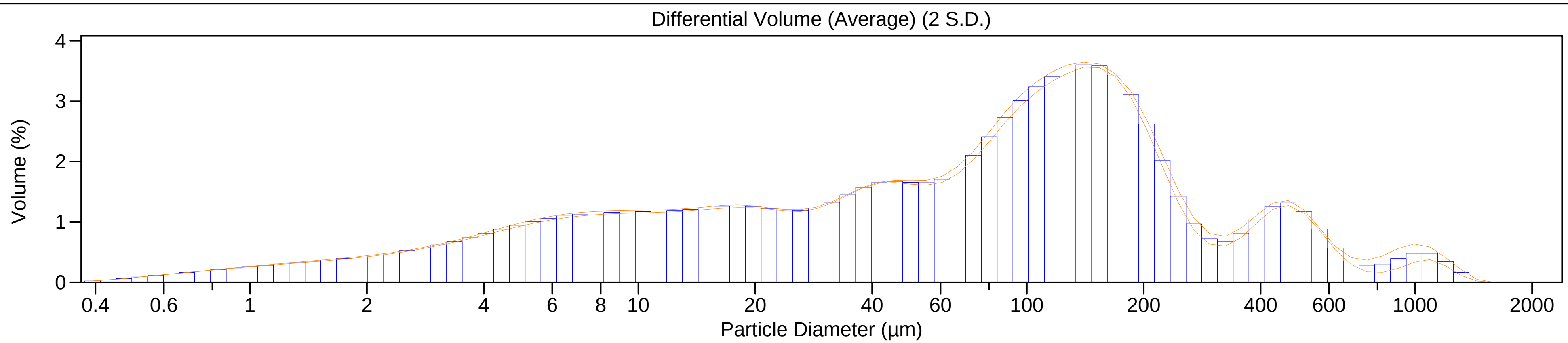
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR42_4_583.$av
COR42_4_583.$av
File ID: COR42
Sample ID: 4
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR42_4_581.$ls
C:\LS13320\Projects\WestVirgina\COR42_4_582.$ls
C:\LS13320\Projects\WestVirgina\COR42_4_583.$ls

Volume Statistics (Arithmetic) COR42_4_583.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	134.1 µm	S.D.:	191.7 µm
Median:	77.59 µm	Variance:	36742 µm^2
Mean/Median ratio:	1.728	C.V.:	143%
Mode:	140.1 µm	Skewness:	3.059 Right skewed
		Kurtosis:	11.46 Leptokurtic

<10%	<25%	<50%	<75%	<90%
4.793 µm	16.40 µm	77.59 µm	160.6 µm	334.8 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

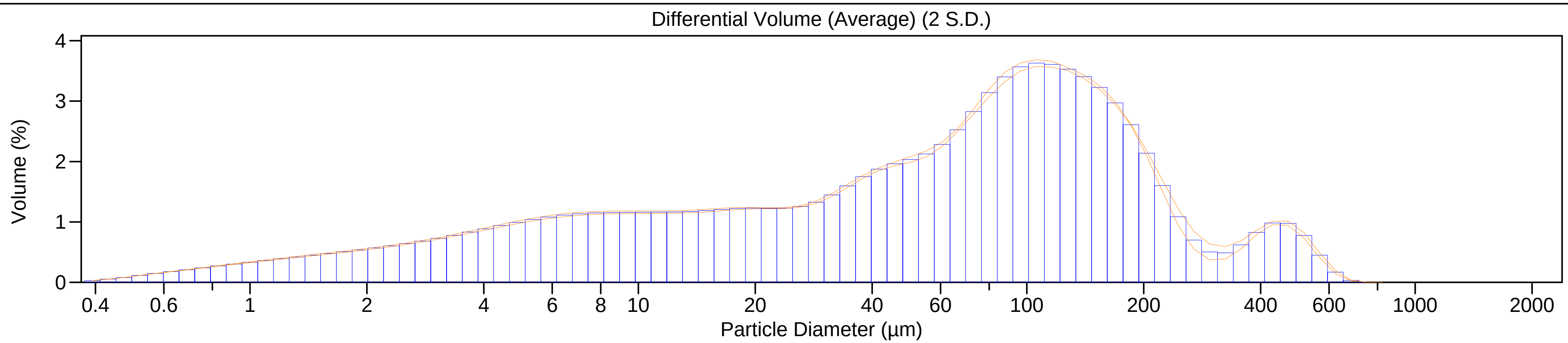
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\COR42_5_586.$av
COR42_5_586.$av
File ID: COR42
Sample ID: 5
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\COR42_5_584.$ls
C:\LS13320\Projects\WestVirgina\COR42_5_585.$ls
C:\LS13320\Projects\WestVirgina\COR42_5_586.$ls

Volume Statistics (Arithmetic) COR42_5_586.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	92.98 µm	S.D.:	107.8 µm
Median:	62.90 µm	Variance:	11625 $µm^2$
Mean/Median ratio:	1.478	C.V.:	116%
Mode:	105.9 µm	Skewness:	2.153 Right skewed
		Kurtosis:	5.451 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.891 µm	13.99 µm	62.90 µm	128.9 µm	206.2 µm



AR101242

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

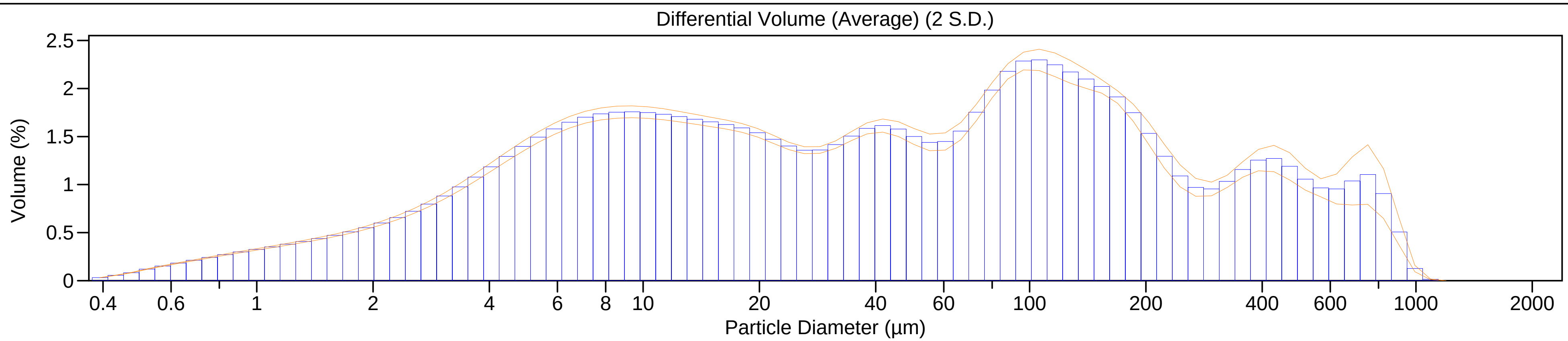
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD01_1_670.$av
KRSD01_1_670.$av
File ID: KRSD01
Sample ID: 1
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD01_1_668.$ls
C:\LS13320\Projects\WestVirgina\KRSD01_1_669.$ls
C:\LS13320\Projects\WestVirgina\KRSD01_1_670.$ls

Volume Statistics (Arithmetic) KRSD01_1_670.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	121.7 µm	S.D.:	185.9 µm
Median:	40.43 µm	Variance:	34557 µm^2
Mean/Median ratio:	3.010	C.V.:	153%
Mode:	105.9 µm	Skewness:	2.283 Right skewed
		Kurtosis:	4.961 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.607 µm	9.147 µm	40.43 µm	141.3 µm	384.6 µm



AR101243

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

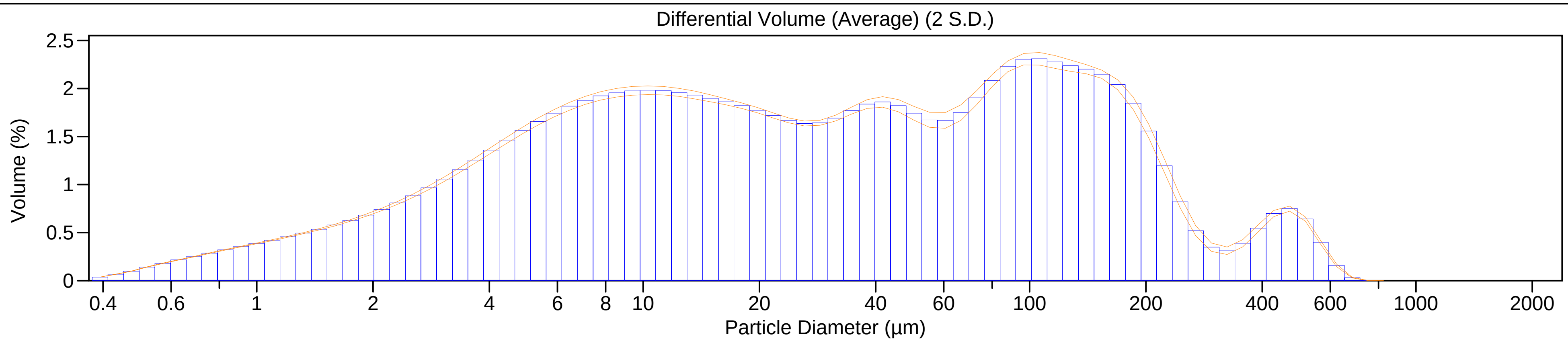
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD01_2_676.$av
KRSD01_2_676.$av
File ID: KRSD01
Sample ID: 2
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD01_2_674.$ls
C:\LS13320\Projects\WestVirgina\KRSD01_2_675.$ls
C:\LS13320\Projects\WestVirgina\KRSD01_2_676.$ls

Volume Statistics (Arithmetic) KRSD01_2_676.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	69.31 µm	S.D.:	100.8 µm
Median:	26.53 µm	Variance:	10157 µm^2
Mean/Median ratio:	2.613	C.V.:	145%
Mode:	105.9 µm	Skewness:	2.662 Right skewed
		Kurtosis:	8.285 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.043 µm	7.613 µm	26.53 µm	94.99 µm	179.0 µm



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LS Particle Size Analyzer

24 Sep 2009

Kanawha River

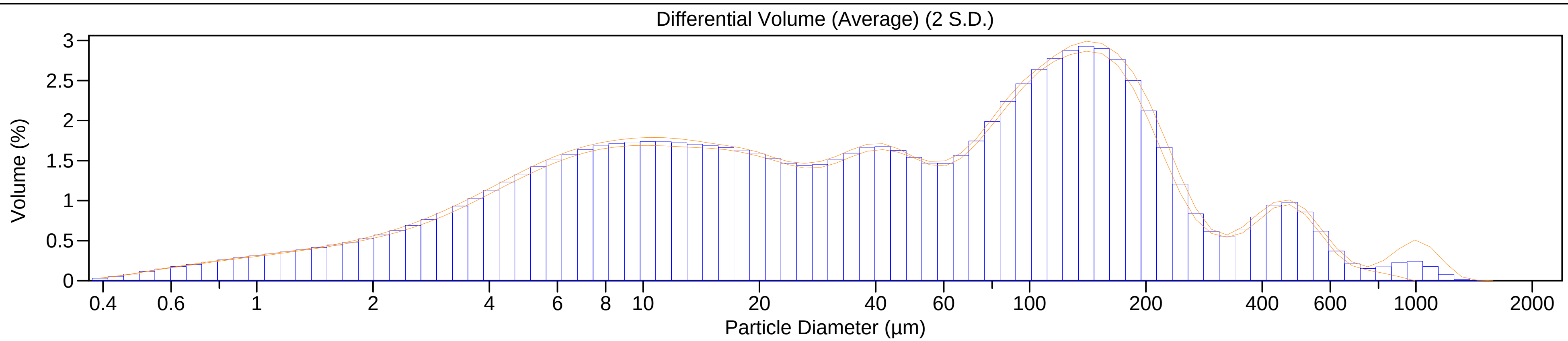
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD01_3_682.$av
KRSD01_3_682.$av
File ID: KRSD01
Sample ID: 3
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD01_3_680.$ls
C:\LS13320\Projects\WestVirgina\KRSD01_3_681.$ls
C:\LS13320\Projects\WestVirgina\KRSD01_3_682.$ls

Volume Statistics (Arithmetic) KRSD01_3_682.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	98.73 µm	S.D.:	148.2 µm
Median:	41.23 µm	Variance:	21957 µm^2
Mean/Median ratio:	2.394	C.V.:	150%
Mode:	140.1 µm	Skewness:	3.204 Right skewed
		Kurtosis:	13.76 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.762 µm	9.681 µm	41.23 µm	132.0 µm	230.2 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

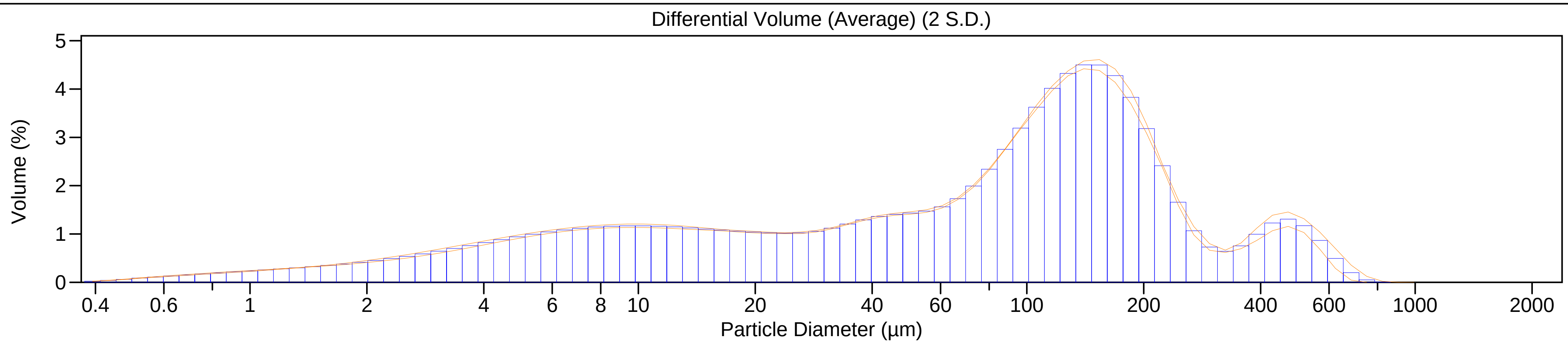
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD01_4_685.$av
KRSD01_4_685.$av
File ID: KRSD01
Sample ID: 4
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD01_4_683.$ls
C:\LS13320\Projects\WestVirgina\KRSD01_4_684.$ls
C:\LS13320\Projects\WestVirgina\KRSD01_4_685.$ls

Volume Statistics (Arithmetic) KRSD01_4_685.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	116.6 µm	S.D.:	126.7 µm
Median:	89.21 µm	Variance:	16041 µm^2
Mean/Median ratio:	1.307	C.V.:	109%
Mode:	140.1 µm	Skewness:	1.868 Right skewed
		Kurtosis:	3.919 Leptokurtic

<10%	<25%	<50%	<75%	<90%
4.840 µm	17.09 µm	89.21 µm	160.8 µm	250.3 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

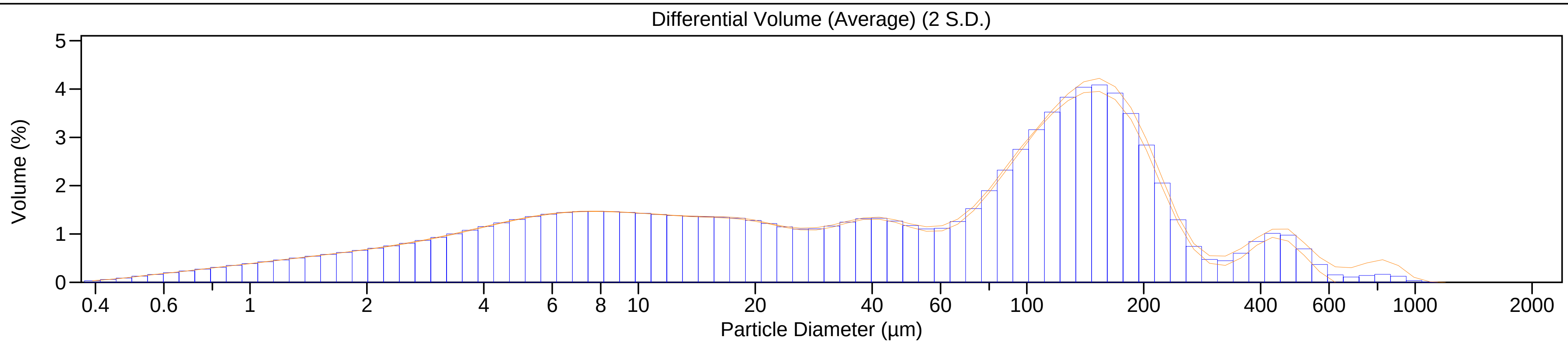
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD01_5_691.$av
KRSD01_5_691.$av
File ID: KRSD01
Sample ID: 5
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD01_5_689.$ls
C:\LS13320\Projects\WestVirgina\KRSD01_5_690.$ls
C:\LS13320\Projects\WestVirgina\KRSD01_5_691.$ls

Volume Statistics (Arithmetic) KRSD01_5_691.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	97.90 µm	S.D.:	122.3 µm
Median:	57.83 µm	Variance:	14952 μm^2
Mean/Median ratio:	1.693	C.V.:	125%
Mode:	153.8 µm	Skewness:	2.479 Right skewed
		Kurtosis:	8.928 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.179 µm	9.264 µm	57.83 µm	145.5 µm	215.8 µm



AR101247

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

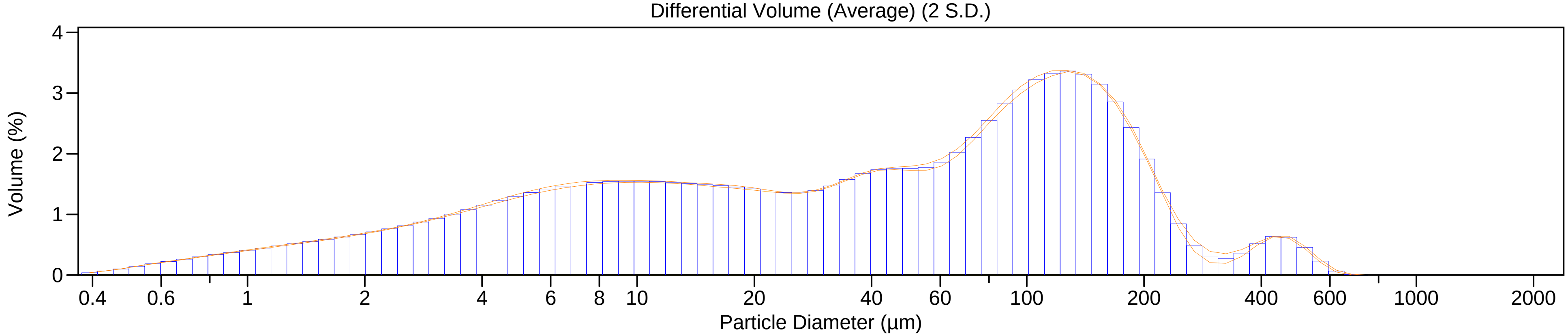
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD04_1_628.$av
KRSD04_1_628.$av
File ID: KRSD04
Sample ID: 1
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD04_1_626.$ls
C:\LS13320\Projects\WestVirgina\KRSD04_1_627.$ls
C:\LS13320\Projects\WestVirgina\KRSD04_1_628.$ls

Volume Statistics (Arithmetic) KRSD04_1_628.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	76.45 µm	S.D.:	93.42 µm
Median:	42.74 µm	Variance:	8727 µm^2
Mean/Median ratio:	1.789	C.V.:	122%
Mode:	127.7 µm	Skewness:	2.290 Right skewed
		Kurtosis:	6.960 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.081 µm	8.957 µm	42.74 µm	115.9 µm	180.5 µm



AR101248

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD04_2_631.$av
KRSD04_2_631.$av
File ID: KRSD04
Sample ID: 2
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD04_2_629.$ls
C:\LS13320\Projects\WestVirgina\KRSD04_2_630.$ls
C:\LS13320\Projects\WestVirgina\KRSD04_2_631.$ls

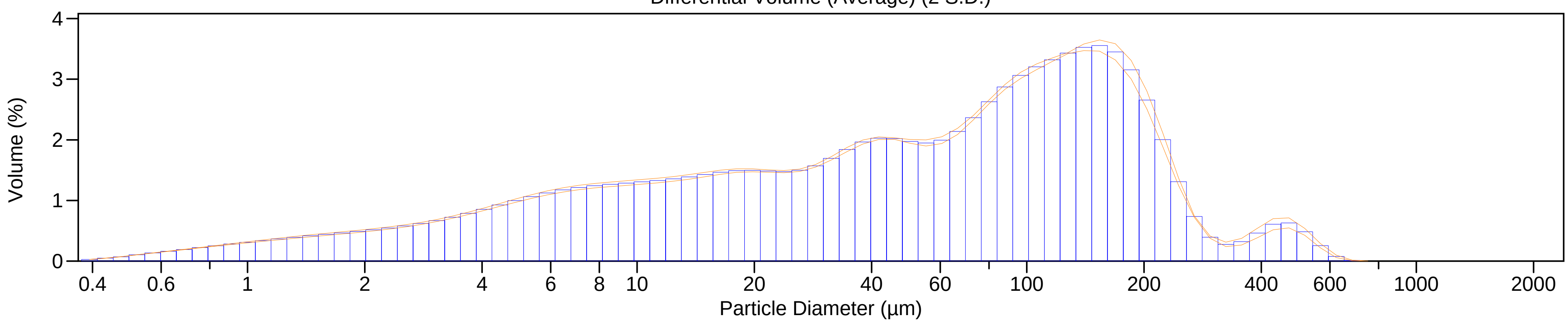
Volume Statistics (Arithmetic) KRSD04_2_631.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	85.68 µm	S.D.:	95.28 µm
Median:	54.94 µm	Variance:	9079 µm^2
Mean/Median ratio:	1.559	C.V.:	111%
Mode:	153.8 µm	Skewness:	2.066 Right skewed
		Kurtosis:	5.872 Leptokurtic

<10%	<25%	<50%	<75%	<90%
4.236 µm	13.63 µm	54.94 µm	130.0 µm	195.8 µm

Differential Volume (Average) (2 S.D.)



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

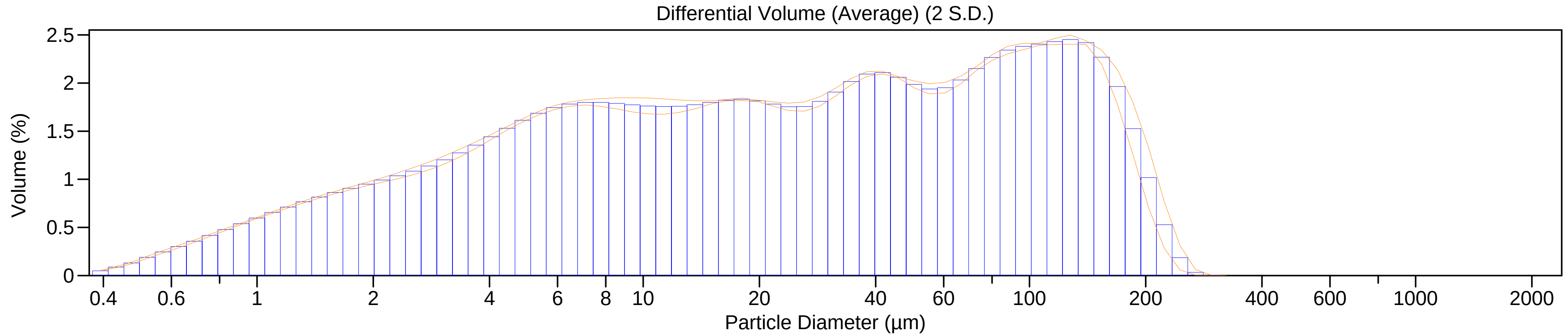
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD04_3_640.$av
KRSD04_3_640.$av
File ID: KRSD04
Sample ID: 3
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD04_3_638.$ls
C:\LS13320\Projects\WestVirgina\KRSD04_3_639.$ls
C:\LS13320\Projects\WestVirgina\KRSD04_3_640.$ls

Volume Statistics (Arithmetic) KRSD04_3_640.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	46.91 µm	S.D.:	53.75 µm
Median:	22.49 µm	Variance:	2889 µm^2
Mean/Median ratio:	2.086	C.V.:	115%
Mode:	127.7 µm	Skewness:	1.349 Right skewed
		Kurtosis:	0.986 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.196 µm	6.107 µm	22.49 µm	73.97 µm	133.5 µm



Kanawha River

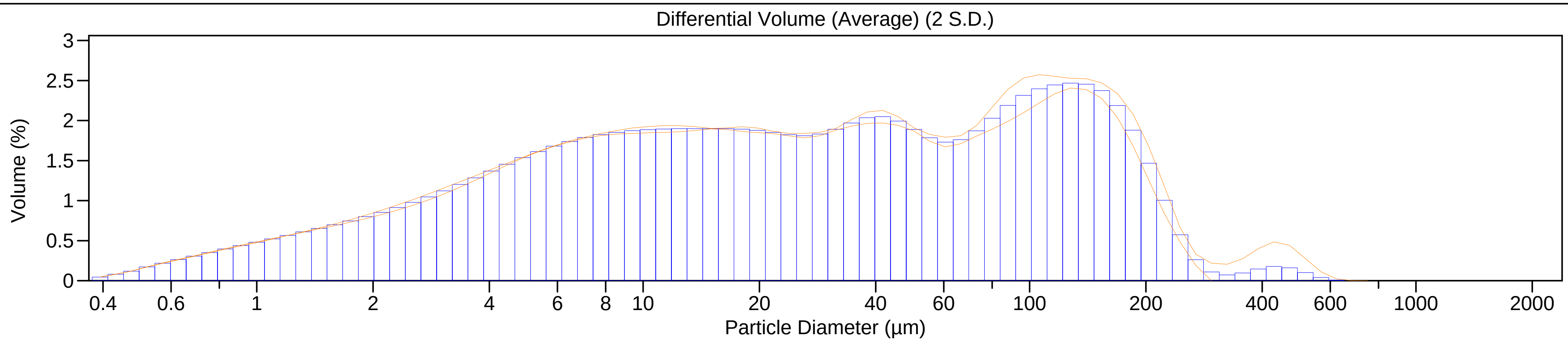
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD04_4_643.$av
KRSD04_4_643.$av
File ID: KRSD04
Sample ID: 4
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD04_4_641.$ls
C:\LS13320\Projects\WestVirgina\KRSD04_4_642.$ls
C:\LS13320\Projects\WestVirgina\KRSD04_4_643.$ls

Volume Statistics (Arithmetic) KRSD04_4_643.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	54.50 µm	S.D.:	68.69 µm
Median:	24.44 µm	Variance:	4718 µm^2
Mean/Median ratio:	2.230	C.V.:	126%
Mode:	127.7 µm	Skewness:	2.275 Right skewed
		Kurtosis:	8.062 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.609 µm	7.035 µm	24.44 µm	83.63 µm	150.8 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

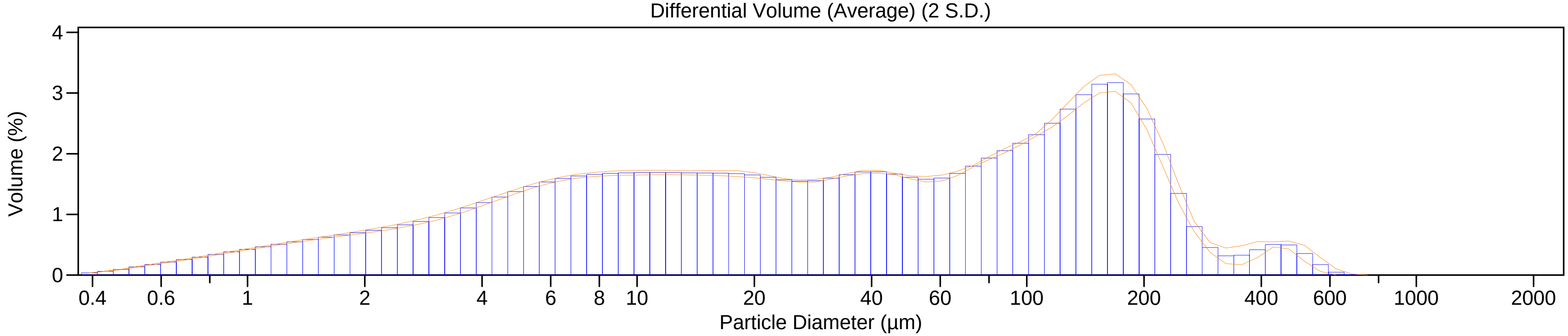
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD04_5_646.$av
KRSD04_5_646.$av
File ID: KRSD04
Sample ID: 5
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD04_5_644.$ls
C:\LS13320\Projects\WestVirgina\KRSD04_5_645.$ls
C:\LS13320\Projects\WestVirgina\KRSD04_5_646.$ls

Volume Statistics (Arithmetic) KRSD04_5_646.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	75.20 µm	S.D.:	92.91 µm
Median:	34.51 µm	Variance:	8633 µm^2
Mean/Median ratio:	2.179	C.V.:	124%
Mode:	168.9 µm	Skewness:	2.040 Right skewed
		Kurtosis:	5.482 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.000 µm	8.362 µm	34.51 µm	121.0 µm	193.1 µm



AR101252

Kanawha River

File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD05_1_475.$av
KRSD05_1_475.$av
File ID: KRSD05
Sample ID: 1
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD05_1_473.$ls
C:\LS13320\Projects\WestVirgina\KRSD05_1_474.$ls
C:\LS13320\Projects\WestVirgina\KRSD05_1_475.$ls

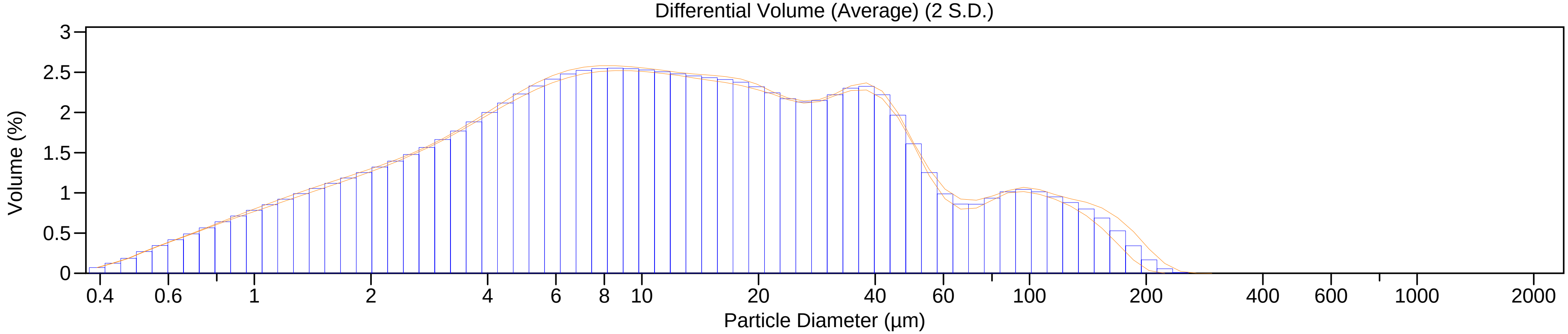
Volume Statistics (Arithmetic) KRSD05_1_475.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	24.65 µm	S.D.:	34.28 µm
Median:	11.07 µm	Variance:	1175 µm^2
Mean/Median ratio:	2.227	C.V.:	139%
Mode:	8.537 µm	Skewness:	2.513 Right skewed
		Kurtosis:	6.821 Leptokurtic

<10%	<25%	<50%	<75%	<90%
1.732 µm	4.232 µm	11.07 µm	30.10 µm	64.44 µm

Differential Volume (Average) (2 S.D.)



AR101253

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD05_2_481.$av
KRSD05_2_481.$av
File ID: KRSD05
Sample ID: 2
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD05_2_479.$ls
C:\LS13320\Projects\WestVirgina\KRSD05_2_480.$ls
C:\LS13320\Projects\WestVirgina\KRSD05_2_481.$ls

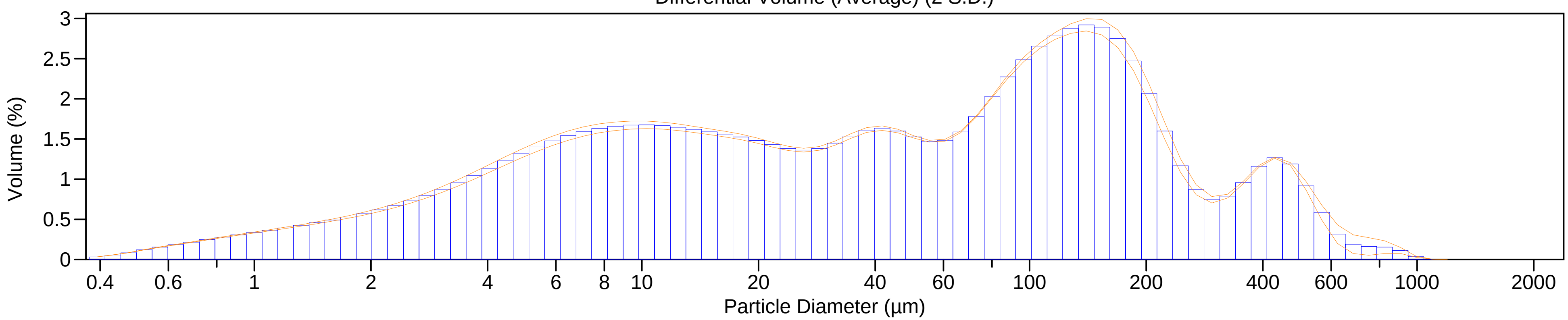
Volume Statistics (Arithmetic) KRSD05_2_481.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	97.73 µm	S.D.:	132.9 µm
Median:	43.33 µm	Variance:	17674 µm^2
Mean/Median ratio:	2.255	C.V.:	136%
Mode:	140.1 µm	Skewness:	2.381 Right skewed
		Kurtosis:	6.937 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.555 µm	9.509 µm	43.33 µm	135.2 µm	246.2 µm

Differential Volume (Average) (2 S.D.)



AR101254

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD05_3_487.$av
KRSD05_3_487.$av
File ID: KRSD05
Sample ID: 3
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD05_3_485.$ls
C:\LS13320\Projects\WestVirgina\KRSD05_3_486.$ls
C:\LS13320\Projects\WestVirgina\KRSD05_3_487.$ls

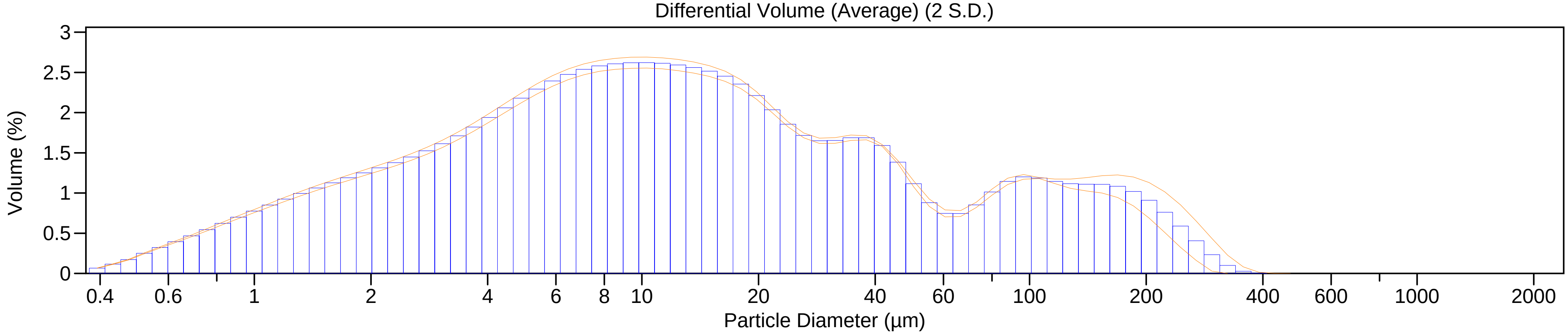
Volume Statistics (Arithmetic) KRSD05_3_487.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	33.53 µm	S.D.:	53.71 µm
Median:	11.20 µm	Variance:	2884 µm^2
Mean/Median ratio:	2.992	C.V.:	160%
Mode:	10.29 µm	Skewness:	2.535 Right skewed
		Kurtosis:	6.493 Leptokurtic

<10%	<25%	<50%	<75%	<90%
1.753 µm	4.327 µm	11.20 µm	32.74 µm	107.8 µm

Differential Volume (Average) (2 S.D.)



LS Particle Size Analyzer

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Kanawha River

File name:	**C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD05_4_496.$av**
	KRSD05_4_496.$av
File ID:	**KRSD05**
Sample ID:	**4**
Operator:	**ANDES**
Optical model:	**Fraunhofer.rf780z**
LS 13 320 SW	**Aqueous Liquid Module**

Run length: **60 seconds**

Pump speed: **80**

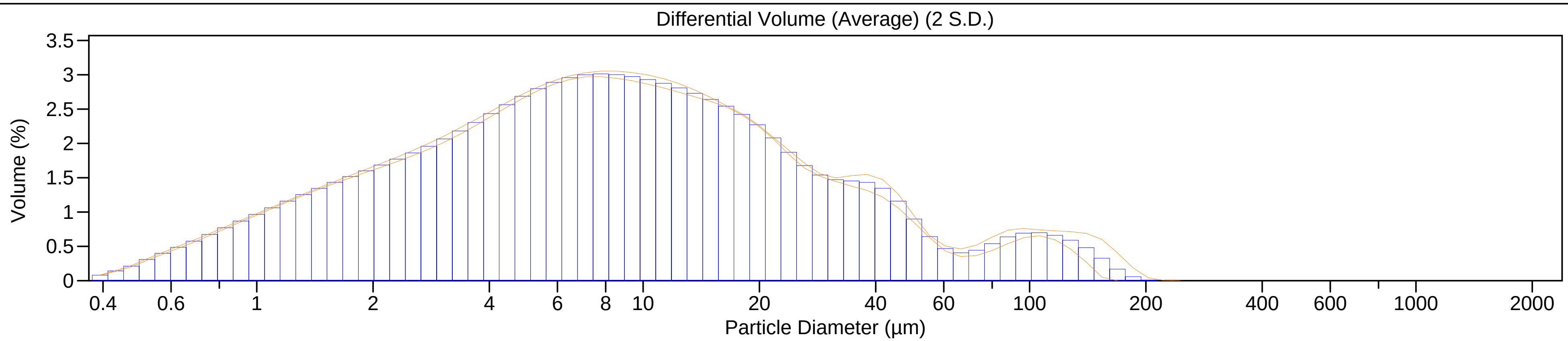
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD05_4_494.$ls
C:\LS13320\Projects\WestVirgina\KRSD05_4_495.$ls
C:\LS13320\Projects\WestVirgina\KRSD05_4_496.$ls

Volume Statistics (Arithmetic) KRSD05_4_496.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	17.04 µm	S.D.:	25.92 µm
Median:	7.898 µm	Variance:	672.1 μm^2
Mean/Median ratio:	2.158	C.V.:	152%
Mode:	7.776 µm	Skewness:	3.154 Right skewed
		Kurtosis:	11.12 Leptokurtic

<10%	<25%	<50%	<75%	<90%
1.489 µm	3.320 µm	7.898 µm	18.19 µm	40.45 µm



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Kanawha River

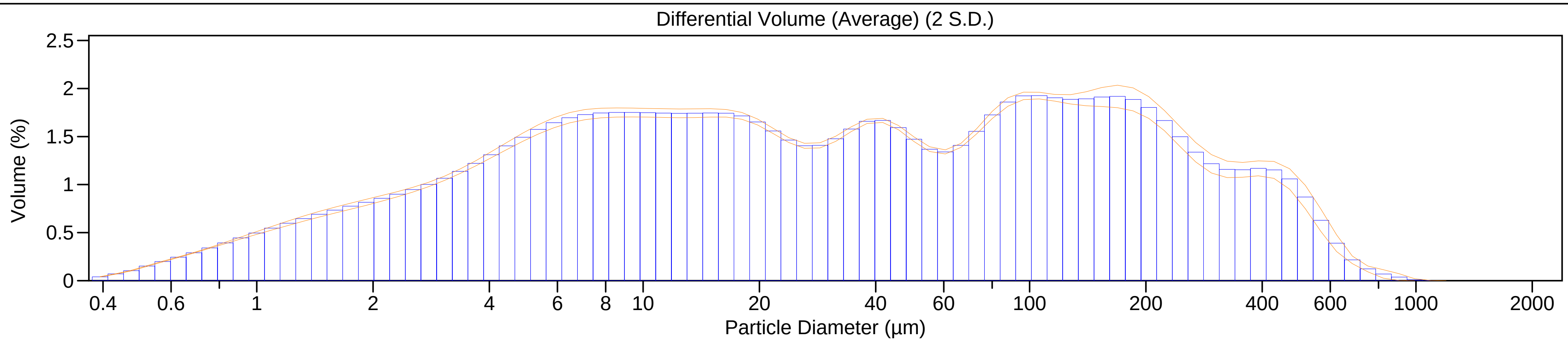
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD05_5_499.$av
KRSD05_5_499.$av
File ID: KRSD05
Sample ID: 5
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD05_5_497.$ls
C:\LS13320\Projects\WestVirgina\KRSD05_5_498.$ls
C:\LS13320\Projects\WestVirgina\KRSD05_5_499.$ls

Volume Statistics (Arithmetic) KRSD05_5_499.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	90.71 µm	S.D.:	131.9 µm
Median:	29.16 µm	Variance:	17405 µm^2
Mean/Median ratio:	3.111	C.V.:	145%
Mode:	105.9 µm	Skewness:	2.209 Right skewed
		Kurtosis:	5.300 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.588 µm	7.205 µm	29.16 µm	122.2 µm	268.1 µm



AR101257

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD05_6_505.$av
KRSD05_6_505.$av
File ID: KRSD05
Sample ID: 6
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD05_6_503.$ls
C:\LS13320\Projects\WestVirgina\KRSD05_6_504.$ls
C:\LS13320\Projects\WestVirgina\KRSD05_6_505.$ls

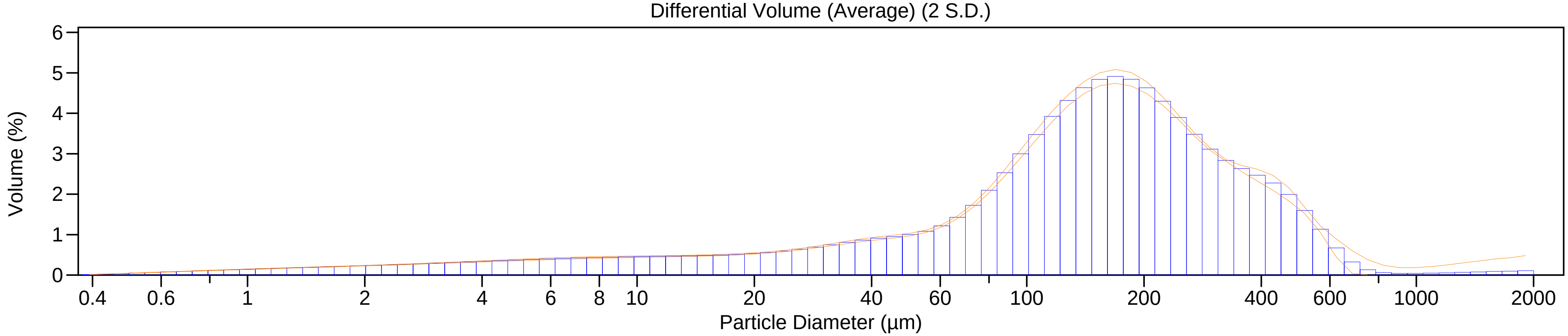
Volume Statistics (Arithmetic) KRSD05_6_505.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	185.2 µm	S.D.:	175.7 µm
Median:	149.1 µm	Variance:	30877 µm^2
Mean/Median ratio:	1.242	C.V.:	94.9%
Mode:	168.9 µm	Skewness:	3.330 Right skewed
		Kurtosis:	22.50 Leptokurtic

<10%	<25%	<50%	<75%	<90%
14.16 µm	75.35 µm	149.1 µm	247.2 µm	392.0 µm

Differential Volume (Average) (2 S.D.)



AR101258

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name:	**C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD10_1_709.$av**
	KRSD10_1_709.$av
File ID:	**KRSD10**
Sample ID:	**1**
Operator:	**ANDES**
Optical model:	**Fraunhofer.rf780z**
LS 13 320 SW	**Aqueous Liquid Module**
	Run length: 60 seconds
Pump speed:	**80**

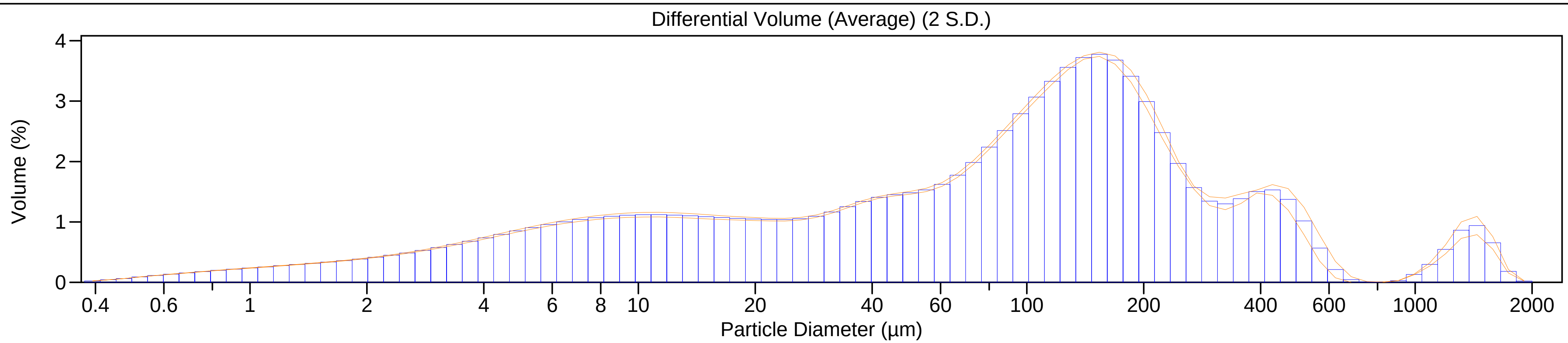
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD10_1_707.$ls
C:\LS13320\Projects\WestVirgina\KRSD10_1_708.$ls
C:\LS13320\Projects\WestVirgina\KRSD10_1_709.$ls

Volume Statistics (Arithmetic) KRSD10_1_709.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	165.9 µm	S.D.:	267.9 µm
Median:	93.04 µm	Variance:	71785 µm^2
Mean/Median ratio:	1.783	C.V.:	162%
Mode:	153.8 µm	Skewness:	3.615 Right skewed
		Kurtosis:	14.40 Leptokurtic

<10%	<25%	<50%	<75%	<90%
5.209 µm	19.44 µm	93.04 µm	183.9 µm	371.2 µm



AR101259

Kanawha River

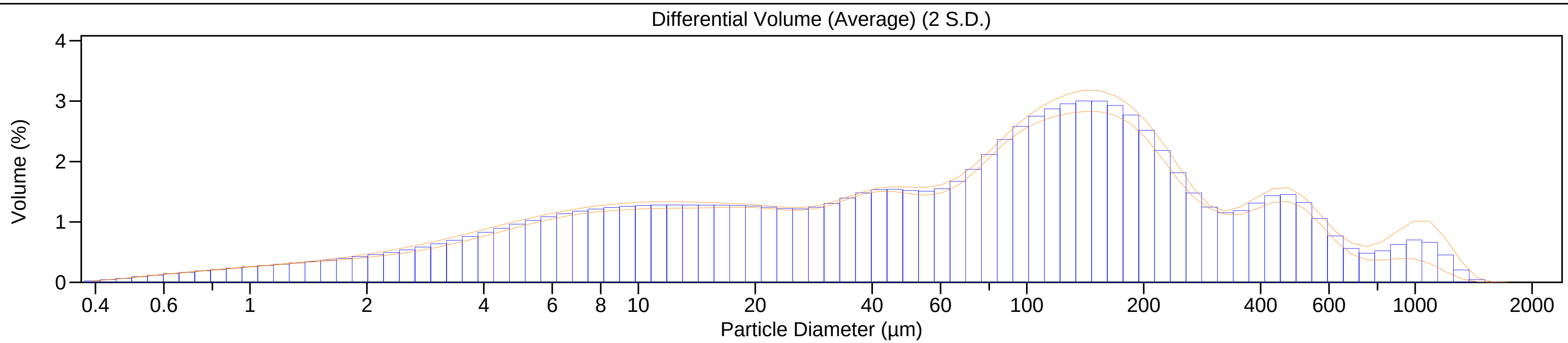
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD10_2_712.$av
KRSD10_2_712.$av
File ID: KRSD10
Sample ID: 2
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD10_2_710.$ls
C:\LS13320\Projects\WestVirgina\KRSD10_2_711.$ls
C:\LS13320\Projects\WestVirgina\KRSD10_2_712.$ls

Volume Statistics (Arithmetic) KRSD10_2_712.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	152.9 µm	S.D.:	218.4 µm
Median:	78.29 µm	Variance:	47714 µm^2
Mean/Median ratio:	1.953	C.V.:	143%
Mode:	140.1 µm	Skewness:	2.628 Right skewed
		Kurtosis:	7.843 Leptokurtic

<10%	<25%	<50%	<75%	<90%
4.719 µm	15.26 µm	78.29 µm	182.9 µm	417.7 µm



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Kanawha River

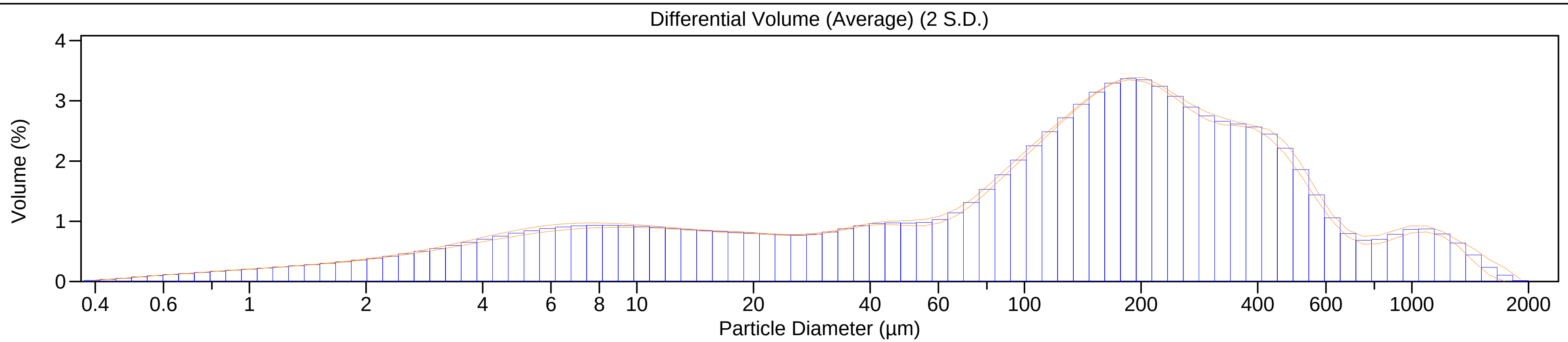
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD10_3_715.$av
KRSD10_3_715.$av
File ID: KRSD10
Sample ID: 3
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD10_3_713.$ls
C:\LS13320\Projects\WestVirgina\KRSD10_3_714.$ls
C:\LS13320\Projects\WestVirgina\KRSD10_3_715.$ls

Volume Statistics (Arithmetic) KRSD10_3_715.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	224.3 µm	S.D.:	276.2 µm
Median:	142.0 µm	Variance:	76260 µm^2
Mean/Median ratio:	1.580	C.V.:	123%
Mode:	185.4 µm	Skewness:	2.296 Right skewed
		Kurtosis:	6.188 Leptokurtic

<10%	<25%	<50%	<75%	<90%
5.671 µm	28.77 µm	142.0 µm	297.4 µm	526.8 µm



AR101261

LS Particle Size Analyzer

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Kanawha River

File name:	**C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD10_4_721.$av**
	KRSD10_4_721.$av
File ID:	**KRSD10**
Sample ID:	**4**
Operator:	**ANDES**
Optical model:	**Fraunhofer.rf780z**
LS 13 320 SW	**Aqueous Liquid Module**

Run length: 60 seconds

Pump speed: 80

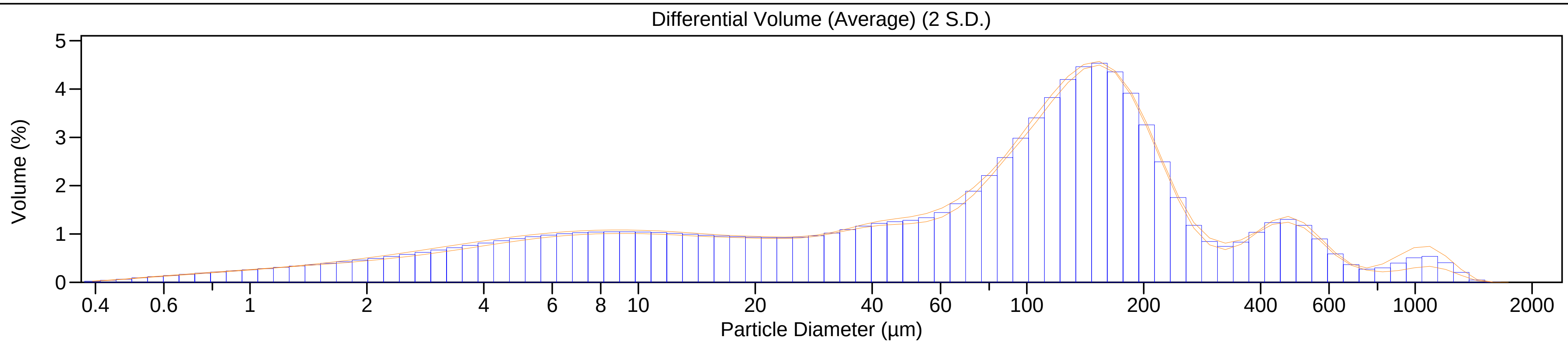
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD10_4_719.$ls
C:\LS13320\Projects\WestVirgina\KRSD10_4_720.$ls
C:\LS13320\Projects\WestVirgina\KRSD10_4_721.$ls

Volume Statistics (Arithmetic) KRSD10_4_721.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	145.8 µm	S.D.:	196.3 µm
Median:	98.36 µm	Variance:	38547 µm^2
Mean/Median ratio:	1.482	C.V.:	135%
Mode:	153.8 µm	Skewness:	3.013 Right skewed
		Kurtosis:	11.23 Leptokurtic

<10%	<25%	<50%	<75%	<90%
4.571 µm	18.64 µm	98.36 µm	174.5 µm	344.8 µm



LS Particle Size Analyzer

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Kanawha River

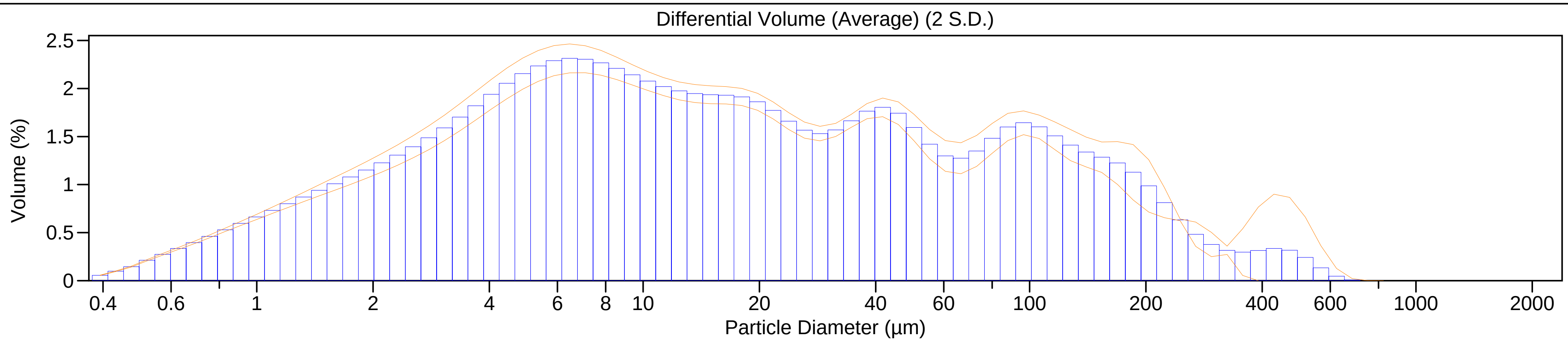
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD10_5_724.$av
KRSD10_5_724.$av
File ID: KRSD10
Sample ID: 5
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD10_5_722.$ls
C:\LS13320\Projects\WestVirgina\KRSD10_5_723.$ls
C:\LS13320\Projects\WestVirgina\KRSD10_5_724.$ls

Volume Statistics (Arithmetic) KRSD10_5_724.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	47.07 µm	S.D.:	78.94 µm
Median:	13.72 µm	Variance:	6232 µm^2
Mean/Median ratio:	3.430	C.V.:	168%
Mode:	6.453 µm	Skewness:	3.177 Right skewed
		Kurtosis:	12.64 Leptokurtic

<10%	<25%	<50%	<75%	<90%
1.956 µm	4.681 µm	13.72 µm	52.25 µm	136.5 µm



AR101263

Kanawha River

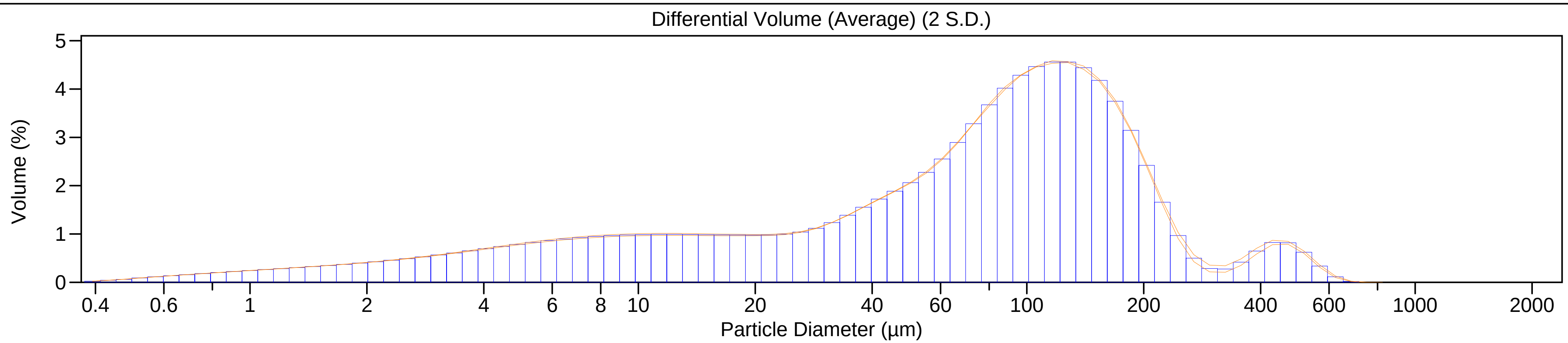
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD14_1_457.$av
KRSD14_1_457.$av
File ID: KRSD14
Sample ID: 1
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD14_1_455.$ls
C:\LS13320\Projects\WestVirgina\KRSD14_1_456.$ls
C:\LS13320\Projects\WestVirgina\KRSD14_1_457.$ls

Volume Statistics (Arithmetic) KRSD14_1_457.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	96.89 µm	S.D.:	97.90 µm
Median:	78.45 µm	Variance:	9585 µm^2
Mean/Median ratio:	1.235	C.V.:	101%
Mode:	116.3 µm	Skewness:	2.141 Right skewed
		Kurtosis:	6.272 Leptokurtic

<10%	<25%	<50%	<75%	<90%
5.276 µm	22.74 µm	78.45 µm	135.0 µm	193.8 µm



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Kanawha River

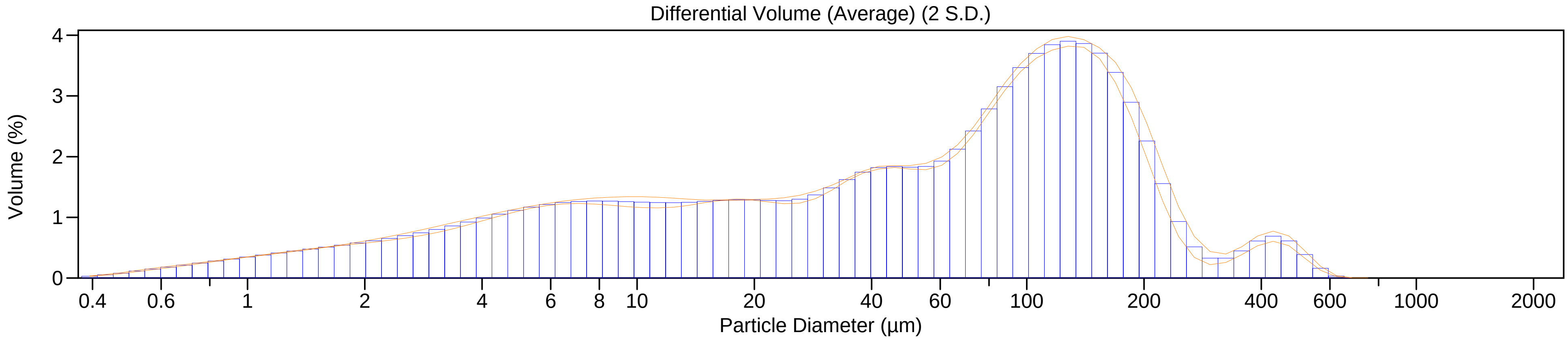
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD14_2_433.$av
KRSD14_2_433.$av
File ID: KRSD14
Sample ID: 2
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD14_2_431.$ls
C:\LS13320\Projects\WestVirgina\KRSD14_2_432.$ls
C:\LS13320\Projects\WestVirgina\KRSD14_2_433.$ls

Volume Statistics (Arithmetic) KRSD14_2_433.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	84.00 µm	S.D.:	92.43 µm
Median:	57.87 µm	Variance:	8543 µm^2
Mean/Median ratio:	1.451	C.V.:	110%
Mode:	127.7 µm	Skewness:	2.021 Right skewed
		Kurtosis:	5.617 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.626 µm	11.87 µm	57.87 µm	126.8 µm	187.4 µm



AR101265

LS Particle Size Analyzer

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Kanawha River

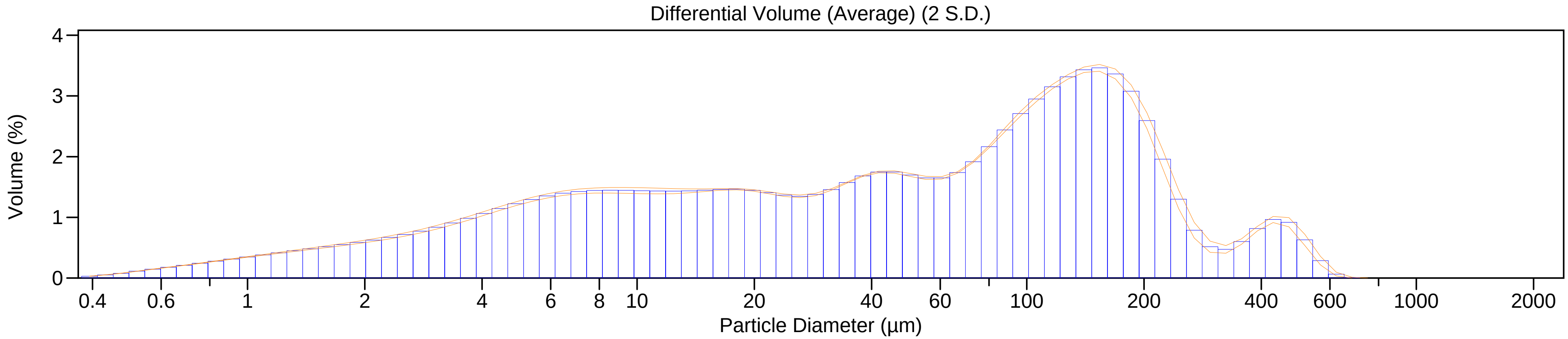
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD14_3_436.$av
KRSD14_3_436.$av
File ID: KRSD14
Sample ID: 3
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD14_3_434.$ls
C:\LS13320\Projects\WestVirgina\KRSD14_3_435.$ls
C:\LS13320\Projects\WestVirgina\KRSD14_3_436.$ls

Volume Statistics (Arithmetic) KRSD14_3_436.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	88.82 µm	S.D.:	105.3 µm
Median:	49.68 µm	Variance:	11088 µm^2
Mean/Median ratio:	1.788	C.V.:	119%
Mode:	153.8 µm	Skewness:	1.960 Right skewed
		Kurtosis:	4.496 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.557 µm	10.41 µm	49.68 µm	134.7 µm	208.3 µm



AR101266

Kanawha River

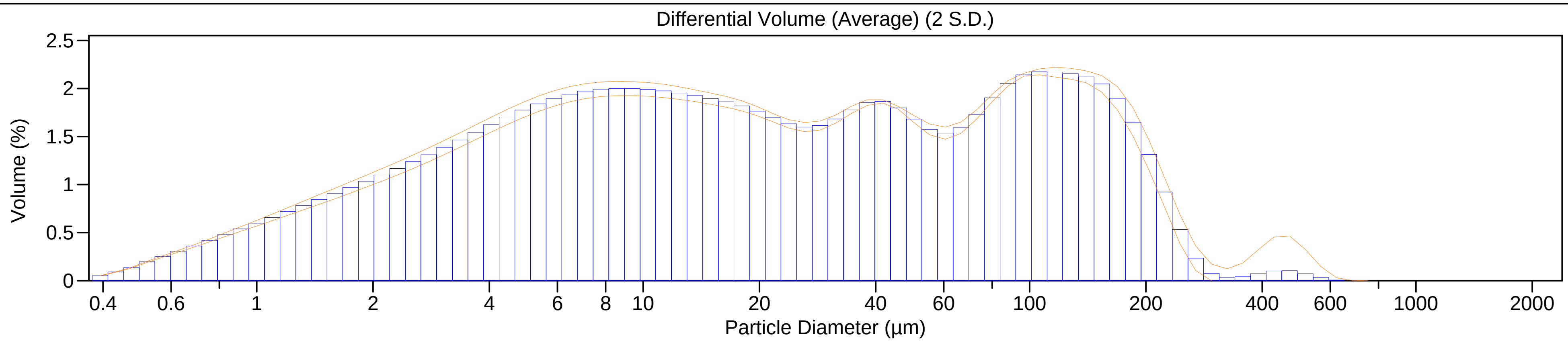
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD14_4_439.$av
KRSD14_4_439.$av
File ID: KRSD14
Sample ID: 4
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD14_4_437.$ls
C:\LS13320\Projects\WestVirgina\KRSD14_4_438.$ls
C:\LS13320\Projects\WestVirgina\KRSD14_4_439.$ls

Volume Statistics (Arithmetic) KRSD14_4_439.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	48.18 µm	S.D.:	63.98 µm
Median:	18.18 µm	Variance:	4093 µm^2
Mean/Median ratio:	2.650	C.V.:	133%
Mode:	105.9 µm	Skewness:	2.292 Right skewed
		Kurtosis:	8.246 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.127 µm	5.471 µm	18.18 µm	71.95 µm	141.5 µm



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24 Sep 2009

Kanawha River

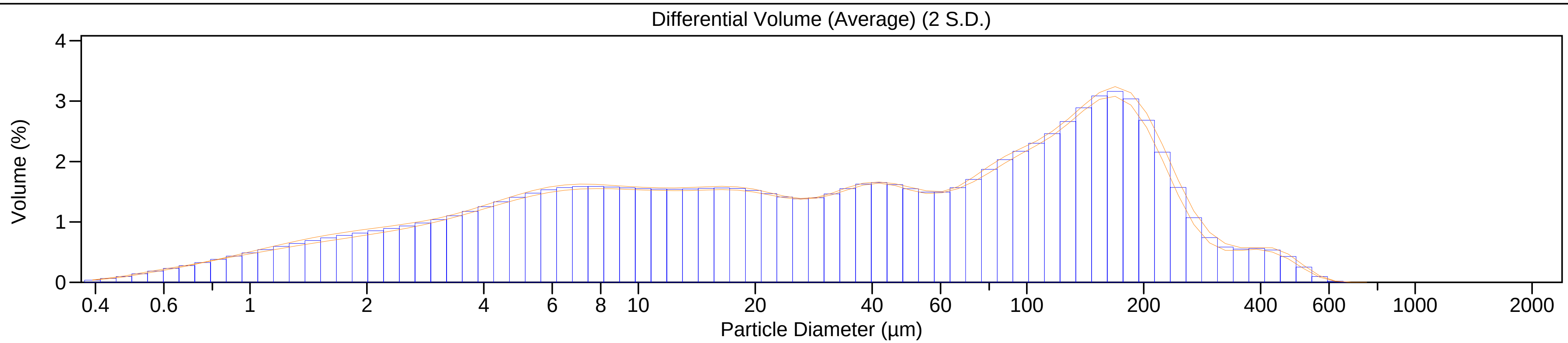
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD14_5_445.$av
KRSD14_5_445.$av
File ID: KRSD14
Sample ID: 5
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD14_5_443.$ls
C:\LS13320\Projects\WestVirgina\KRSD14_5_444.$ls
C:\LS13320\Projects\WestVirgina\KRSD14_5_445.$ls

Volume Statistics (Arithmetic) KRSD14_5_445.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	77.71 µm	S.D.:	94.48 µm
Median:	35.46 µm	Variance:	8927 µm^2
Mean/Median ratio:	2.192	C.V.:	122%
Mode:	168.9 µm	Skewness:	1.786 Right skewed
		Kurtosis:	3.784 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.624 µm	7.606 µm	35.46 µm	126.7 µm	203.1 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

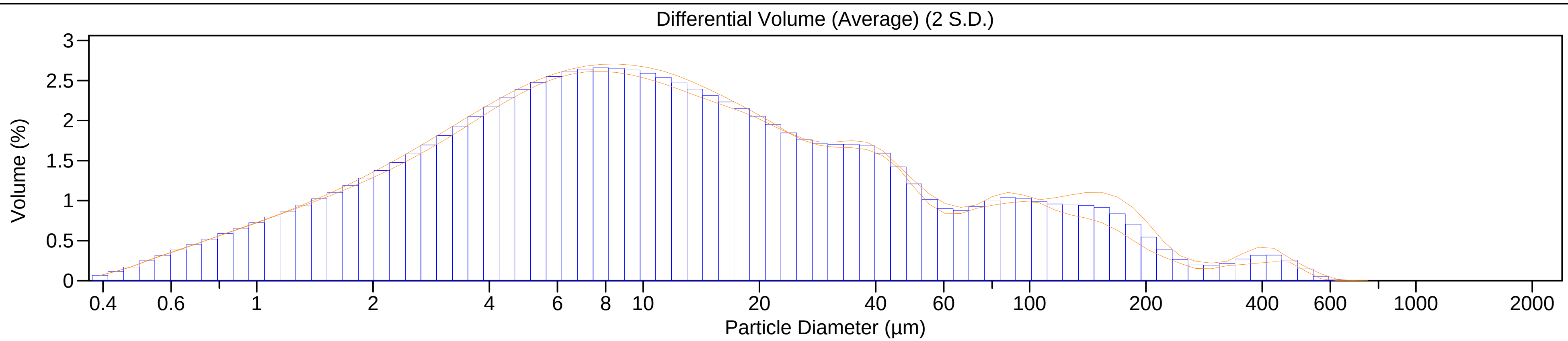
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD20_1_454.$av
KRSD20_1_454.$av
File ID: KRSD20
Sample ID: 1
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD20_1_452.$ls
C:\LS13320\Projects\WestVirgina\KRSD20_1_453.$ls
C:\LS13320\Projects\WestVirgina\KRSD20_1_454.$ls

Volume Statistics (Arithmetic) KRSD20_1_454.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	34.51 µm	S.D.:	66.62 µm
Median:	10.40 µm	Variance:	4438 µm^2
Mean/Median ratio:	3.319	C.V.:	193%
Mode:	7.776 µm	Skewness:	4.001 Right skewed
		Kurtosis:	19.61 Leptokurtic

<10%	<25%	<50%	<75%	<90%
1.810 µm	4.147 µm	10.40 µm	31.04 µm	96.43 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name:	**C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD20_2_424.$av**
	KRSD20_2_424.$av
File ID:	**KRSD20**
Sample ID:	**2**
Operator:	**ANDES**
Optical model:	**Fraunhofer.rf780z**
LS 13 320 SW	**Aqueous Liquid Module**

Run length: **60 seconds**

Pump speed: **80**

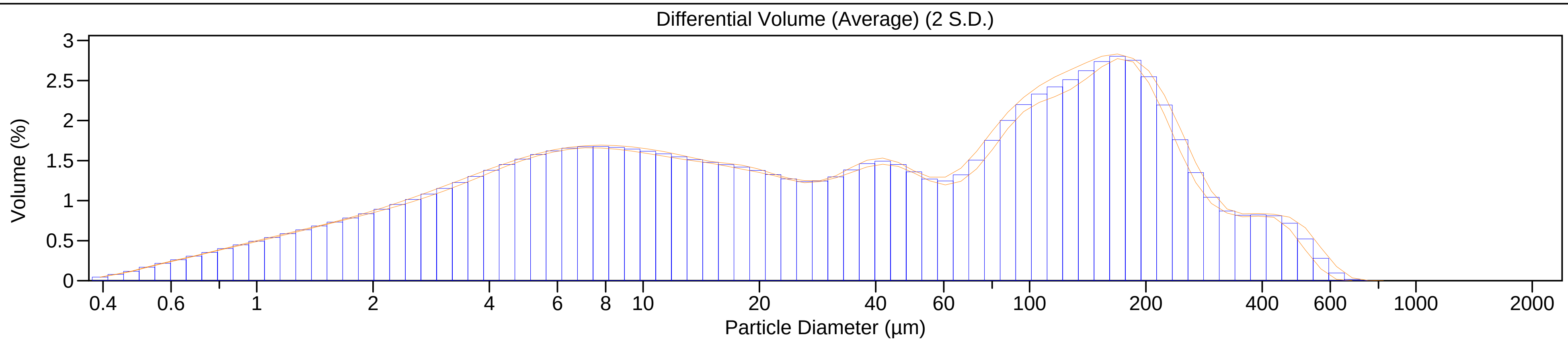
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD20_2_422.$ls
C:\LS13320\Projects\WestVirgina\KRSD20_2_423.$ls
C:\LS13320\Projects\WestVirgina\KRSD20_2_424.$ls

Volume Statistics (Arithmetic) KRSD20_2_424.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	84.62 µm	S.D.:	108.6 µm
Median:	34.11 µm	Variance:	11798 µm^2
Mean/Median ratio:	2.480	C.V.:	128%
Mode:	168.9 µm	Skewness:	1.865 Right skewed
		Kurtosis:	3.781 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.533 µm	6.954 µm	34.11 µm	132.6 µm	225.6 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

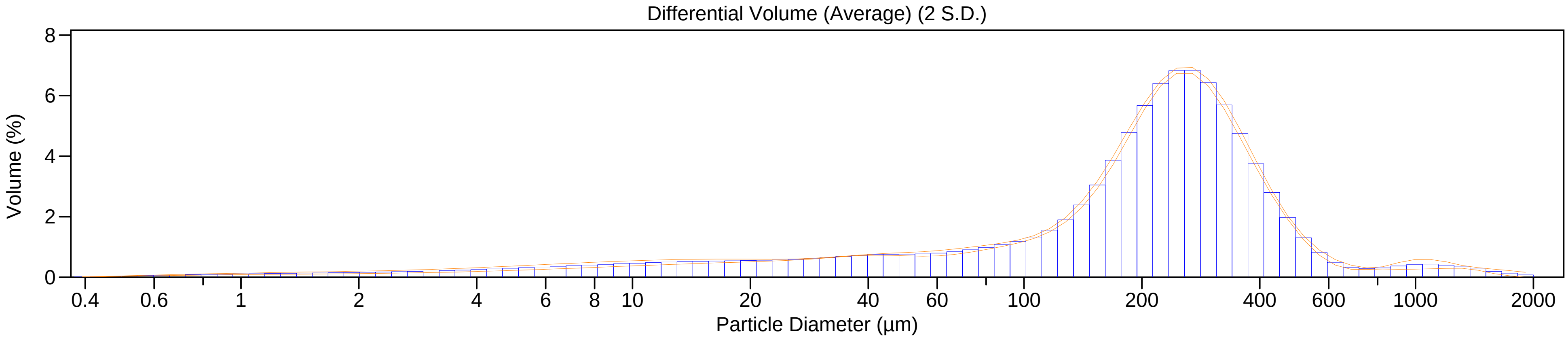
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD20_3_490.$av
KRSD20_3_490.$av
File ID: KRSD20
Sample ID: 3
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD20_3_488.$ls
C:\LS13320\Projects\WestVirgina\KRSD20_3_489.$ls
C:\LS13320\Projects\WestVirgina\KRSD20_3_490.$ls

Volume Statistics (Arithmetic) KRSD20_3_490.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	242.4 µm	S.D.:	220.1 µm
Median:	218.6 µm	Variance:	48457 µm^2
Mean/Median ratio:	1.109	C.V.:	90.8%
Mode:	269.2 µm	Skewness:	2.895 Right skewed
		Kurtosis:	13.25 Leptokurtic

<10%	<25%	<50%	<75%	<90%
18.67 µm	109.9 µm	218.6 µm	310.4 µm	423.2 µm



AR101271

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

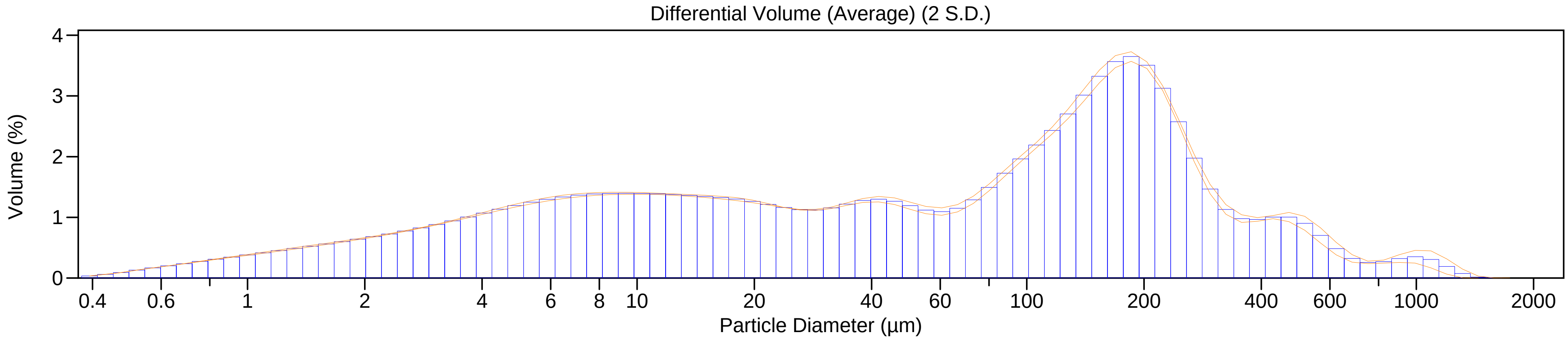
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD20_4_418.$av
KRSD20_4_418.$av
File ID: KRSD20
Sample ID: 4
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD20_4_416.$ls
C:\LS13320\Projects\WestVirgina\KRSD20_4_417.$ls
C:\LS13320\Projects\WestVirgina\KRSD20_4_418.$ls

Volume Statistics (Arithmetic) KRSD20_4_418.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	126.4 µm	S.D.:	173.7 µm
Median:	65.74 µm	Variance:	30183 µm^2
Mean/Median ratio:	1.923	C.V.:	137%
Mode:	185.4 µm	Skewness:	2.850 Right skewed
		Kurtosis:	11.10 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.271 µm	10.11 µm	65.74 µm	179.7 µm	296.1 µm



AR101272

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

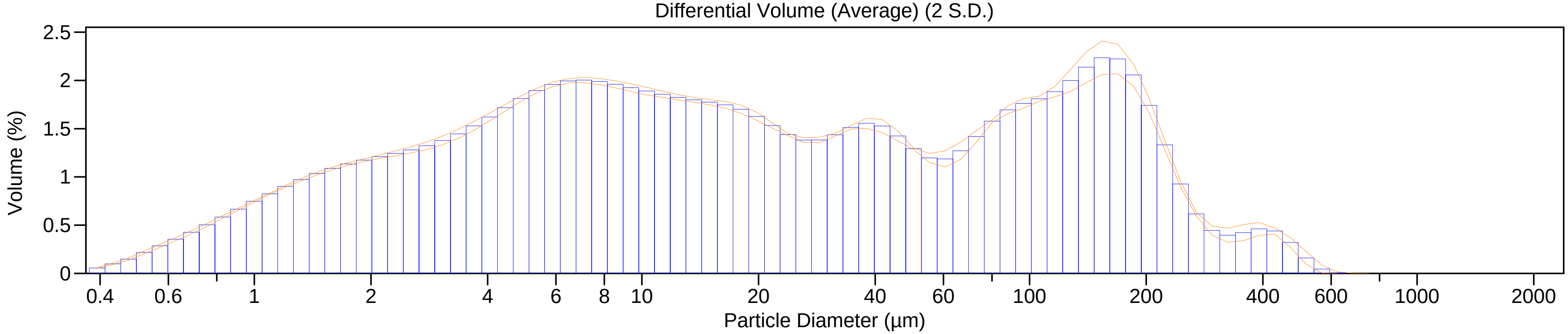
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD20_5_415.$av
KRSD20_5_415.$av
File ID: KRSD20
Sample ID: 5
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD20_5_413.$ls
C:\LS13320\Projects\WestVirgina\KRSD20_5_414.$ls
C:\LS13320\Projects\WestVirgina\KRSD20_5_415.$ls

Volume Statistics (Arithmetic) KRSD20_5_415.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	57.90 µm	S.D.:	84.35 µm
Median:	16.83 µm	Variance:	7114 µm^2
Mean/Median ratio:	3.441	C.V.:	146%
Mode:	153.8 µm	Skewness:	2.289 Right skewed
		Kurtosis:	6.269 Leptokurtic

<10%	<25%	<50%	<75%	<90%
1.825 µm	4.913 µm	16.83 µm	84.48 µm	172.5 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

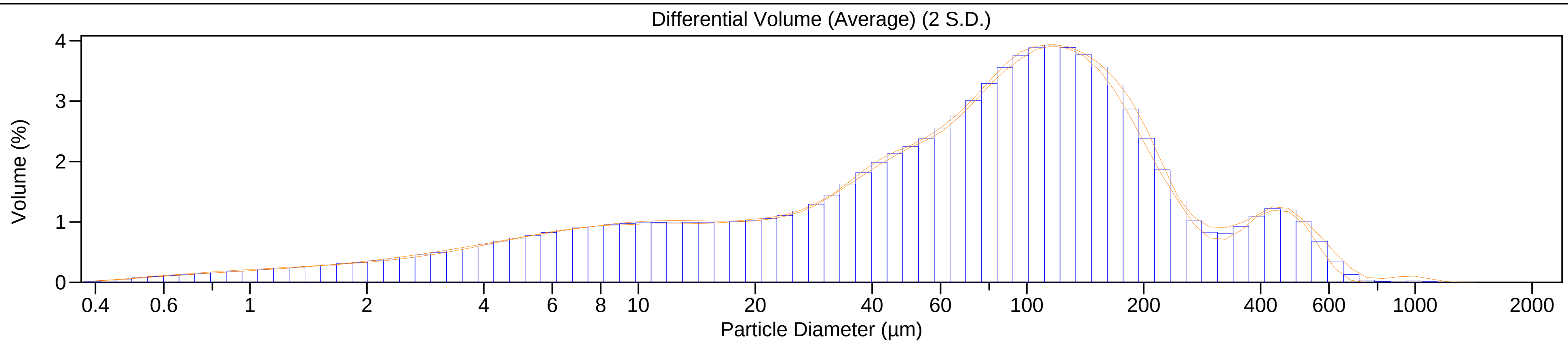
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD24_1_508.$av
KRSD24_1_508.$av
File ID: KRSD24
Sample ID: 1
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD24_1_506.$ls
C:\LS13320\Projects\WestVirgina\KRSD24_1_507.$ls
C:\LS13320\Projects\WestVirgina\KRSD24_1_508.$ls

Volume Statistics (Arithmetic) KRSD24_1_508.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	111.0 µm	S.D.:	122.1 µm
Median:	78.19 µm	Variance:	14909 µm^2
Mean/Median ratio:	1.419	C.V.:	110%
Mode:	116.3 µm	Skewness:	2.145 Right skewed
		Kurtosis:	5.814 Leptokurtic

<10%	<25%	<50%	<75%	<90%
6.146 µm	25.33 µm	78.19 µm	145.8 µm	246.5 µm



AR101274

Kanawha River

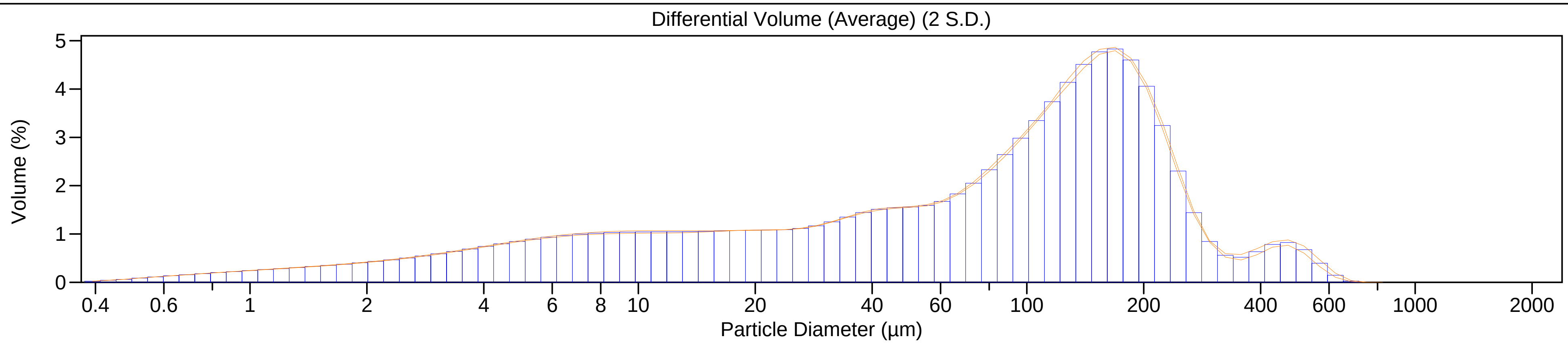
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD24_2_511.$av
KRSD24_2_511.$av
File ID: KRSD24
Sample ID: 2
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD24_2_509.$ls
C:\LS13320\Projects\WestVirgina\KRSD24_2_510.$ls
C:\LS13320\Projects\WestVirgina\KRSD24_2_511.$ls

Volume Statistics (Arithmetic) KRSD24_2_511.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	109.7 µm	S.D.:	106.7 µm
Median:	90.20 µm	Variance:	11395 µm^2
Mean/Median ratio:	1.216	C.V.:	97.4%
Mode:	168.9 µm	Skewness:	1.619 Right skewed
		Kurtosis:	3.629 Leptokurtic

<10%	<25%	<50%	<75%	<90%
5.092 µm	20.07 µm	90.20 µm	164.1 µm	228.7 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name:	**C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD24_3_514.$av**
	KRSD24_3_514.$av
File ID:	**KRSD24**
Sample ID:	**3**
Operator:	**ANDES**
Optical model:	**Fraunhofer.rf780z**
LS 13 320 SW	**Aqueous Liquid Module**

Run length: **60 seconds**

Pump speed: **80**

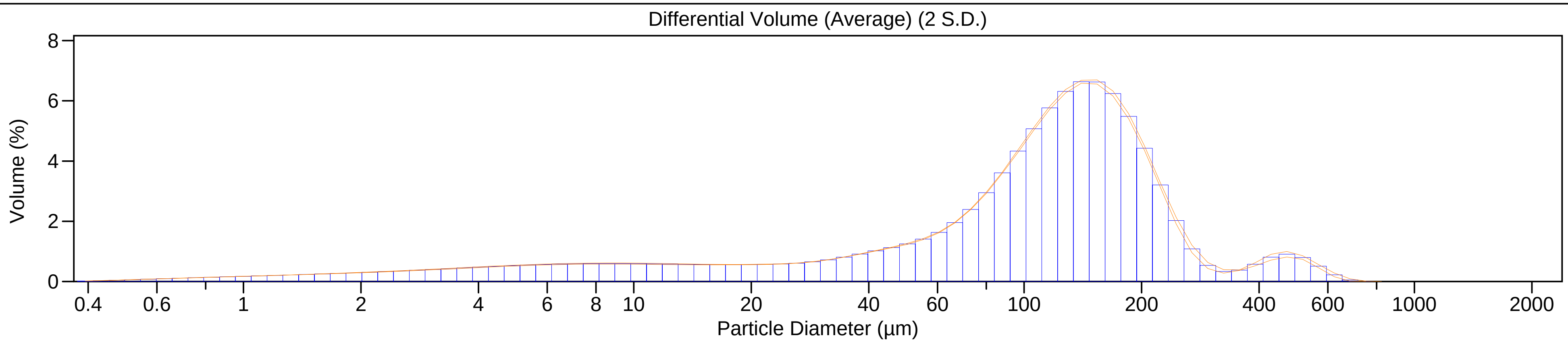
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD24_3_512.$ls
C:\LS13320\Projects\WestVirgina\KRSD24_3_513.$ls
C:\LS13320\Projects\WestVirgina\KRSD24_3_514.$ls

Volume Statistics (Arithmetic) KRSD24_3_514.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	125.9 µm	S.D.:	102.0 µm
Median:	116.5 µm	Variance:	10413 µm^2
Mean/Median ratio:	1.080	C.V.:	81.1%
Mode:	140.1 µm	Skewness:	1.779 Right skewed
		Kurtosis:	5.061 Leptokurtic

<10%	<25%	<50%	<75%	<90%
8.548 µm	57.29 µm	116.5 µm	167.7 µm	222.5 µm



AR101276

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name:	**C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD24_4_517.$av** **KRSD24_4_517.$av**
File ID:	**KRSD24**
Sample ID:	**4**
Operator:	**ANDES**
Optical model:	**Fraunhofer.rf780z**
LS 13 320 SW	**Aqueous Liquid Module**
	Run length: 60 seconds
Pump speed:	**80**

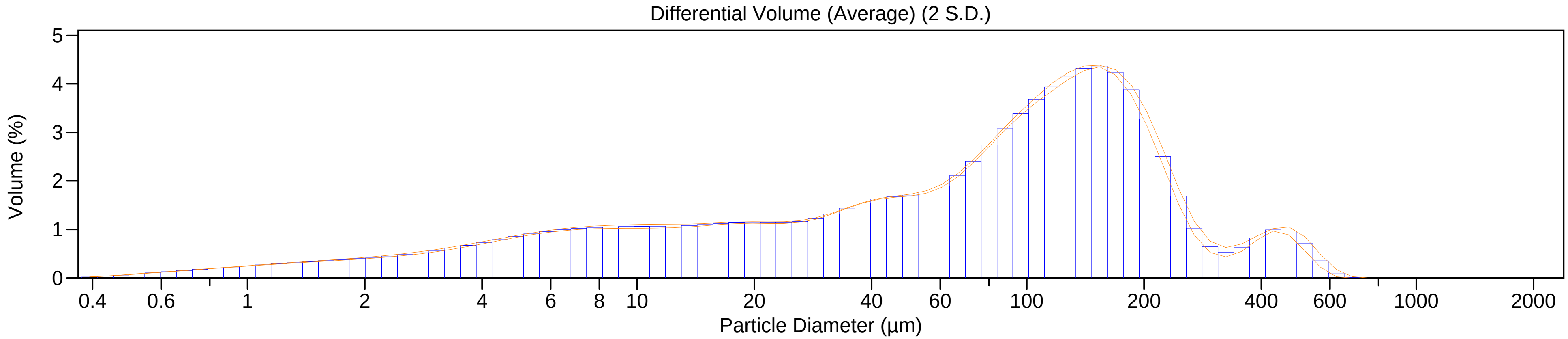
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD24_4_515.$ls
C:\LS13320\Projects\WestVirgina\KRSD24_4_516.$ls
C:\LS13320\Projects\WestVirgina\KRSD24_4_517.$ls

Volume Statistics (Arithmetic) KRSD24_4_517.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	104.9 µm	S.D.:	106.6 µm
Median:	81.99 µm	Variance:	11368 µm^2
Mean/Median ratio:	1.279	C.V.:	102%
Mode:	153.8 µm	Skewness:	1.768 Right skewed
		Kurtosis:	3.936 Leptokurtic

<10%	<25%	<50%	<75%	<90%
5.148 µm	19.45 µm	81.99 µm	152.6 µm	221.5 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

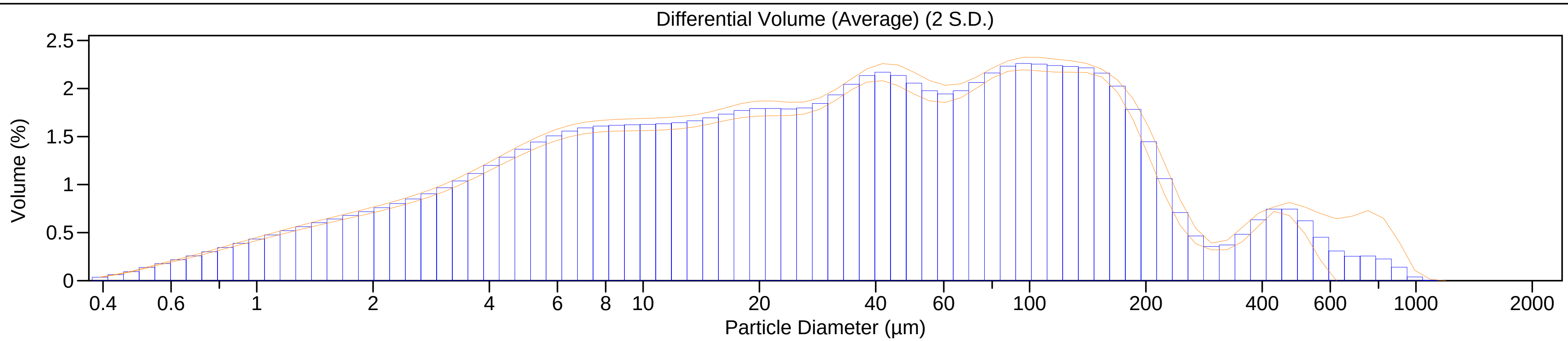
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD24_5_520.$av
KRSD24_5_520.$av
File ID: KRSD24
Sample ID: 5
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD24_5_518.$ls
C:\LS13320\Projects\WestVirgina\KRSD24_5_519.$ls
C:\LS13320\Projects\WestVirgina\KRSD24_5_520.$ls

Volume Statistics (Arithmetic) KRSD24_5_520.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	78.46 µm	S.D.:	123.8 µm
Median:	32.08 µm	Variance:	15329 µm^2
Mean/Median ratio:	2.446	C.V.:	158%
Mode:	96.49 µm	Skewness:	3.240 Right skewed
		Kurtosis:	12.92 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.928 µm	8.316 µm	32.08 µm	98.03 µm	187.7 µm



AR101278

LS Particle Size Analyzer

BECKMAN COULTER™

24 Sep 2009

Kanawha River

File name:	**C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD24_6_523.$av**
	KRSD24_6_523.$av
File ID:	**KRSD24**
Sample ID:	**6**
Operator:	**ANDES**
Optical model:	**Fraunhofer.rf780z**
LS 13 320 SW	**Aqueous Liquid Module**
	Run length: 60 seconds
Pump speed:	**80**

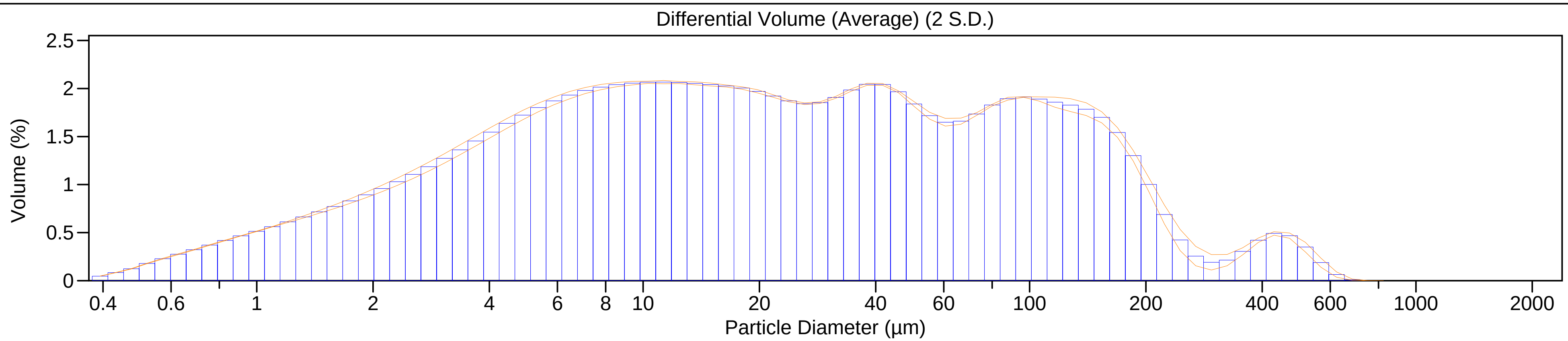
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD24_6_521.$ls
C:\LS13320\Projects\WestVirgina\KRSD24_6_522.$ls
C:\LS13320\Projects\WestVirgina\KRSD24_6_523.$ls

Volume Statistics (Arithmetic) KRSD24_6_523.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	53.43 µm	S.D.:	83.47 µm
Median:	19.44 µm	Variance:	6967 µm^2
Mean/Median ratio:	2.748	C.V.:	156%
Mode:	11.29 µm	Skewness:	3.166 Right skewed
		Kurtosis:	12.53 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.409 µm	6.149 µm	19.44 µm	67.18 µm	144.0 µm



BECKMAN COULTER

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

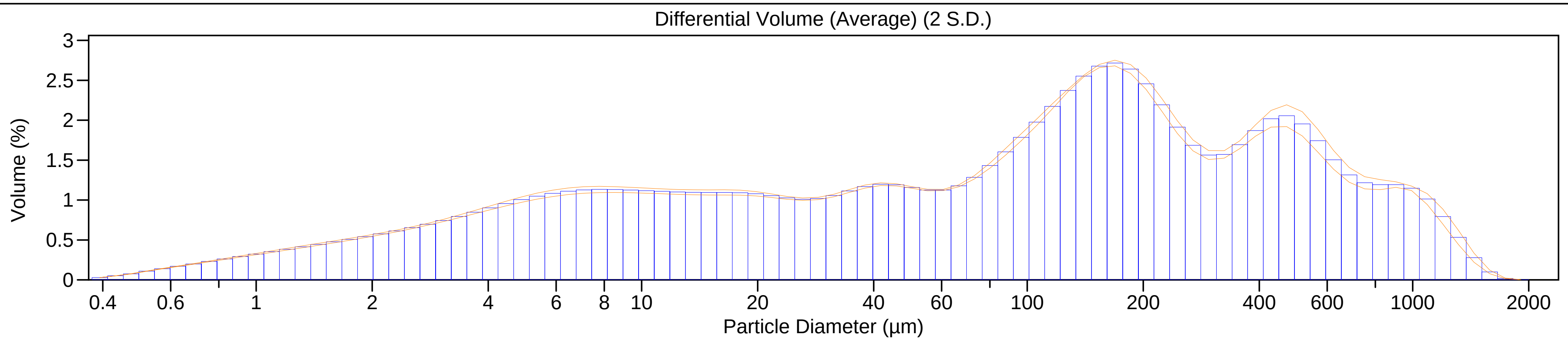
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD25_1_469.$av
KRSD25_1_469.$av
File ID: KRSD25
Sample ID: 1
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD25_1_467.$ls
C:\LS13320\Projects\WestVirgina\KRSD25_1_468.$ls
C:\LS13320\Projects\WestVirgina\KRSD25_1_469.$ls

Volume Statistics (Arithmetic) KRSD25_1_469.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	211.7 µm	S.D.:	284.3 µm
Median:	101.8 µm	Variance:	80851 μm^2
Mean/Median ratio:	2.080	C.V.:	134%
Mode:	168.9 µm	Skewness:	1.970 Right skewed
		Kurtosis:	3.814 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.893 µm	14.29 µm	101.8 µm	278.7 µm	606.6 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

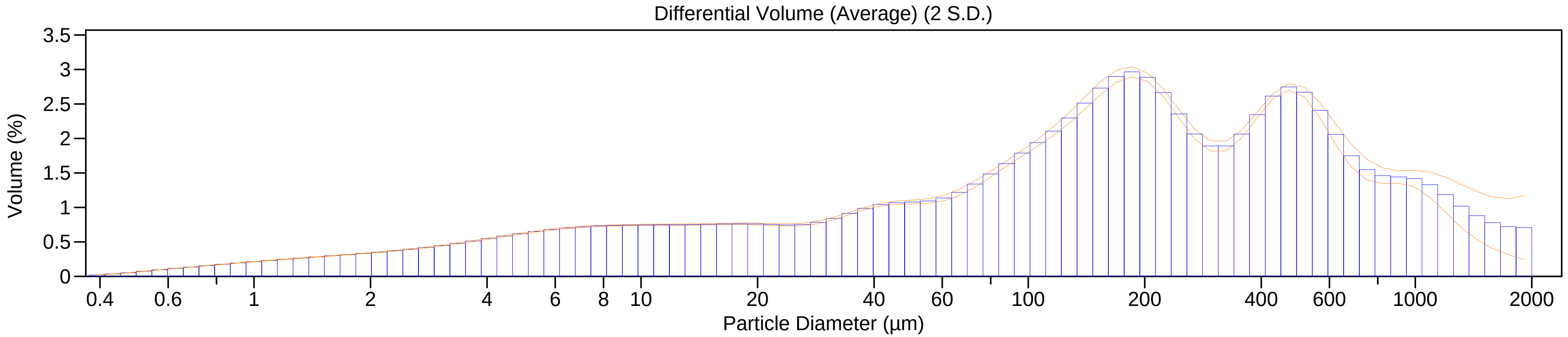
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD25_2_478.$av
KRSD25_2_478.$av
File ID: KRSD25
Sample ID: 2
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD25_2_476.$ls
C:\LS13320\Projects\WestVirgina\KRSD25_2_477.$ls
C:\LS13320\Projects\WestVirgina\KRSD25_2_478.$ls

Volume Statistics (Arithmetic) KRSD25_2_478.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	309.5 µm	S.D.:	382.7 µm
Median:	165.4 µm	Variance:	146.5e3 µm^2
Mean/Median ratio:	1.871	C.V.:	124%
Mode:	185.4 µm	Skewness:	1.928 Right skewed
		Kurtosis:	3.712 Leptokurtic

<10%	<25%	<50%	<75%	<90%
6.760 µm	40.72 µm	165.4 µm	436.3 µm	836.7 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

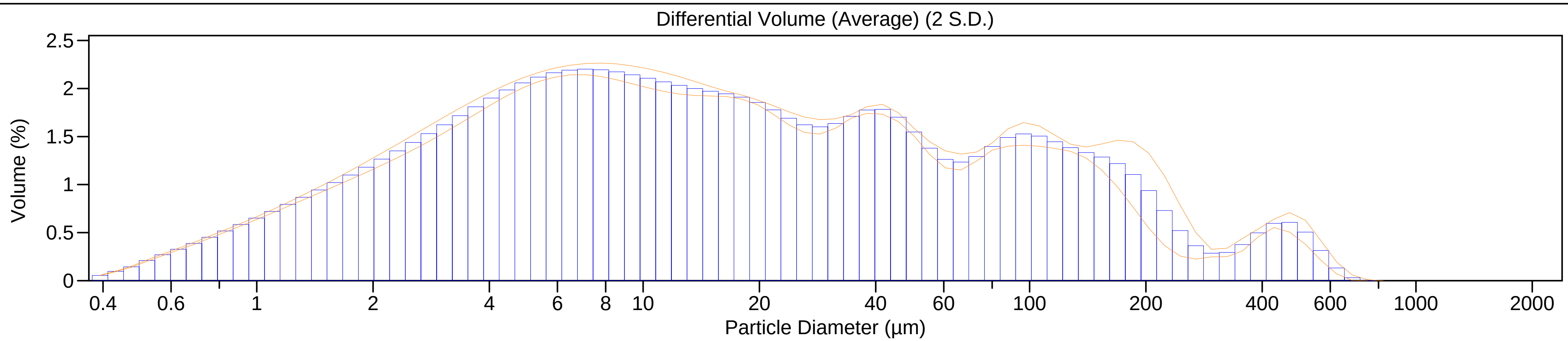
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD25_3_460.$av
KRSD25_3_460.$av
File ID: KRSD25
Sample ID: 3
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD25_3_458.$ls
C:\LS13320\Projects\WestVirgina\KRSD25_3_459.$ls
C:\LS13320\Projects\WestVirgina\KRSD25_3_460.$ls

Volume Statistics (Arithmetic) KRSD25_3_460.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	51.81 µm	S.D.:	92.91 µm
Median:	14.00 µm	Variance:	8632 µm^2
Mean/Median ratio:	3.700	C.V.:	179%
Mode:	7.084 µm	Skewness:	3.267 Right skewed
		Kurtosis:	12.17 Leptokurtic

<10%	<25%	<50%	<75%	<90%
1.961 µm	4.667 µm	14.00 µm	52.86 µm	145.0 µm



AR101282

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

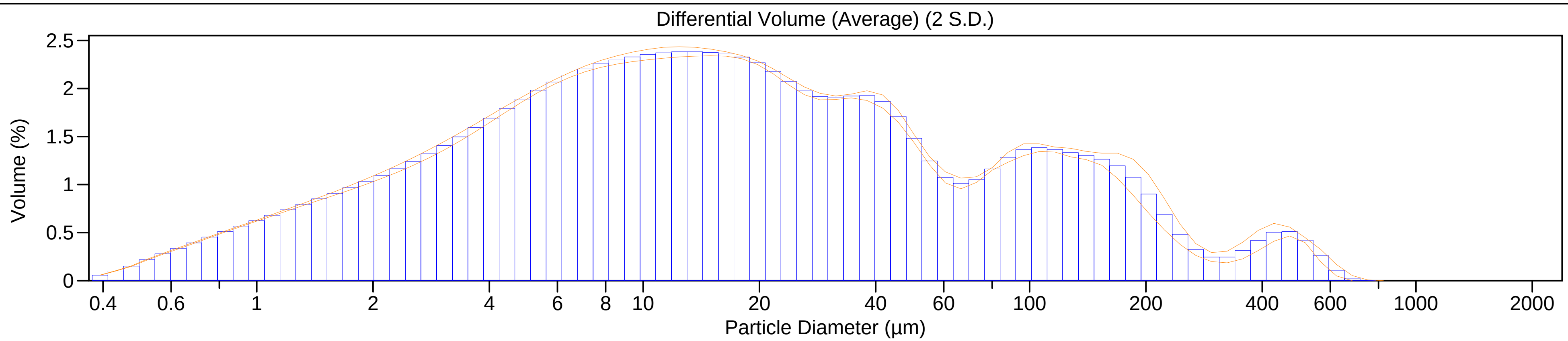
File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD25_4_463.$av
KRSD25_4_463.$av
File ID: KRSD25
Sample ID: 4
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
C:\LS13320\Projects\WestVirgina\KRSD25_4_461.$ls
C:\LS13320\Projects\WestVirgina\KRSD25_4_462.$ls
C:\LS13320\Projects\WestVirgina\KRSD25_4_463.$ls

Volume Statistics (Arithmetic) KRSD25_4_463.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	48.32 µm	S.D.:	87.09 µm
Median:	14.77 µm	Variance:	7584 µm^2
Mean/Median ratio:	3.273	C.V.:	180%
Mode:	13.61 µm	Skewness:	3.457 Right skewed
		Kurtosis:	13.98 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.069 µm	5.270 µm	14.77 µm	45.59 µm	136.7 µm



Kanawha River

File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD25_5_466.$av
KRSD25_5_466.$av
File ID: KRSD25
Sample ID: 5
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
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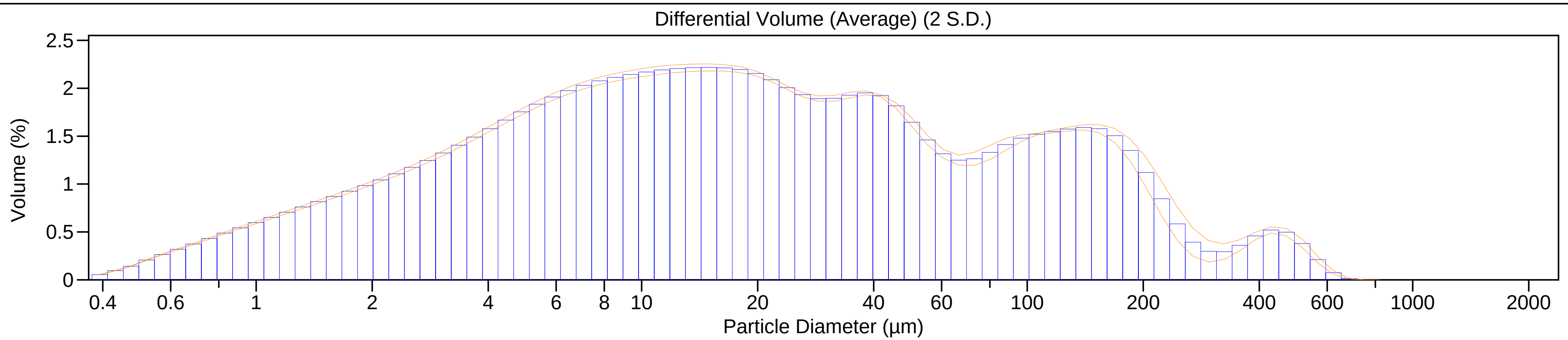
C:\LS13320\Projects\WestVirgina\KRSD25_5_465.$ls
C:\LS13320\Projects\WestVirgina\KRSD25_5_466.$ls

Volume Statistics (Arithmetic) KRSD25_5_466.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	52.73 µm	S.D.:	87.40 µm
Median:	16.96 µm	Variance:	7640 µm^2
Mean/Median ratio:	3.110	C.V.:	166%
Mode:	14.94 µm	Skewness:	3.105 Right skewed
		Kurtosis:	11.49 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.155 µm	5.650 µm	16.96 µm	57.00 µm	151.3 µm



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LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD28_1_694.$av
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File ID: KRSD28
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Operator: ANDES
Optical model: Fraunhofer.rf780z
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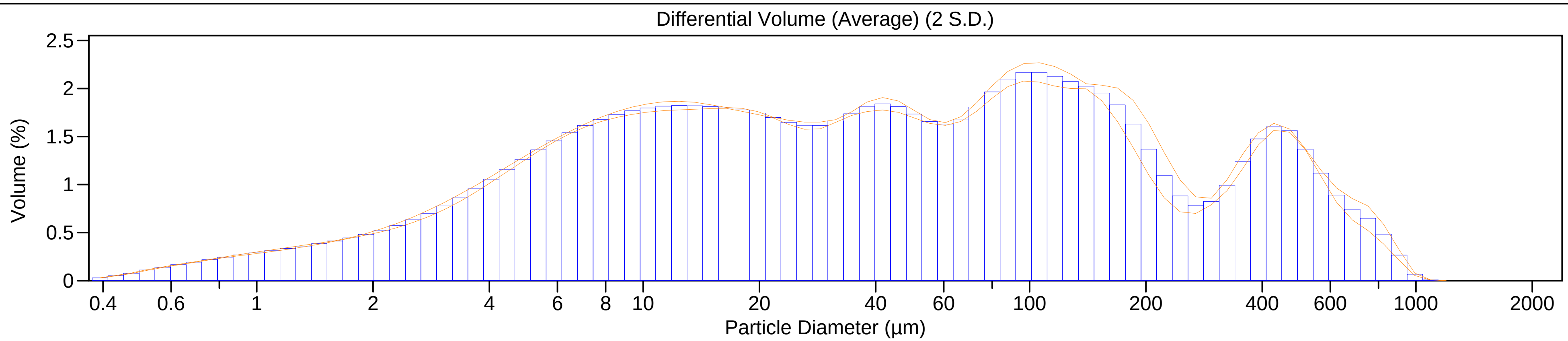
Volume Statistics (Arithmetic) KRSD28_1_694.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	114.1 µm	S.D.:	170.7 µm
Median:	39.06 µm	Variance:	29141 µm^2
Mean/Median ratio:	2.921	C.V.:	150%
Mode:	105.9 µm	Skewness:	2.235 Right skewed
		Kurtosis:	4.853 Leptokurtic

<10%	<25%	<50%	<75%	<90%
4.020 µm	10.25 µm	39.06 µm	133.0 µm	379.0 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

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	KRSD28_2_697.$av
File ID:	**KRSD28**
Sample ID:	**2**
Operator:	**ANDES**
Optical model:	**Fraunhofer.rf780z**
LS 13 320 SW	**Aqueous Liquid Module**

Run length: 60 seconds

Pump speed: 80

Average of 3 files:
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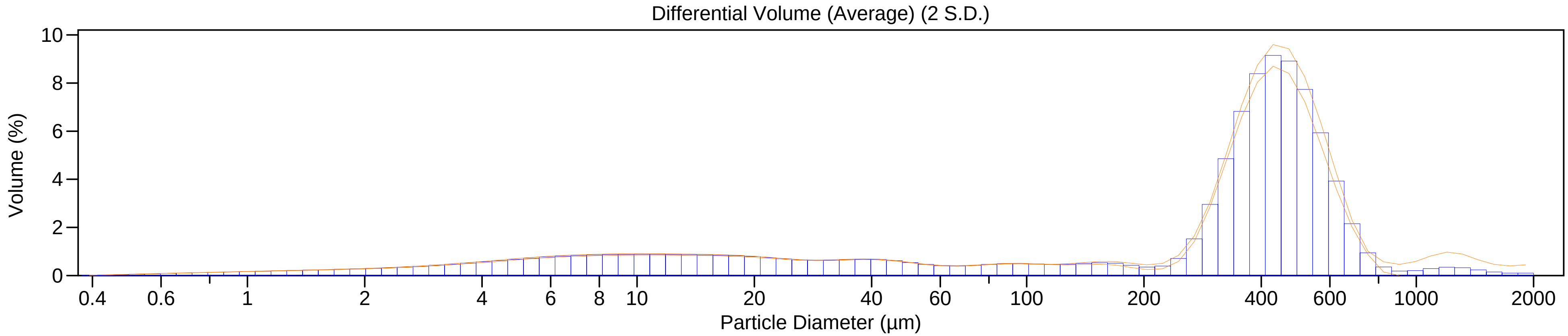
Volume Statistics (Arithmetic) KRSD28_2_697.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	329.3 µm	S.D.:	257.7 µm
Median:	370.6 µm	Variance:	66406 μm^2
Mean/Median ratio:	0.889	C.V.:	78.3%
Mode:	429.2 µm	Skewness:	0.963 Right skewed
		Kurtosis:	3.487 Leptokurtic

<10%	<25%	<50%	<75%	<90%
7.106 µm	42.49 µm	370.6 µm	483.9 µm	589.0 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

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File ID: KRSD28
Sample ID: 3
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
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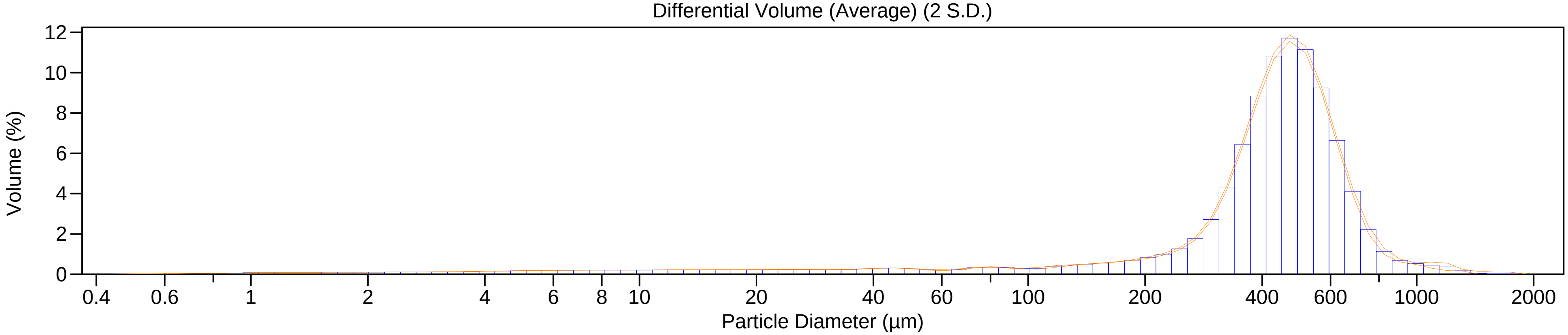
Volume Statistics (Arithmetic) KRSD28_3_700.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	431.4 µm	S.D.:	211.2 µm
Median:	444.2 µm	Variance:	44592 µm^2
Mean/Median ratio:	0.971	C.V.:	49.0%
Mode:	471.1 µm	Skewness:	0.261 Right skewed
		Kurtosis:	2.010 Leptokurtic

<10%	<25%	<50%	<75%	<90%
98.98 µm	337.2 µm	444.2 µm	545.7 µm	651.3 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

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Optical model: Fraunhofer.rf780z
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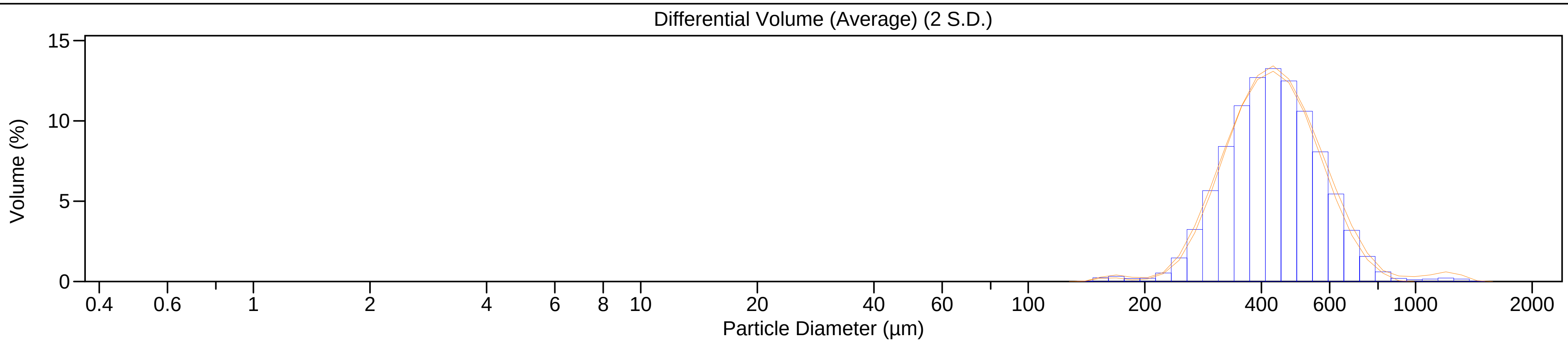
Volume Statistics (Arithmetic) KRSD28_4_703.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	446.1 µm	S.D.:	134.1 µm
Median:	428.0 µm	Variance:	17979 µm^2
Mean/Median ratio:	1.042	C.V.:	30.1%
Mode:	429.2 µm	Skewness:	1.469 Right skewed
		Kurtosis:	5.597 Leptokurtic

<10%	<25%	<50%	<75%	<90%
300.5 µm	354.2 µm	428.0 µm	517.9 µm	612.5 µm



Kanawha River

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File ID: KRSD28
Sample ID: 5
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
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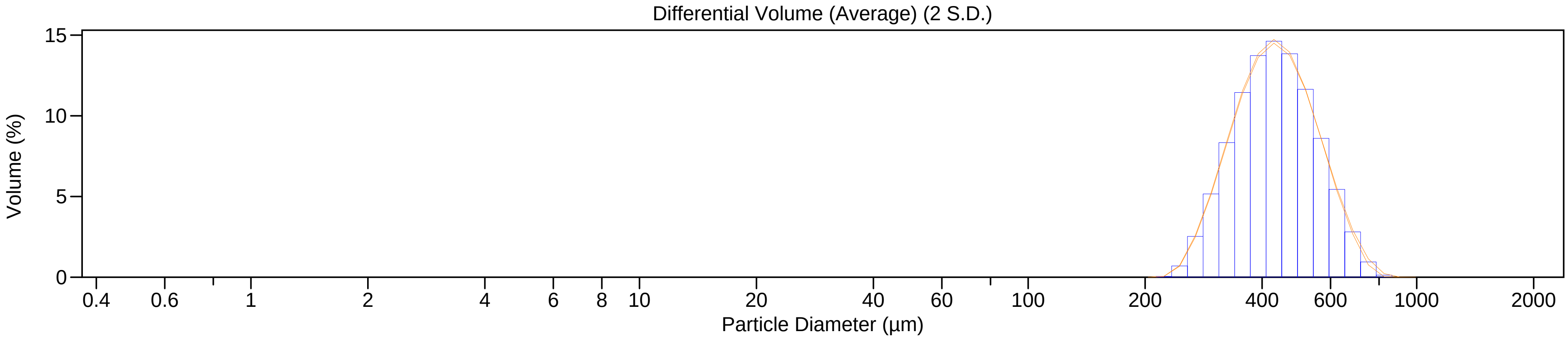
Volume Statistics (Arithmetic) KRSD28_5_706.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	443.8 µm	S.D.:	105.8 µm
Median:	431.7 µm	Variance:	11203 µm^2
Mean/Median ratio:	1.028	C.V.:	23.8%
Mode:	429.2 µm	Skewness:	0.560 Right skewed
		Kurtosis:	-0.036 Platykurtic

<10%	<25%	<50%	<75%	<90%
315.3 µm	363.8 µm	431.7 µm	512.6 µm	590.8 µm



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24 Sep 2009

Kanawha River

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KRSD28_6_718.$av
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Sample ID: 6
Operator: ANDES
Optical model: Fraunhofer.rf780z
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Run length: 60 seconds
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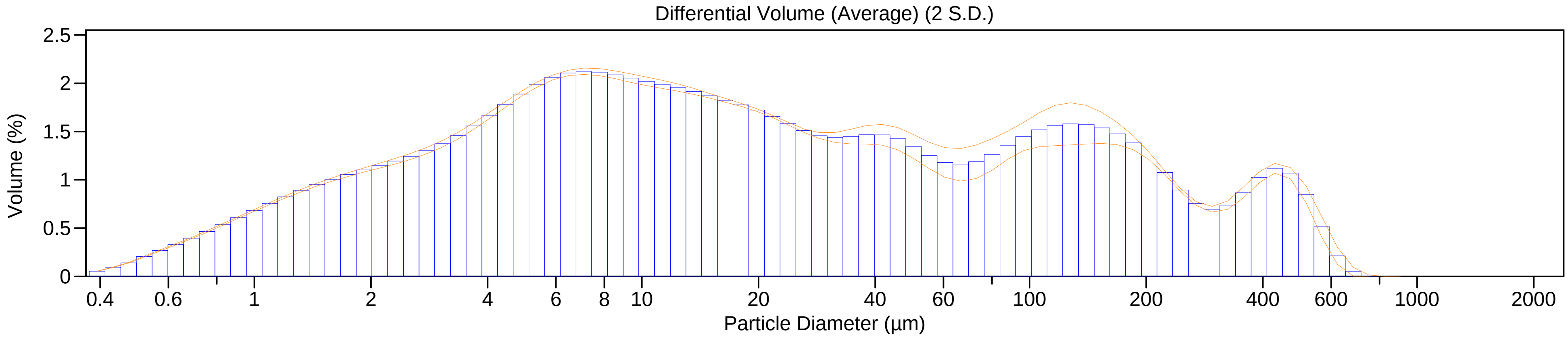
Volume Statistics (Arithmetic) KRSD28_6_718.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	70.14 µm	S.D.:	116.9 µm
Median:	16.26 µm	Variance:	13669 µm^2
Mean/Median ratio:	4.314	C.V.:	167%
Mode:	7.084 µm	Skewness:	2.451 Right skewed
		Kurtosis:	5.874 Leptokurtic

<10%	<25%	<50%	<75%	<90%
1.950 µm	5.112 µm	16.26 µm	81.25 µm	211.2 µm



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

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Optical model: Fraunhofer.rf780z
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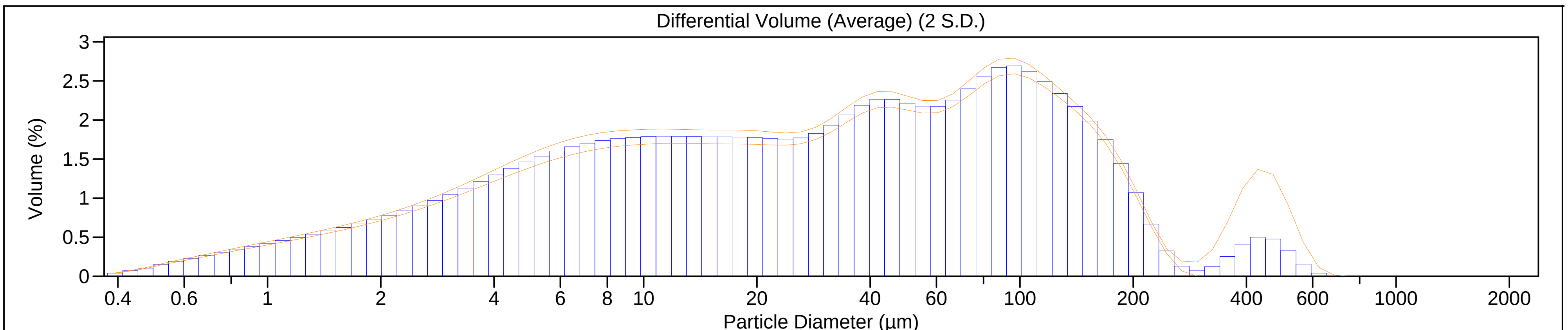
Volume Statistics (Arithmetic) KRSD48_1_649.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	58.81 µm	S.D.:	80.63 µm
Median:	28.92 µm	Variance:	6501 µm^2
Mean/Median ratio:	2.033	C.V.:	137%
Mode:	96.49 µm	Skewness:	3.010 Right skewed
		Kurtosis:	12.10 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.899 µm	7.794 µm	28.92 µm	83.13 µm	145.3 µm



AR101291

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

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Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
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C:\LS13320\Projects\WestVirgina\KRSD48_1_652.$ls

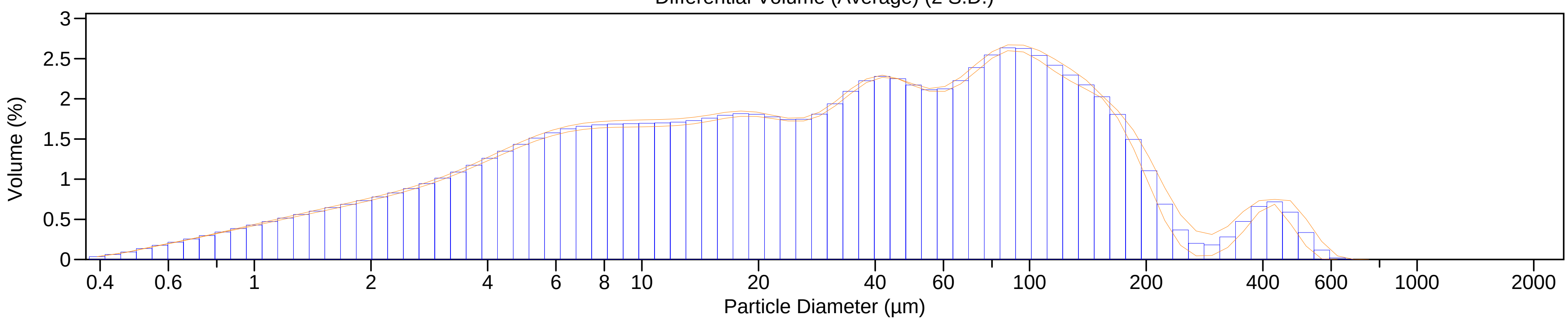
Volume Statistics (Arithmetic) KRSD48_1_652.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	62.67 µm	S.D.:	86.55 µm
Median:	30.23 µm	Variance:	7491 µm^2
Mean/Median ratio:	2.073	C.V.:	138%
Mode:	87.90 µm	Skewness:	2.767 Right skewed
		Kurtosis:	9.367 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.900 µm	7.959 µm	30.23 µm	86.23 µm	154.4 µm

Differential Volume (Average) (2 S.D.)



LS Particle Size Analyzer

24 Sep 2009

Kanawha River

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KRSD48_2_655.$av
File ID: KRSD48
Sample ID: 2
Operator: ANDES
Optical model: Fraunhofer.rf780z
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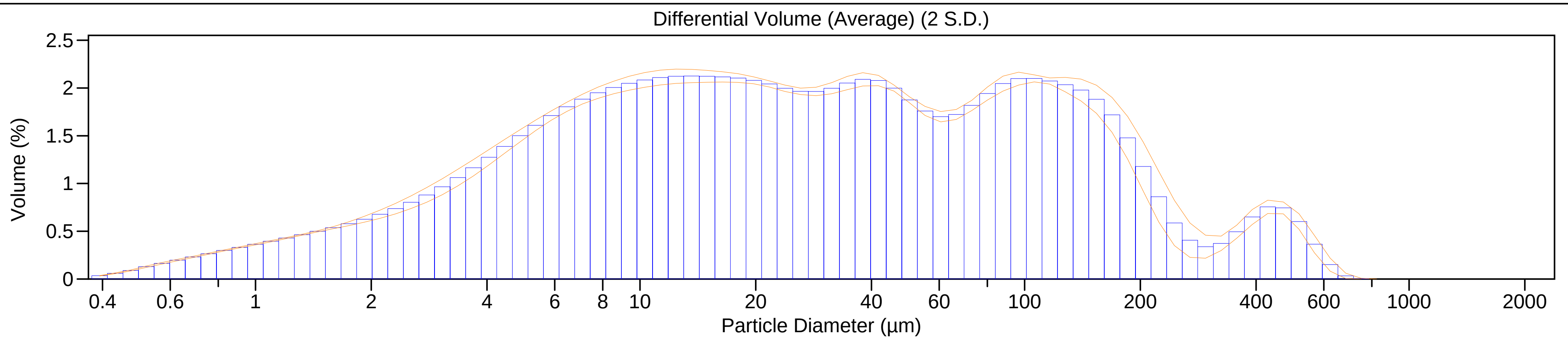
Volume Statistics (Arithmetic) KRSD48_2_655.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	65.61 µm	S.D.:	99.56 µm
Median:	24.87 µm	Variance:	9911 µm^2
Mean/Median ratio:	2.638	C.V.:	152%
Mode:	13.61 µm	Skewness:	2.830 Right skewed
		Kurtosis:	9.101 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.275 µm	8.105 µm	24.87 µm	83.74 µm	168.0 µm



LS Particle Size Analyzer

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24 Sep 2009

Kanawha River

File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD48_3_661.$av
KRSD48_3_661.$av
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Sample ID: 3
Operator: ANDES
Optical model: Fraunhofer.rf780z
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Run length: 60 seconds
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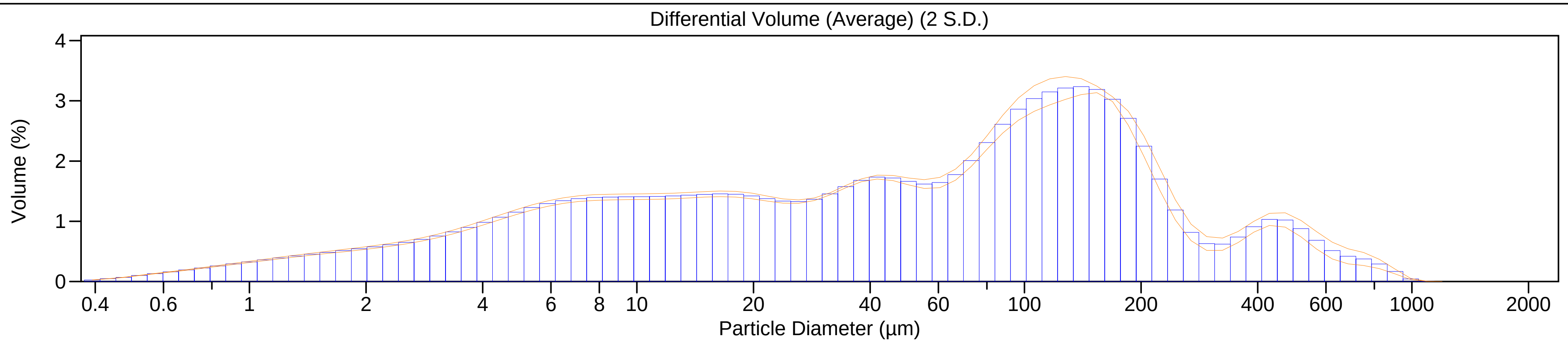
C:\LS13320\Projects\WestVirgina\KRSD48_3_661.$ls

Volume Statistics (Arithmetic) KRSD48_3_661.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	104.5 µm	S.D.:	141.1 µm
Median:	54.74 µm	Variance:	19916 µm^2
Mean/Median ratio:	1.909	C.V.:	135%
Mode:	140.1 µm	Skewness:	2.563 Right skewed
		Kurtosis:	7.869 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.859 µm	11.48 µm	54.74 µm	139.6 µm	240.4 µm



AR101294

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

File name: C:\Documents and Settings\Lisa\My Documents\Projects\WestVirginiaSedflume\ParticleSize\KRSD48_4_664.$av
KRSD48_4_664.$av
File ID: KRSD48
Sample ID: 4
Operator: ANDES
Optical model: Fraunhofer.rf780z
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Pump speed: 80
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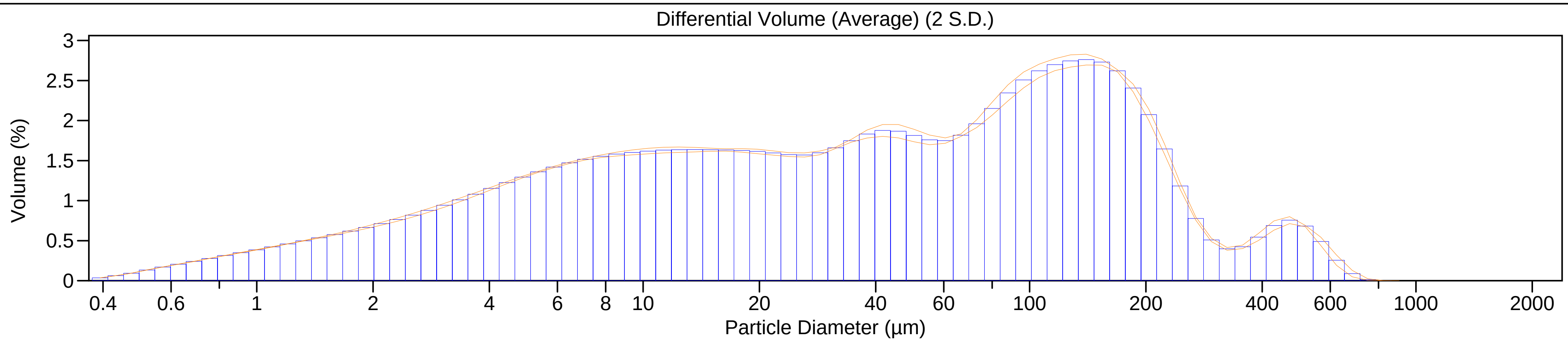
Volume Statistics (Arithmetic) KRSD48_4_664.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	80.75 µm	S.D.:	107.2 µm
Median:	37.76 µm	Variance:	11495 µm^2
Mean/Median ratio:	2.138	C.V.:	133%
Mode:	140.1 µm	Skewness:	2.407 Right skewed
		Kurtosis:	6.986 Leptokurtic

<10%	<25%	<50%	<75%	<90%
3.155 µm	9.036 µm	37.76 µm	117.0 µm	199.1 µm



AR101295

LS Particle Size Analyzer

24 Sep 2009

Kanawha River

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KRSD48_5_667.$av
File ID: KRSD48
Sample ID: 5
Operator: ANDES
Optical model: Fraunhofer.rf780z
LS 13 320 SW Aqueous Liquid Module
Run length: 60 seconds
Pump speed: 80
Average of 3 files:
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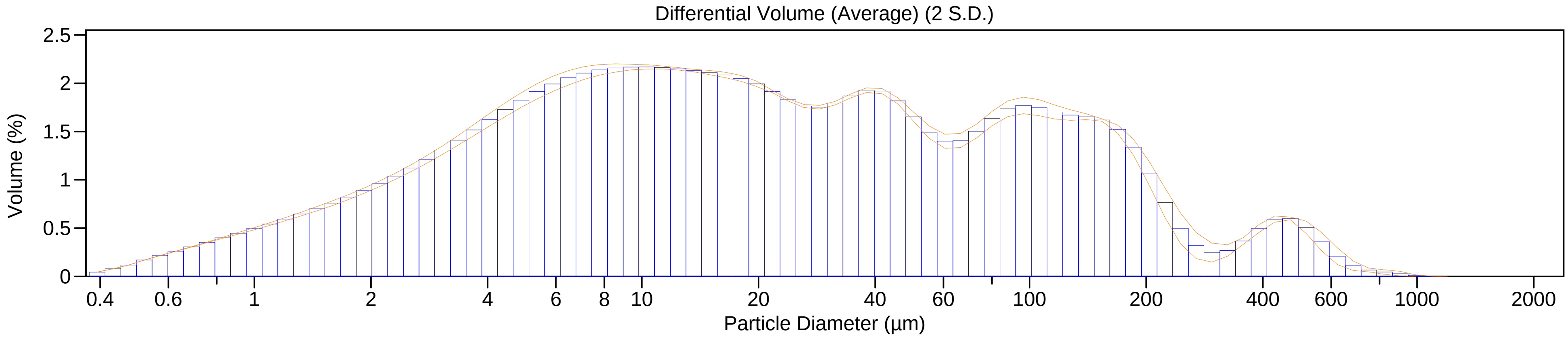
C:\LS13320\Projects\WestVirgina\KRSD48_5_666.$ls
C:\LS13320\Projects\WestVirgina\KRSD48_5_667.$ls

Volume Statistics (Arithmetic) KRSD48_5_667.$av

Calculations from 0.375 µm to 2000 µm

Volume:	100%		
Mean:	58.52 µm	S.D.:	100.8 µm
Median:	18.05 µm	Variance:	10155 μm^2
Mean/Median ratio:	3.242	C.V.:	172%
Mode:	10.29 µm	Skewness:	3.432 Right skewed
		Kurtosis:	14.57 Leptokurtic

<10%	<25%	<50%	<75%	<90%
2.457 µm	6.022 µm	18.05 µm	67.26 µm	156.1 µm



AR101296

APPENDIX L

MODELING SUMMARY AND RESULTS

APPENDIX L

MODELING SUMMARY AND RESULTS

KANAWHA RIVER
NITRO, WEST VIRGINIA

FEBRUARY 2015
REF. NO. 031884 (51) – APPENDIX L
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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ACRONYMS

2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
Anchor QEA	Anchor QEA, L.L.C
AOC	Administrative Order on Consent
cfs	cubic feet per second
CRA	Conestoga-Rovers & Associates
EE/CA	Engineering Evaluation/Cost Analysis
EFDC	Environmental Fluid Dynamics Code
EMS	Environmental Modeling Systems Inc.
EOC	Extent of Contamination
FESWMS	Finite Element Surface Water Modeling System
FEMA	Federal Emergency Management Agency
FHWA	U.S. Federal Highways Administration's
Flexsys	Flexsys America L.P.
FST2DH	Flow and Sediment Transport model
ft/s	feet per second
Golder	Golder Associates, Inc.
Monsanto Company	the corporation presently known as Monsanto Company
n	Manning coefficients
River	Kanawha River
Site	Consists of the normal pool of an approximate 14-mile portion of the Kanawha River from the Coal River downstream to the Winfield Locks and Dam (between RM 31.1 and RM 45.5)
SMS	Surface Water Modeling System
U.S. EPA	United States Environmental Protection Agency
WV	West Virginia
WV DEP	West Virginia Department of Environmental Protection

1.0 INTRODUCTION

Conestoga-Rovers & Associates (CRA) prepared an Engineering Evaluation and Cost Analysis (EE/CA) Work Plan to be submitted by Monsanto Company for the Kanawha River (River) Site (Site) located in Nitro, West Virginia (WV). Monsanto Company and Pharmacia Corporation negotiated with the United States Environmental Protection Agency (U.S. EPA) and the West Virginia Department of Environmental Protection (WV DEP) the terms of an Administrative Order by Consent (AOC) to perform the EE/CA. The overall objective of the EE/CA is to characterize the nature and extent of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD) at the Site that has been and/or is currently being released from what is now the Flexsys America L.P. (Flexsys) plant on Plant Road in Nitro, WV (the "Nitro facility"). The Site is located in the southwest portion of WV, near Nitro, approximately twelve miles northwest of Charleston. This EE/CA Work Plan includes a phased extent of contamination (EOC) study work plan to identify historical and/or potential ongoing 2,3,7,8-TCDD source areas to the River and to identify and fill data gaps to characterize the extent of the 2,3,7,8-TCDD at the Site.

One of the tasks described in the AOC was to perform a sediment stability evaluation of the sediments in the River. As part of this task, hydrodynamic and sediment transport modeling was completed to develop a more accurate understanding of sediment stability, transport, and recovery within the Site and with particular focus on areas of elevated 2,3,7,8-TCDD concentration. The objectives of the modeling were to:

- Develop a detailed understanding of hydrodynamics within the River to evaluate sediment stability over a range of storm and non-storm flow conditions. This aids in the evaluation of sediment transport as well as preliminary cap design activities for alternatives involving capping.
- Determine the stability of deposits of impacted sediments and identify areas within the channel and floodplain which have the ability to transport sediment during a 100-year flood event.

The hydrodynamics of the River were studied using a two-dimensional hydrodynamic model called Surface Water Modeling System (SMS) and a three-dimensional model that solves the vertically hydrostatic, free surface, and turbulence averaged equations of motion for a variable density fluid called the Environmental Fluid Dynamics Code (EFDC).

2.0 SITE DESCRIPTION

The River is a tributary of the Ohio River and approximately 97 miles in length located in both the Kanawha and Putnam Counties. This hydrodynamic study was conducted on a 14-mile section of the River located between the confluence of the Coal and River and Winfield Dam. Although the River is primarily oriented north to south, the sharp bend near the Winfield Dam creates an east to west orientation.

The average width of the River channel ranges between approximately 800 to 1,200 feet. Average water depths in the main channel vary from approximately 25 to 45 feet with a maximum water depth of 60 feet. The side slopes of the River are steep, typically 2:1 to 3:1 (horizontal:vertical), descending to the channel depth within 50 to 150 feet of the shoreline. The deepest part of the channel (i.e., thalweg) tends to migrate toward the outside of meander bends (i.e., toward the left side of the River across from Nitro, and toward the right side of the River approaching Winfield Dam), locally forming steeper banks in these areas.

A bathymetric and geophysical survey of the Site was completed by Golder Associates, Inc. (Golder), under the supervision of Anchor QEA, L.L.C (Anchor), to map the distribution and thickness of fine-grained, soft sediment deposits which may be subject to scour and erosion. The survey identified that bedrock outcrops appear to be exposed or covered by a thin sediment veneer on many of the side-slope areas, especially on the lower portions of the side slopes. The survey also noted that finer grained sediments appeared to be mainly restricted to shallower, near shore benches and bays.

During the 100-year flood event, the River delivers a total of 226,000 cubic feet per second (cfs) of flow to the Winfield Dam. The River is large with several tributaries, 11 in total, entering within the limits of the Study Area. The largest tributary is the Pocatalico River, which contributes 20,900 cfs of flow during the 100-year flood event.

3.0 MODELING APPROACH

The SMS, developed by Aquaveo and distributed by Environmental Modeling Systems Inc. (EMS), was used for hydrodynamic modeling of the River. SMS is a comprehensive environment for one-, two-, and three-dimensional hydrodynamic modeling. The SMS environment includes pre- and post-processors for a number of numerical models. In this Project, the U.S. Federal Highways Administration's (FHWA) Finite Element Surface Water Modeling System (FESWMS) was used to calculate flow directions and velocities in the river. FESWMS is a hydrodynamic model that supports both super and sub-critical flow analyses, including area wetting and drying. It uses the depth-averaged Flow and Sediment Transport model (FST2DH), a two-dimensional finite element surface water model that can compute the direction of flow and water surface elevation in a horizontal plane.

The FESWMS model was setup for the River and its floodplain between the confluence of the Coal and River and Winfield Dam. A curvilinear, mostly orthogonal grid was developed for the floodplain. The grid was defined by 54,787 nodes connected into 19,579 quadrilateral and triangular elements. The bathymetric surface required for the modeling was created in ArcView from a Digital Elevation Map (United States Geological Survey) and a hydrographic and geophysical survey conducted by Golder in 2005.

One initial and two boundary conditions were used in the model to properly capture all key hydrodynamic features of the system. The initial boundary condition was used to define initial water surface elevation at the beginning of the simulation. The upstream boundary condition characterized flows entering the model domain. These flows entering the model domain include the most upstream section of River and all contributing tributaries located in the study area. The contributing flows were determined from Flood Insurance Studies provided by the Federal Emergency Management Agency (FEMA). A downstream head boundary defined the water surface elevation at the downstream end of the model domain (Flood Insurance Study, FEMA). A bottom friction was defined to specify different Manning coefficients (n) for the floodplain (n = 0.079) and the channel (n = 0.03) (Flood Insurance Study, FEMA).

The SMS Steering Module was used to run the simulations in a spin-down mode. The spin-down mode is used when the desired boundary conditions differ greatly from the cold start (bathtub) conditions. The Steering Module iteratively solves the nonlinear flow equations in a series of progressive runs until a convergence is obtained. A combination of manual and automated wetting-drying was used to decrease the time required for model convergence. The model scenarios were run in a steady state mode.

4.0 MODELING RESULTS

The modeling scenario simulated using the FESWMS model was the 100-year flood event. The water surface elevation, water depth, and flow velocity and direction for the 100-year flood scenario predicted are presented on Figures L.1 to L.12. The model simulated sloped water surface elevations in the floodplain surrounding the River that ranged from 578 feet in the downstream sections of the floodplain to 588 feet in the upstream sections of the floodplain. The model results indicated that the flow velocities ranged from 4 feet per second (ft/s) to a maximum flow velocity within the channel of 8 ft/s and ranged from 0 ft/s to a maximum of 4 ft/s in the floodplain. The extent of flooding was observed to be very small with the flow mostly concentrated within the River network. High flow velocities are mostly seen in the main channel following the thalweg of the River. High velocities were also observed at the mouth of the tributaries entering into the River, the highest velocity being associated with the Pocatalico River.

The shear velocity was calculated in SMS by using a shear velocity formula based on Manning's equation and Shields curve. The shear velocity formula was input into the model data calculator function:

$$U* = \sqrt{(\frac{n^2}{1.49^2} * g) * u^2 * \frac{1}{\sqrt[3]{d}}}$$

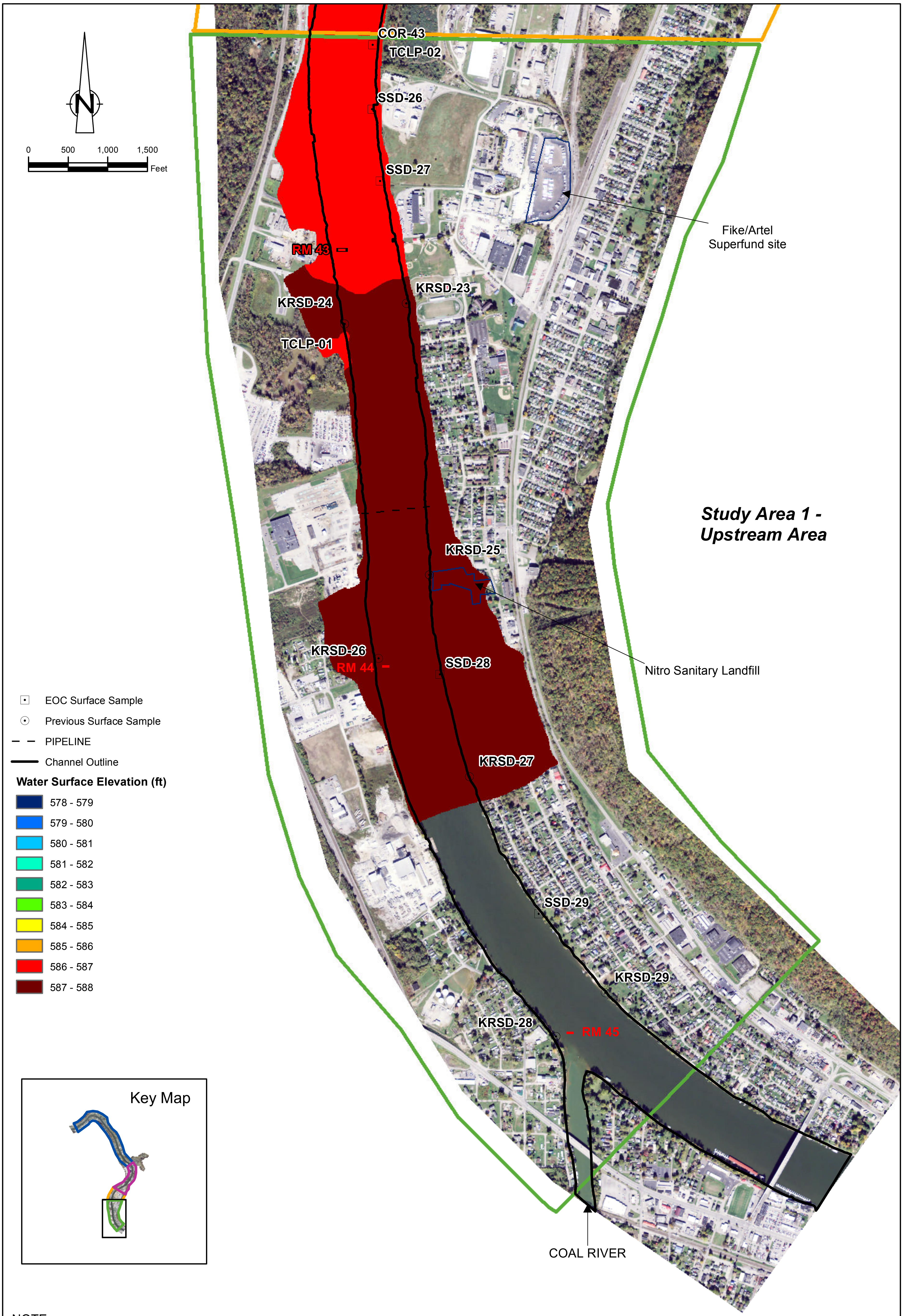
where:

U_* - Shear Velocity (ft/s)
n - Manning coefficient
g - gravity (ft/s^2)
u - velocity (ft/s)
d - water depth (ft)

The shear velocity was used to estimate the minimum velocity needed to initiate sediment movement within the River. The shear velocities calculated for each of the study areas for the 100-year flood are presented on Figures L.13 to L.16. The shear velocities calculated indicate that during the 100-year flood event, the loose clays and silts within the River channel will move downstream. As presented on Figures L.13 to L.16, there are a few small areas along the outside edge of the floodplain where high shear velocities are present. These localized areas are not representative of predicted behavior and are considered oddities. These oddities in the results are due to artifacts from the model which are based on the grid formations developed. Regardless of the presence of these few oddities, the results indicate that sediment will move in the channel and banks of the River.

Recovery rates on a Site-wide basis are projected to be approximately 1.95% per year on average. This evaluation is based on incoming sediment load to the project containing 2,3,7,8-TCDD at concentrations equivalent to the current SWAC of Study Area 1 (upstream of Nitro). Reductions in upstream loading of 2,3,7,8-TCDD would further accelerate this trend. Projected fish tissue concentrations based on these reductions are discussed in Section 8.1 of the EE/CA Report.

Based on the stability of the sediments identified in Sedflume testing (Appendix K of the EE/CA), the area in front of the Former Flexsys Facility (COR 39 area) and the area directly across the River (COR 36) become erosive under conditions less than the 100-year storm events. Due to the elevated 2,3,7,8-TCDD concentrations in these areas, these areas are targeted for evaluation under the Remedial Action Alternatives evaluated as part of the EE/CA. Other areas of the Site do not represent areas which combine erosive potential with elevated 2,3,7,8-TCDD concentrations.



NOTE:
(1) Property boundaries shown are approximate.
(2) The lateral extent of the Site and Study Area boundaries are limited to the River within the water surface defined by the normal pool elevation. Adjacent areas are included for reference only, and do not form part of the Site.

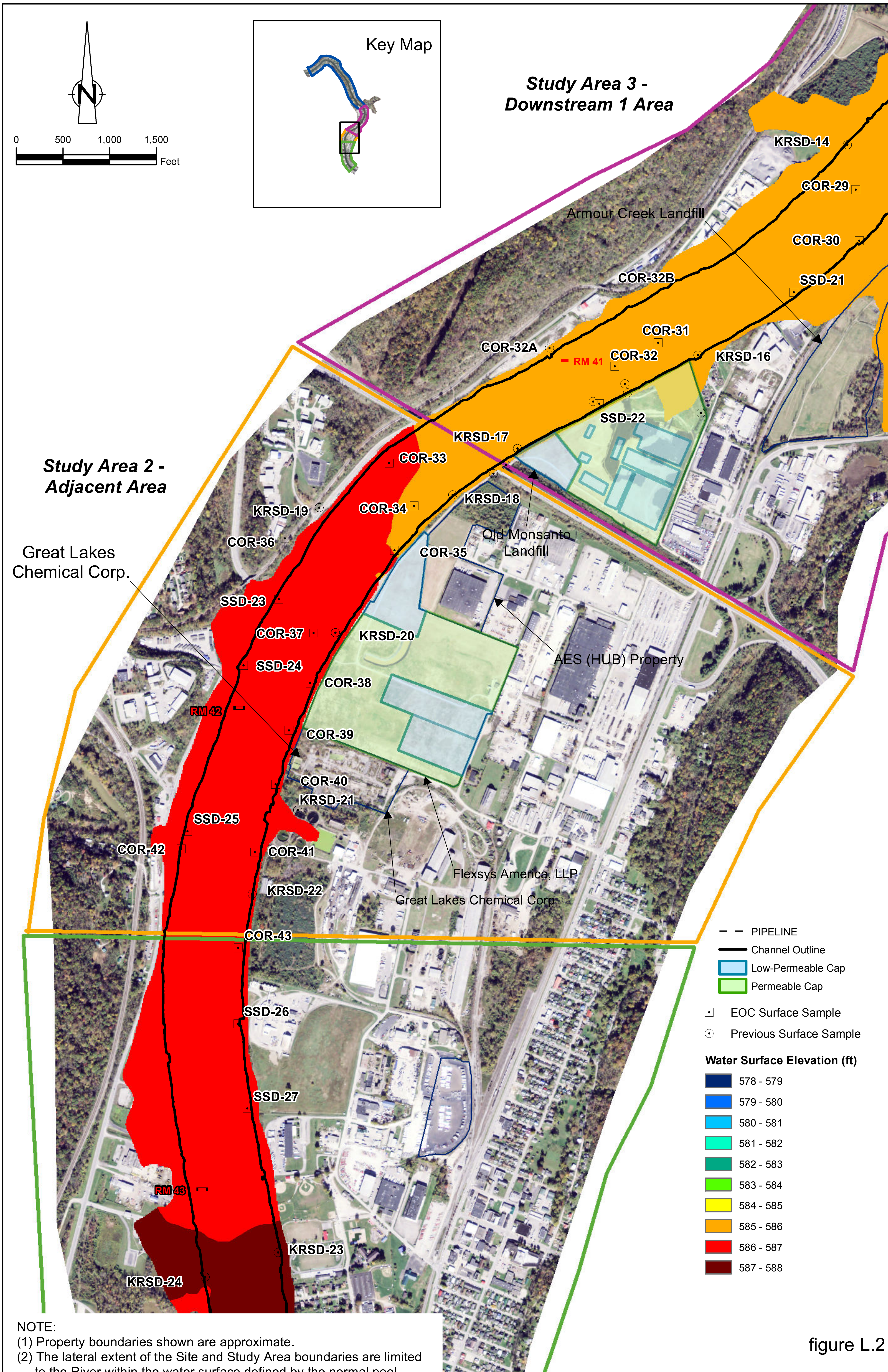
SOURCE: AERIAL NATIONAL AGRICULTURE IMAGERY PROGRAM DATED 2014 (WEST VIRGINIA SOUTH SPC, NAD83)

figure L.1

100 YEAR FLOOD – STUDY AREA 1
WATER SURFACE ELEVATION
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

031884-00(REP051)GIS-WA034 February 25, 2015

AR101307

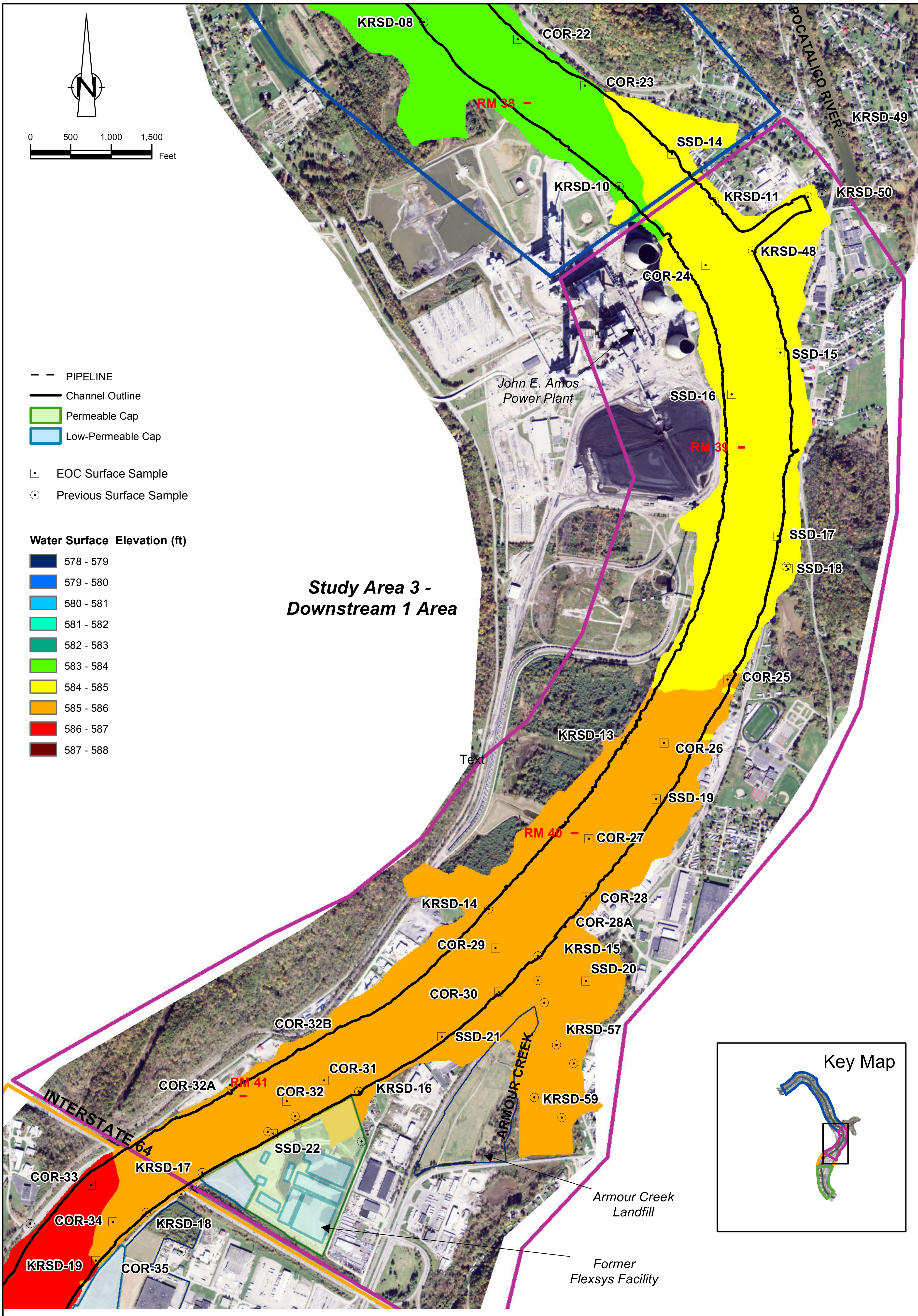


NOTE:
(1) Property boundaries shown are approximate.
(2) The lateral extent of the Site and Study Area boundaries are limited to the River within the water surface defined by the normal pool elevation. Adjacent areas are included for reference only, and do not form part of the Site.

figure L.2

100 YEAR FLOOD – STUDY AREA 2
WATER SURFACE ELEVATION
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

SOURCE: AERIAL NATIONAL AGRICULTURE IMAGERY PROGRAM DATED 2014 (WEST VIRGINIA SOUTH SPC, NAD83)



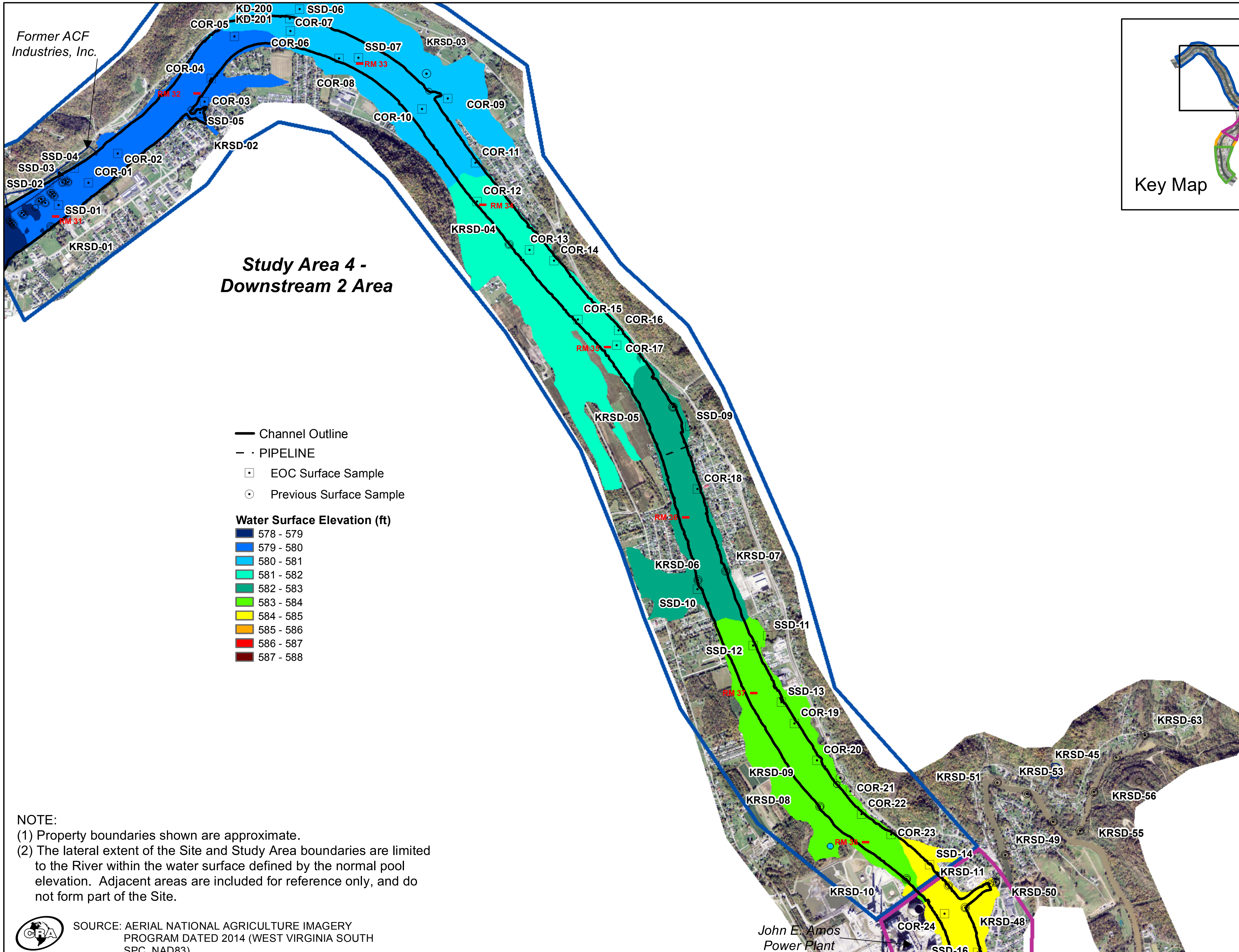
NOTE:
(1) Property boundaries shown are approximate.
(2) The lateral extent of the Site and Study Area boundaries are limited to the River within the water surface defined by the normal pool elevation. Adjacent areas are included for reference only, and do not form part of the Site.

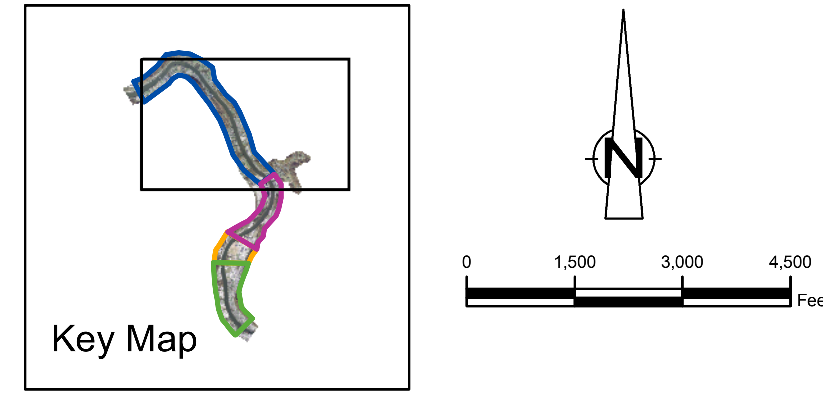
SOURCE: AERIAL NATIONAL AGRICULTURE IMAGERY PROGRAM DATED 2014 (WEST VIRGINIA SOUTH SPC, NAD83)

figure L.3

100 YEAR FLOOD – STUDY AREA 3
WATER SURFACE ELEVATION
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

031884-00(REP051)GIS-WA036 February 25, 2015





— Channel Outline
- · PIPELINE
EOC Surface Sample
Previous Surface Sample

Water Surface Elevation (ft)
578 - 579
579 - 580
580 - 581
581 - 582
582 - 583
583 - 584
584 - 585
585 - 586
586 - 587
587 - 588

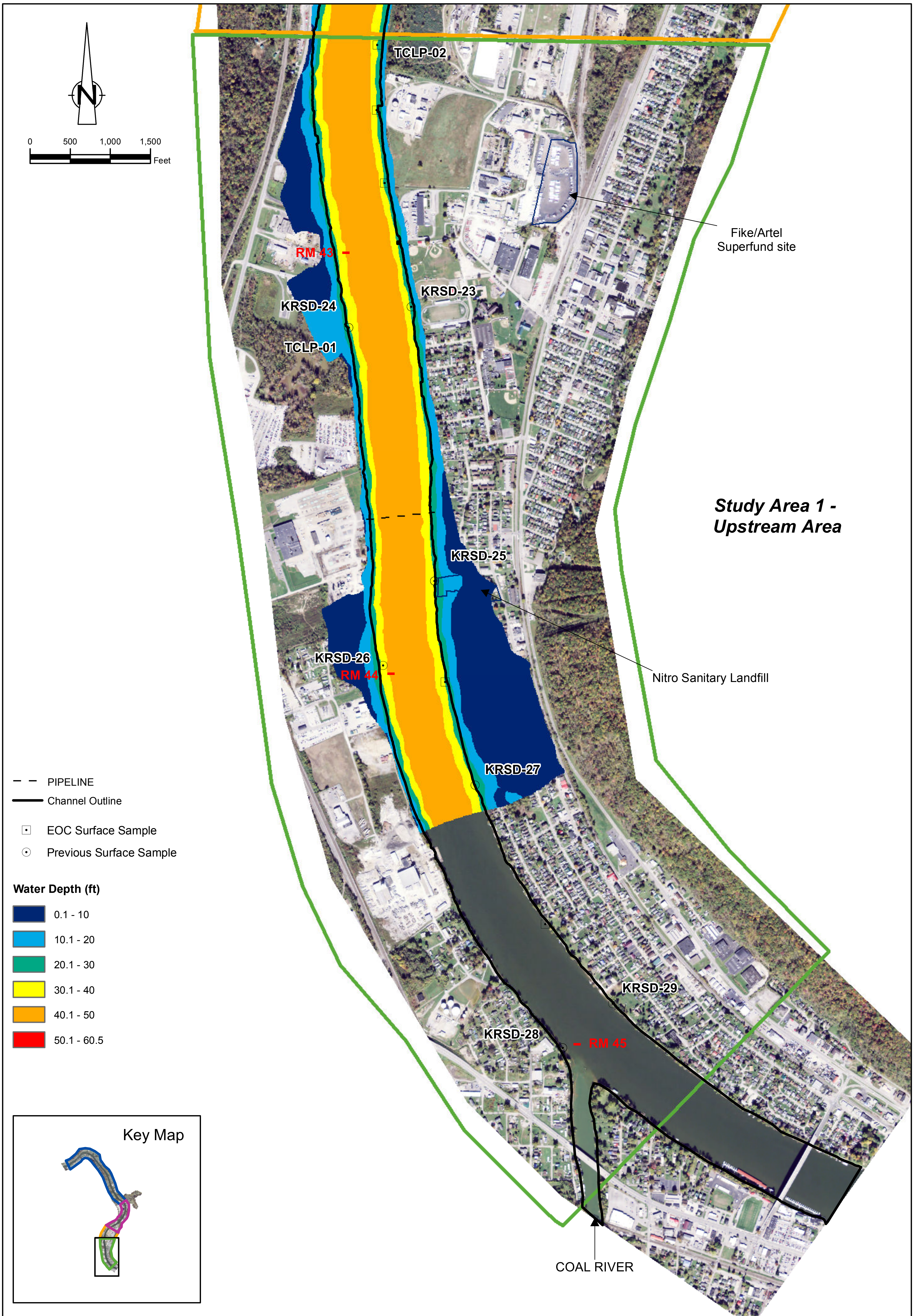
NOTE:
(1) Property boundaries shown are approximate.
(2) The lateral extent of the Site and Study Area boundaries are limited to the River within the water surface defined by the normal pool elevation. Adjacent areas are included for reference only, and do not form part of the Site.

CRA

SOURCE: AERIAL NATIONAL AGRICULTURE IMAGERY PROGRAM DATED 2014 (WEST VIRGINIA SOUTH SPC, NAD83)

figure L.4

100 YEAR FLOOD – STUDY AREA 4
WATER SURFACE ELEVATION
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

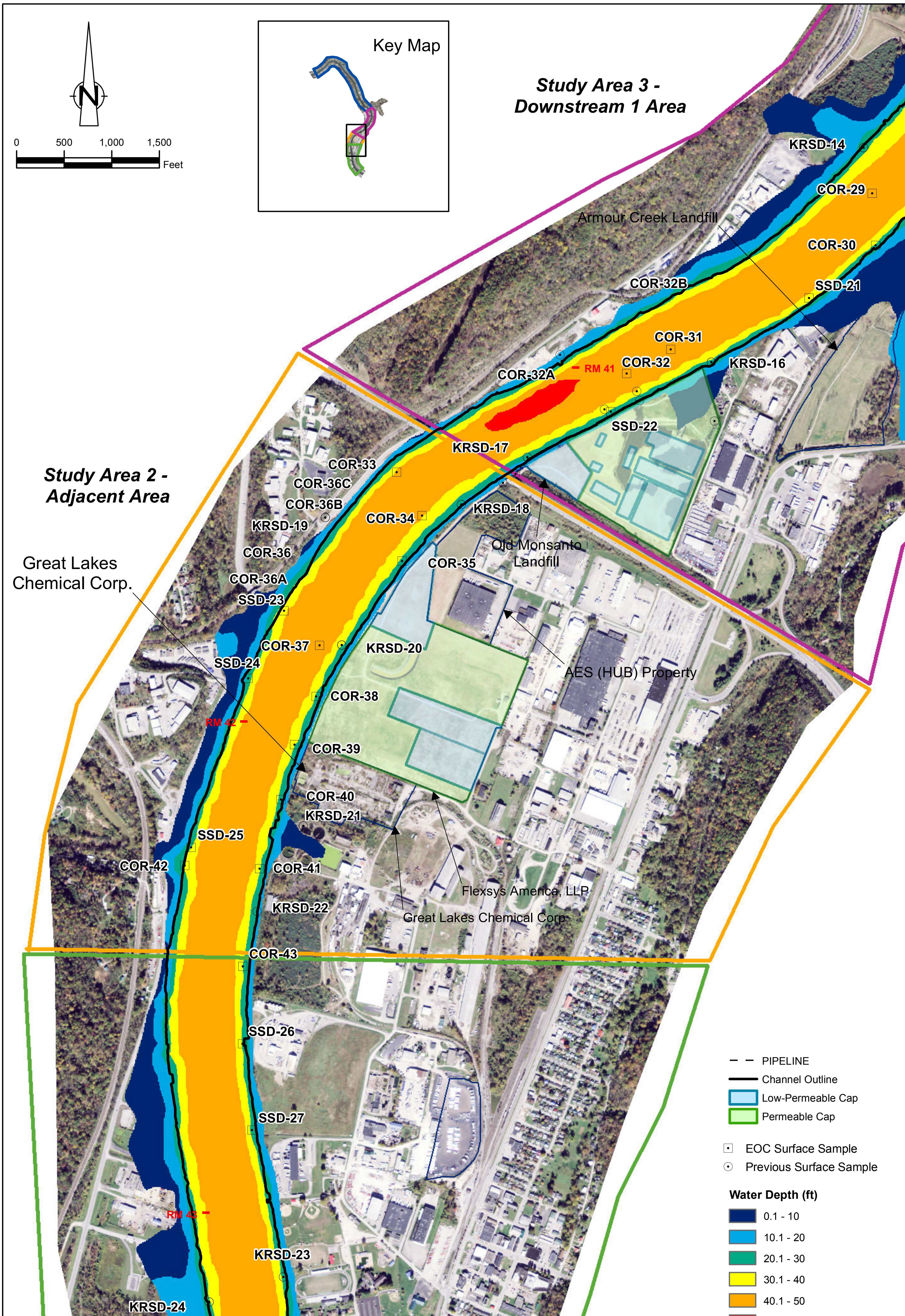


NOTE:
(1) Property boundaries shown are approximate.
(2) The lateral extent of the Site and Study Area boundaries are limited to the River within the water surface defined by the normal pool elevation. Adjacent areas are included for reference only, and do not form part of the Site.

SOURCE: AERIAL NATIONAL AGRICULTURE IMAGERY PROGRAM DATED 2014 (WEST VIRGINIA SOUTH SPC, NAD83)

figure L.5

100 YEAR FLOOD – STUDY AREA 1
WATER DEPTH
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA



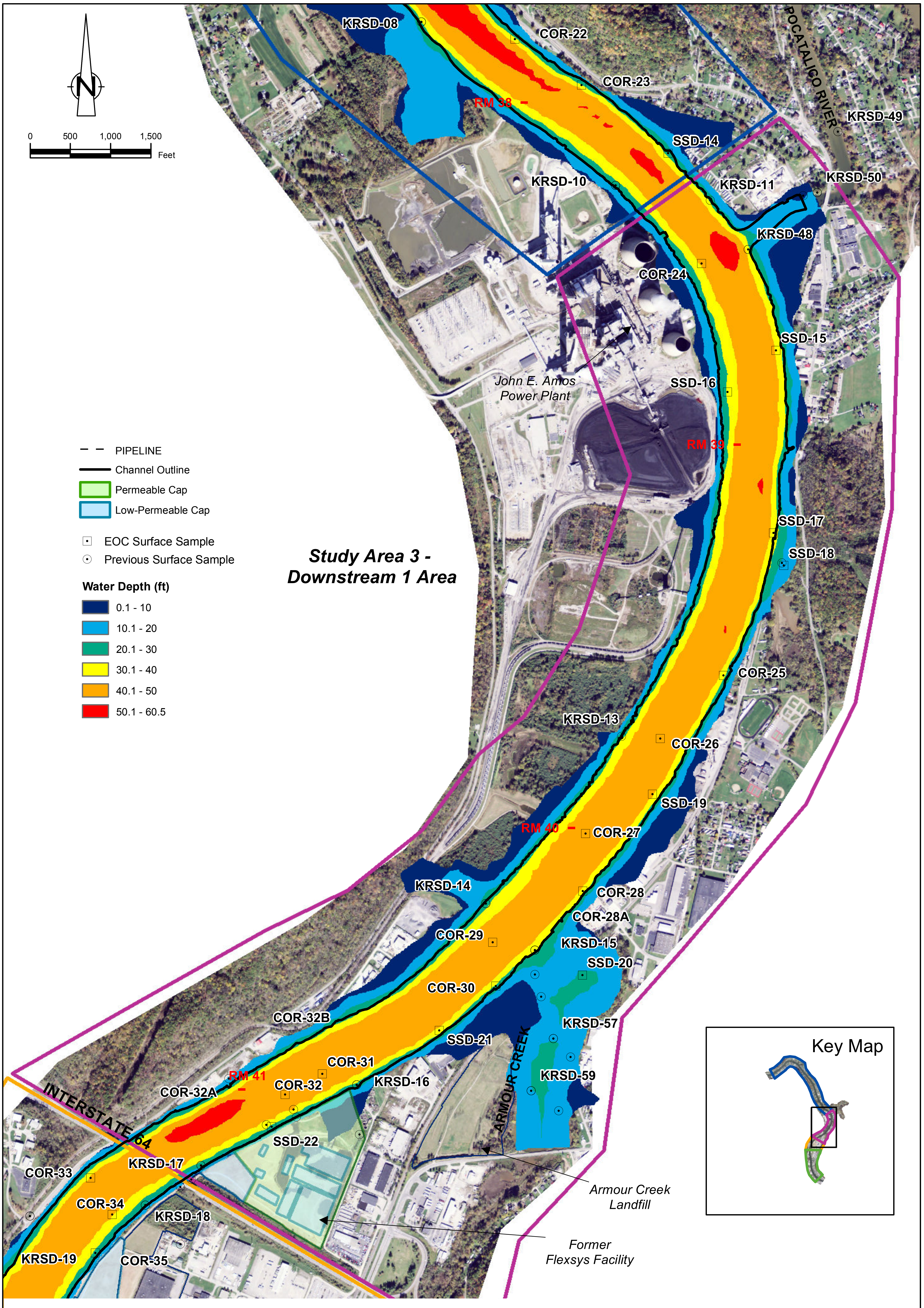
NOTE:
(1) Property boundaries shown are approximate.
(2) The lateral extent of the Site and Study Area boundaries are limited to the River within the water surface defined by the normal pool elevation. Adjacent areas are included for reference only, and do not form part of the Site.

figure L.6

100 YEAR FLOOD – STUDY AREA 2
WATER DEPTH
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

CRA

SOURCE: AERIAL NATIONAL AGRICULTURE IMAGERY PROGRAM DATED 2014 (WEST VIRGINIA SOUTH SPC, NAD83)



NOTE:
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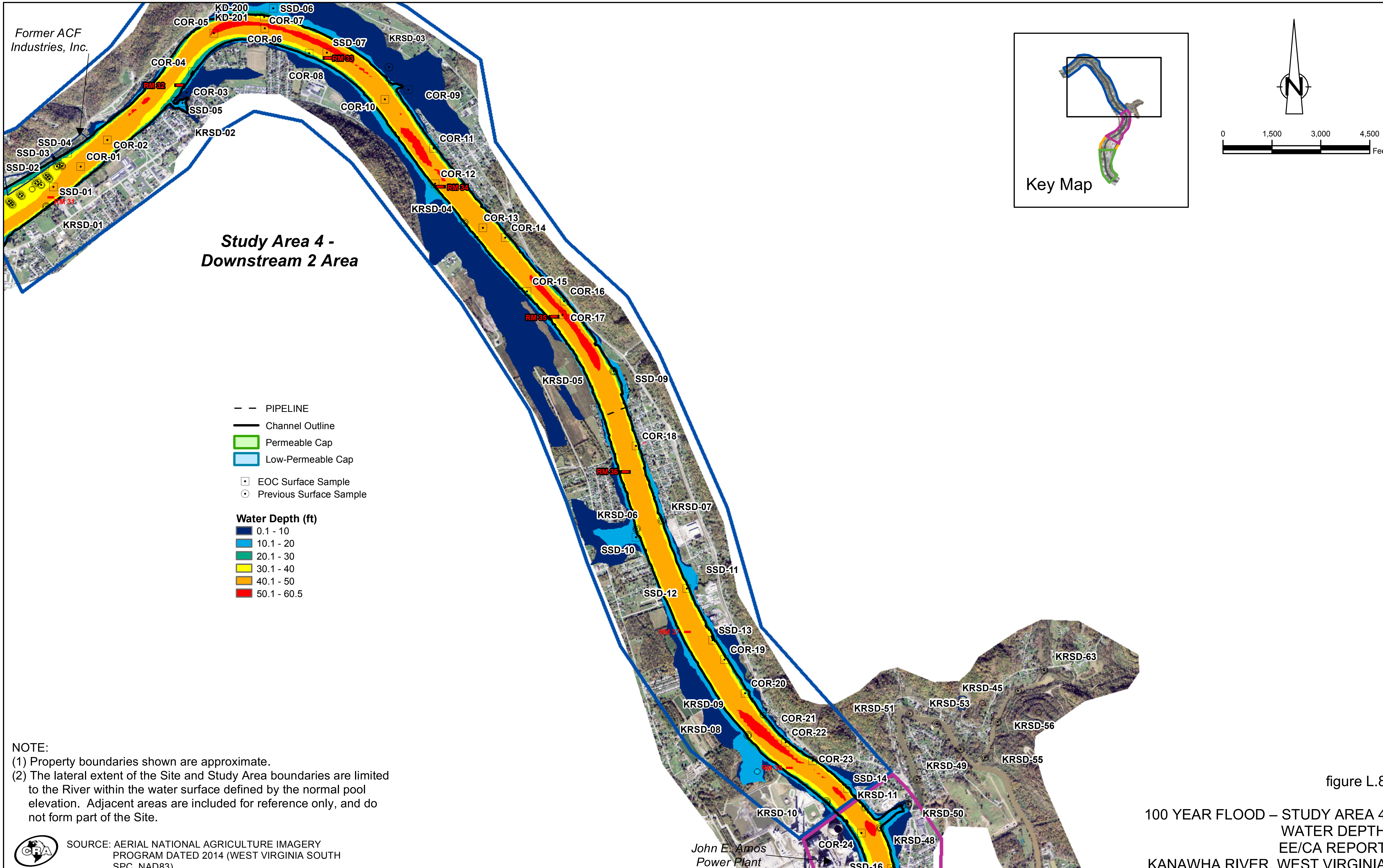
SOURCE: AERIAL NATIONAL AGRICULTURE IMAGERY PROGRAM DATED 2014 (WEST VIRGINIA SOUTH SPC, NAD83)

figure L.7

100 YEAR FLOOD – STUDY AREA 3
WATER DEPTH
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

031884-00(REP051)GIS-WA040 February 25, 2015

AR101313



NOTE:
(1) Property boundaries shown are approximate.
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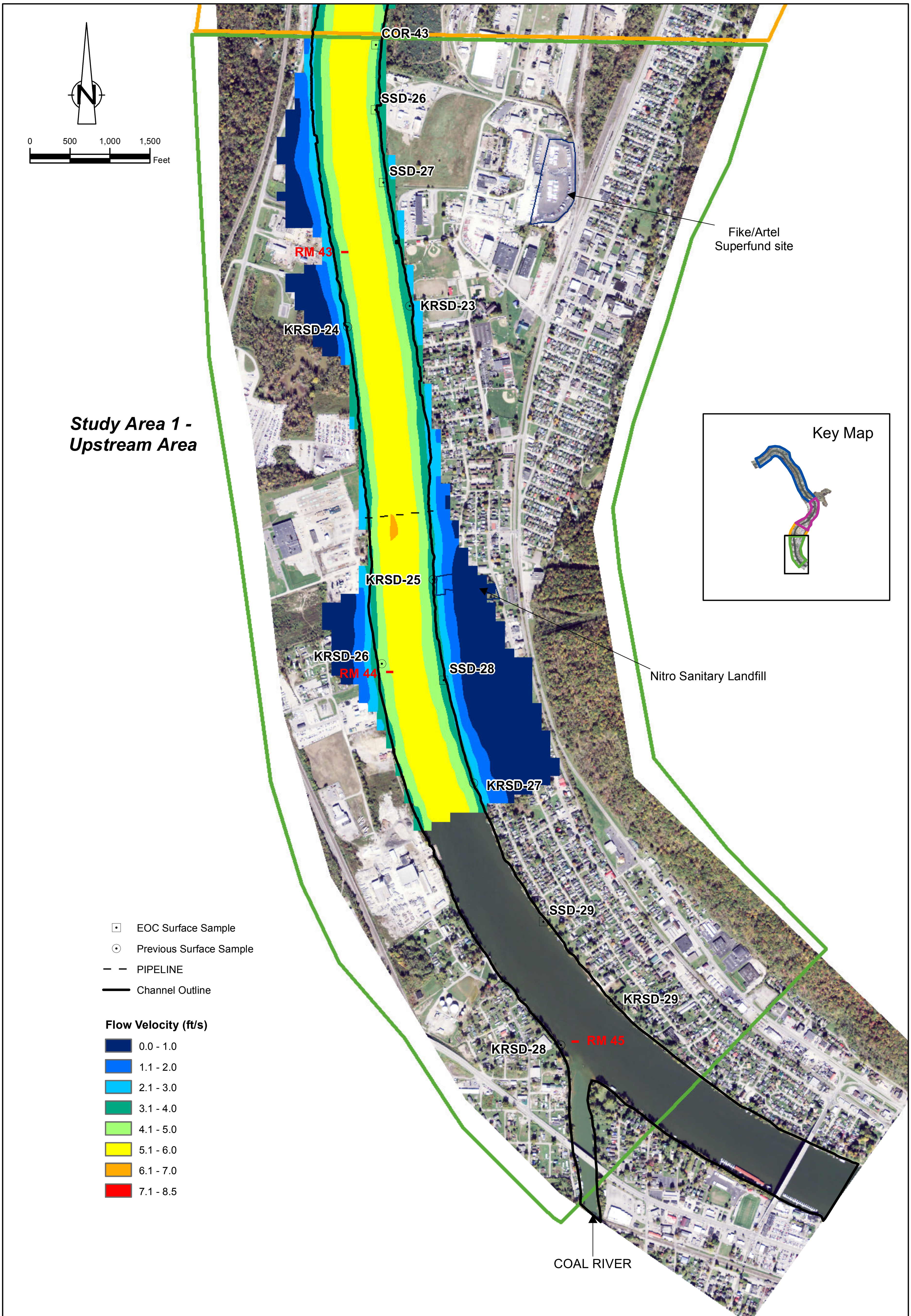
SOURCE: AERIAL NATIONAL AGRICULTURE IMAGERY PROGRAM DATED 2014 (WEST VIRGINIA SOUTH SPC, NAD83)

figure L.8

100 YEAR FLOOD – STUDY AREA 4
WATER DEPTH
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

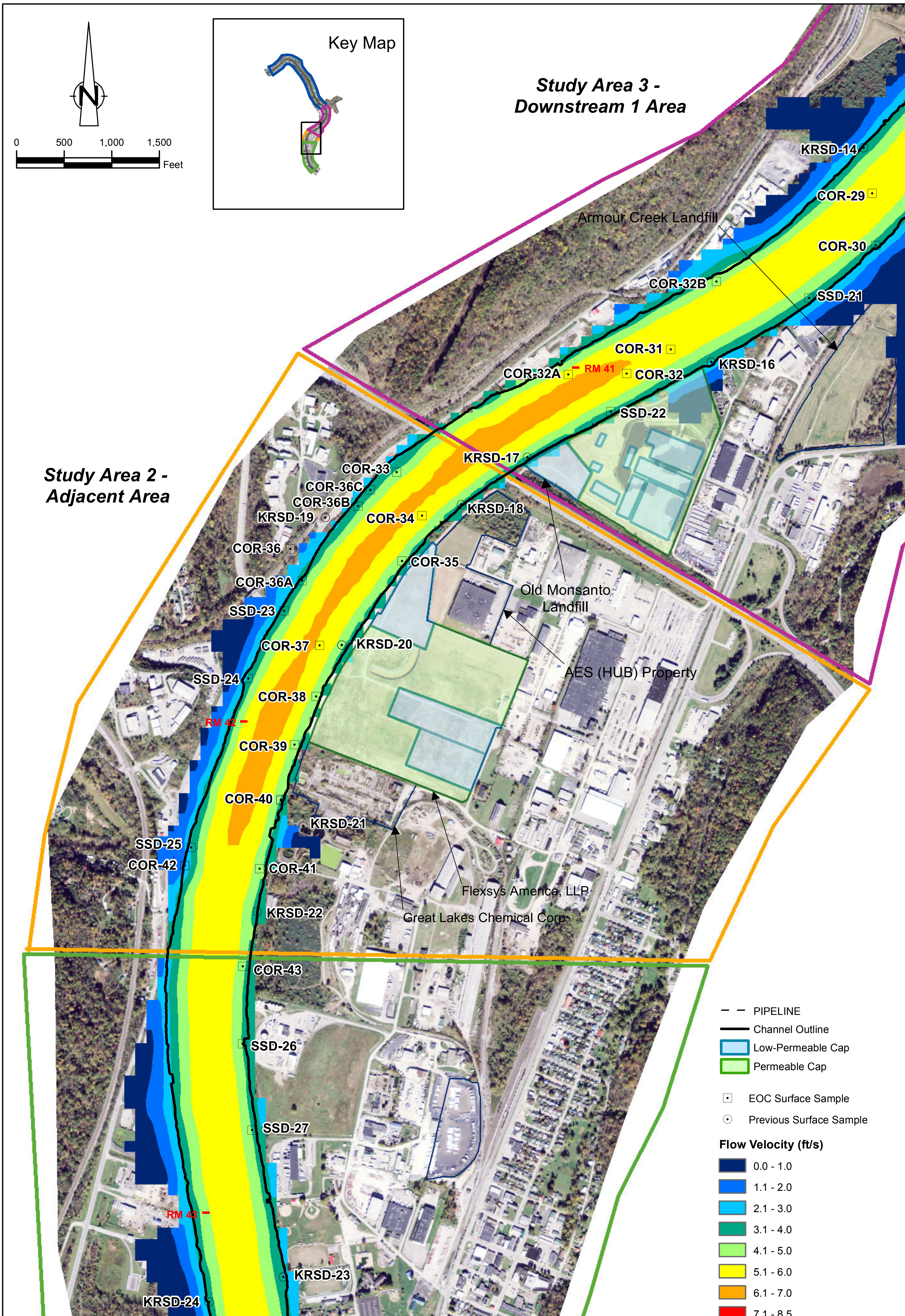


NOTE:
(1) Property boundaries shown are approximate.
(2) The lateral extent of the Site and Study Area boundaries are limited to the River within the water surface defined by the normal pool elevation. Adjacent areas are included for reference only, and do not form part of the Site.

SOURCE: AERIAL NATIONAL AGRICULTURE IMAGERY PROGRAM DATED 2014 (WEST VIRGINIA SOUTH SPC, NAD83)

figure L.9

100 YEAR FLOOD – STUDY AREA 1
FLOW VELOCITY
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA



NOTE:
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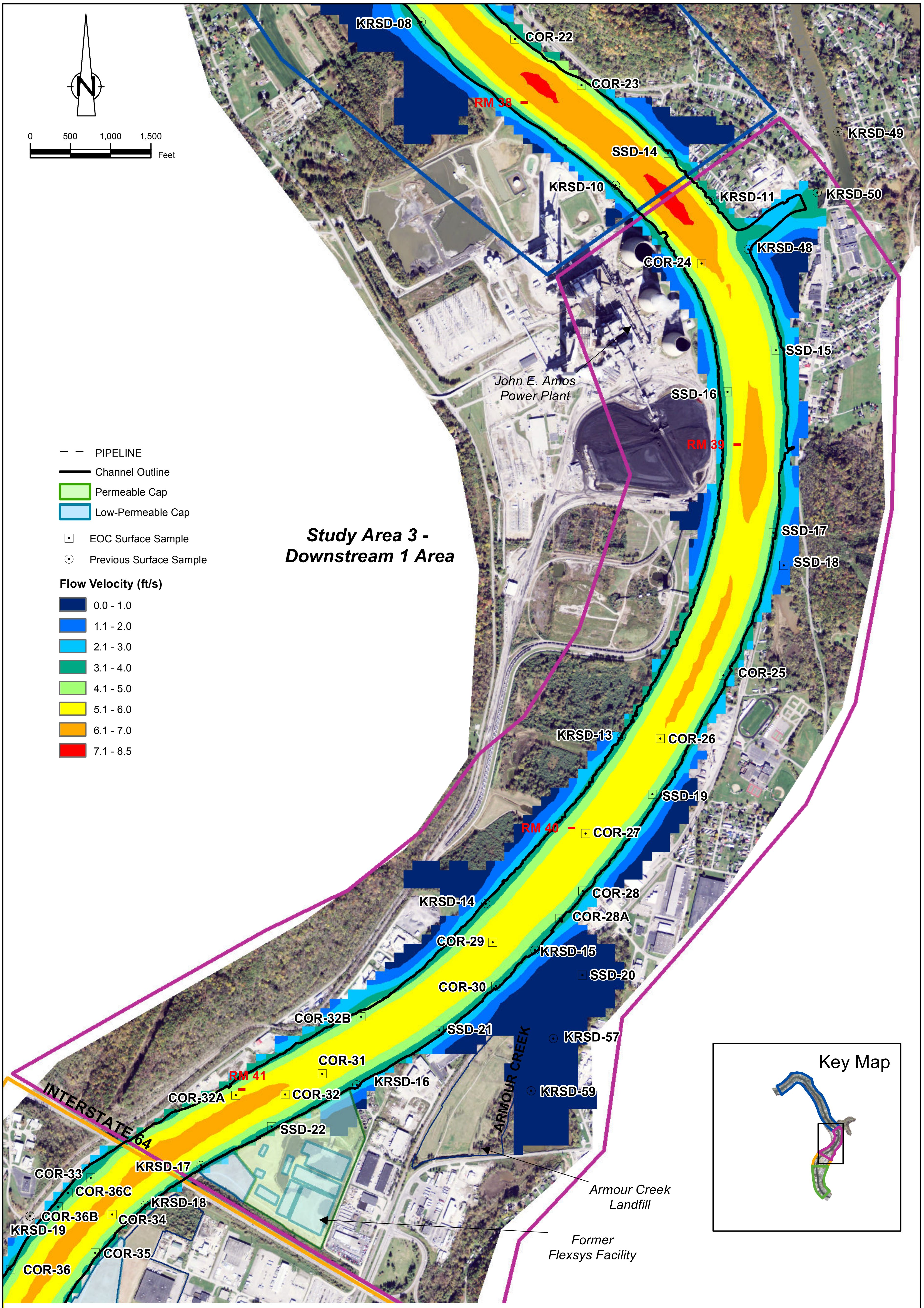
SOURCE: AERIAL NATIONAL AGRICULTURE IMAGERY PROGRAM DATED 2014 (WEST VIRGINIA SOUTH SPC, NAD83)

figure L.10

100 YEAR FLOOD – STUDY AREA 2
FLOW VELOCITY
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA



NOTE:
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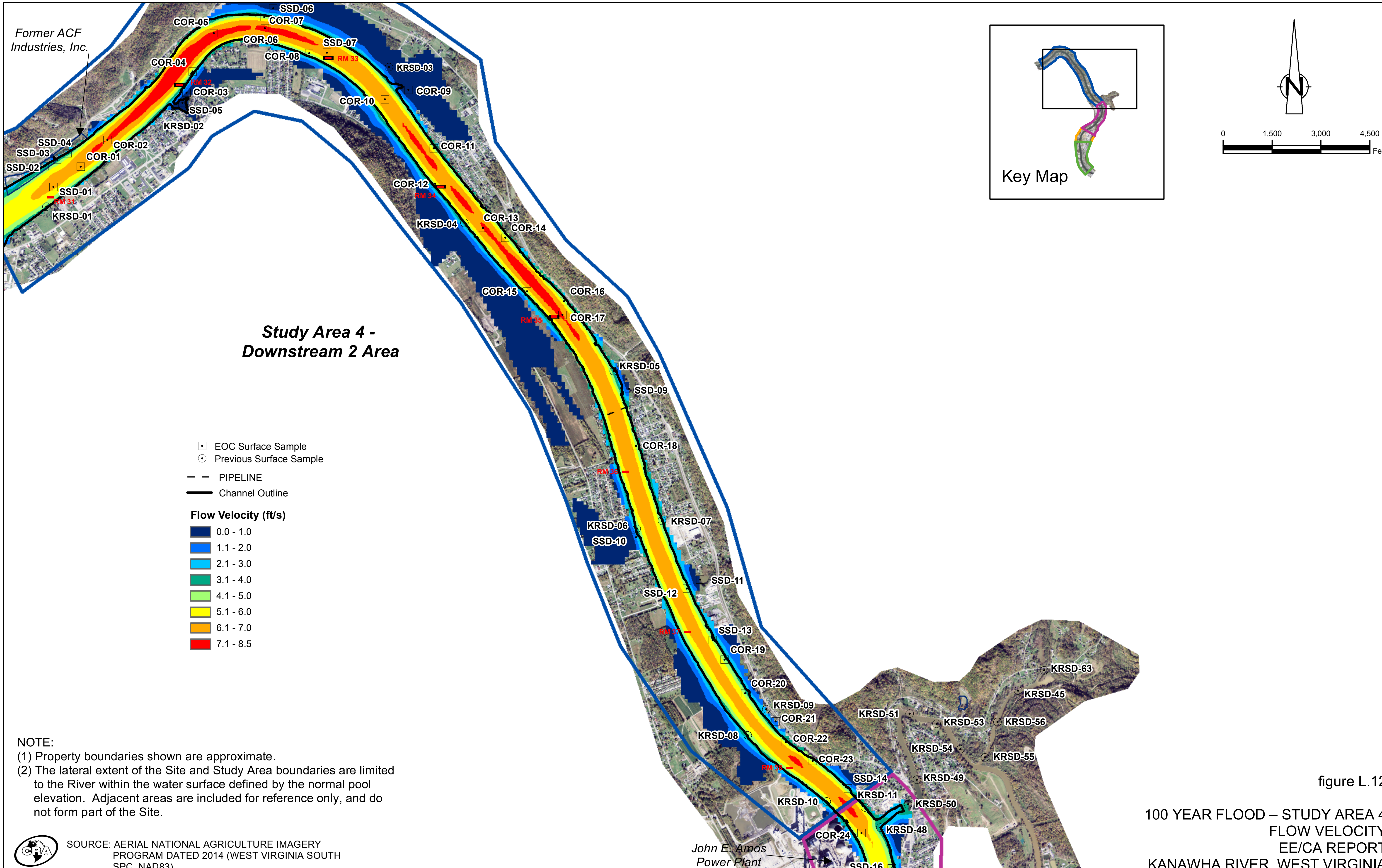
SOURCE: AERIAL NATIONAL AGRICULTURE IMAGERY PROGRAM DATED 2014 (WEST VIRGINIA SOUTH SPC, NAD83)

figure L.11

100 YEAR FLOOD – STUDY AREA 3
FLOW VELOCITY
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

031884-00(REP051)GIS-WA044 February 25, 2015



NOTE:
(1) Property boundaries shown are approximate.
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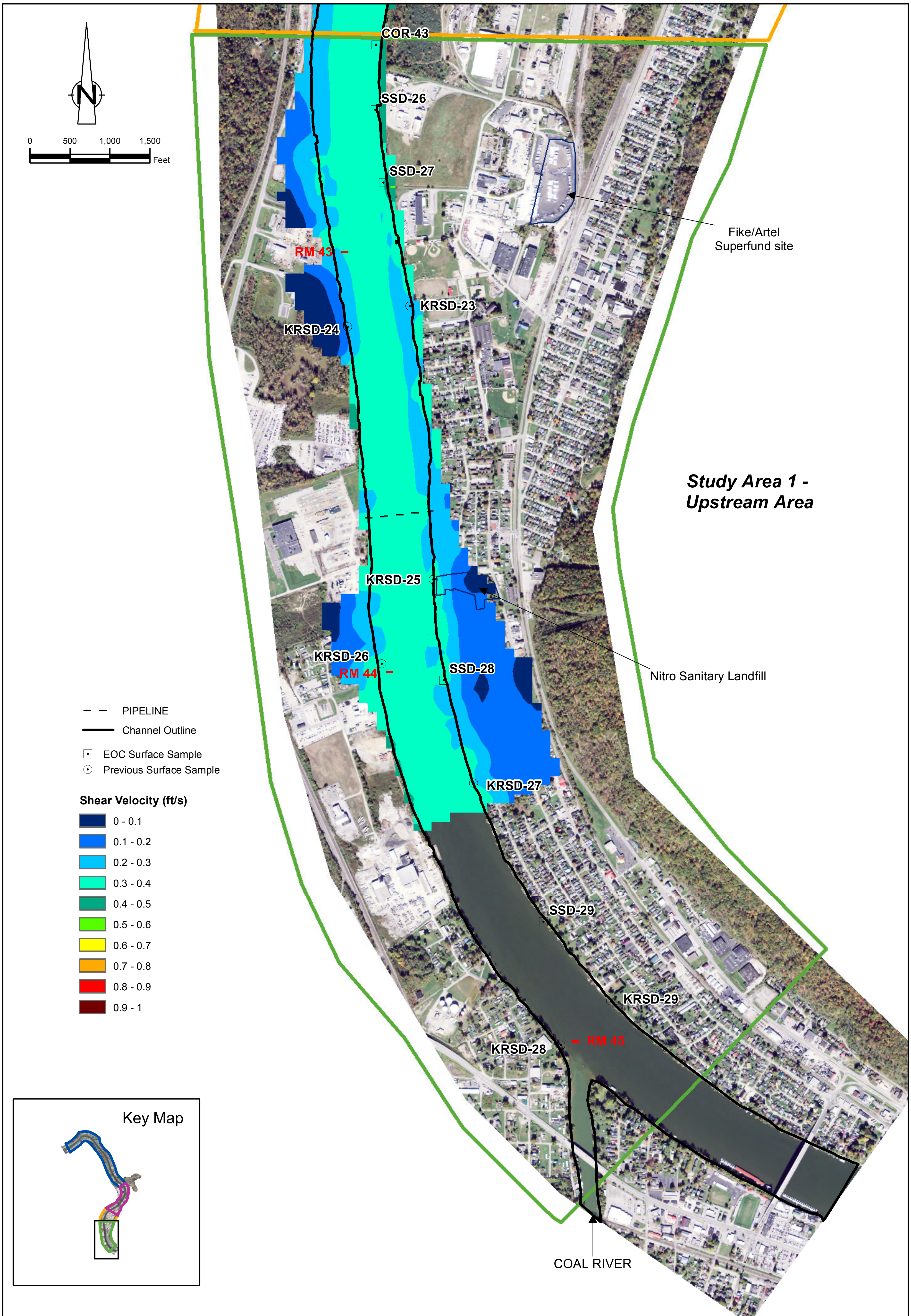
SOURCE: AERIAL NATIONAL AGRICULTURE IMAGERY PROGRAM DATED 2014 (WEST VIRGINIA SOUTH SPC, NAD83)

figure L.12

100 YEAR FLOOD – STUDY AREA 4
FLOW VELOCITY
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA



NOTE:
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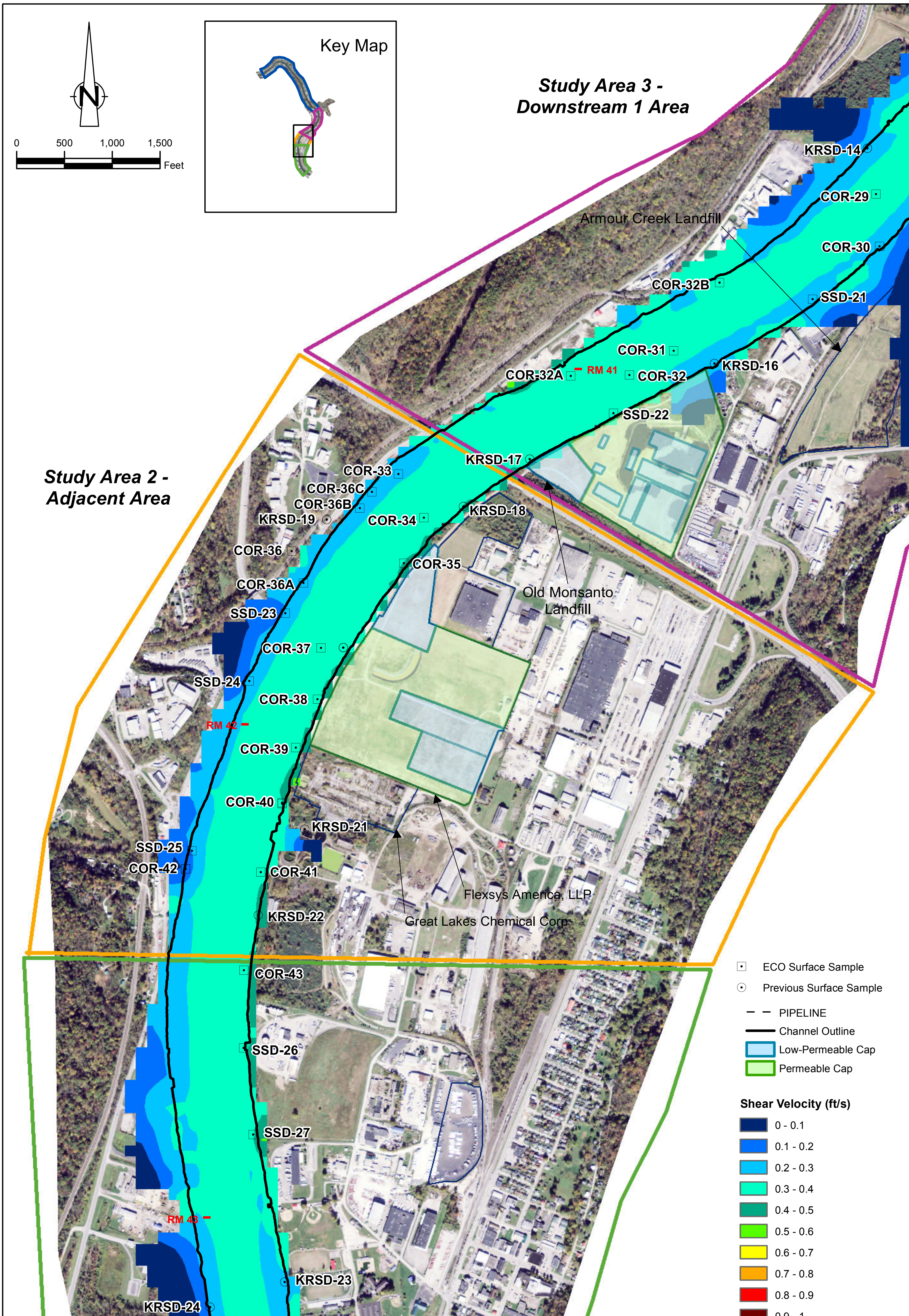
CRA

SOURCE: AERIAL NATIONAL AGRICULTURE IMAGERY PROGRAM DATED 2014 (WEST VIRGINIA SOUTH SPC, NAD83)

figure L.13

100 YEAR FLOOD – STUDY AREA 1
SHEAR VELOCITY
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA



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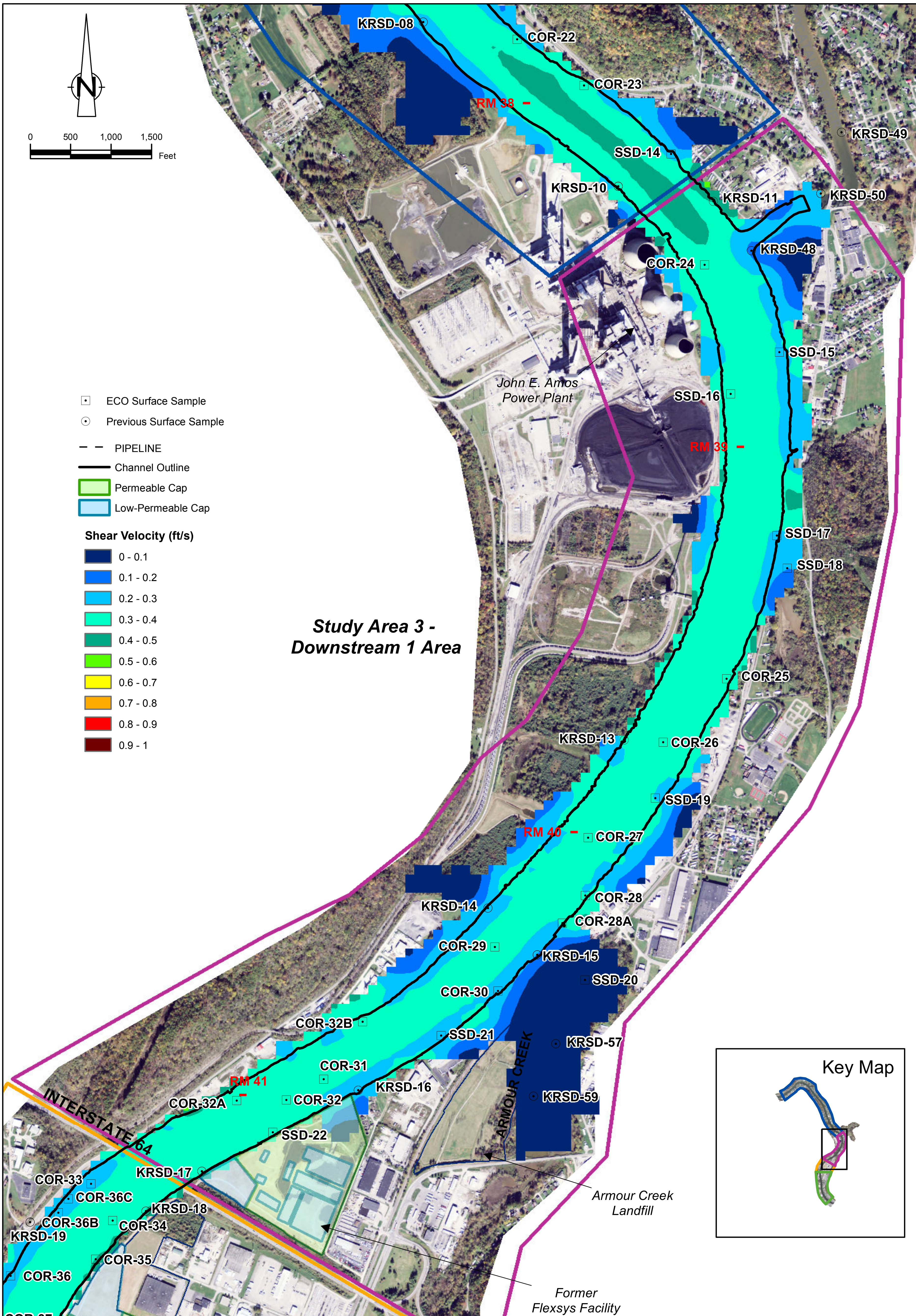
SOURCE: AERIAL NATIONAL AGRICULTURE IMAGERY PROGRAM DATED 2014 (WEST VIRGINIA SOUTH SPC, NAD83)

figure L.14

100 YEAR FLOOD – STUDY AREA 2
SHEAR VELOCITY
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA



NOTE:
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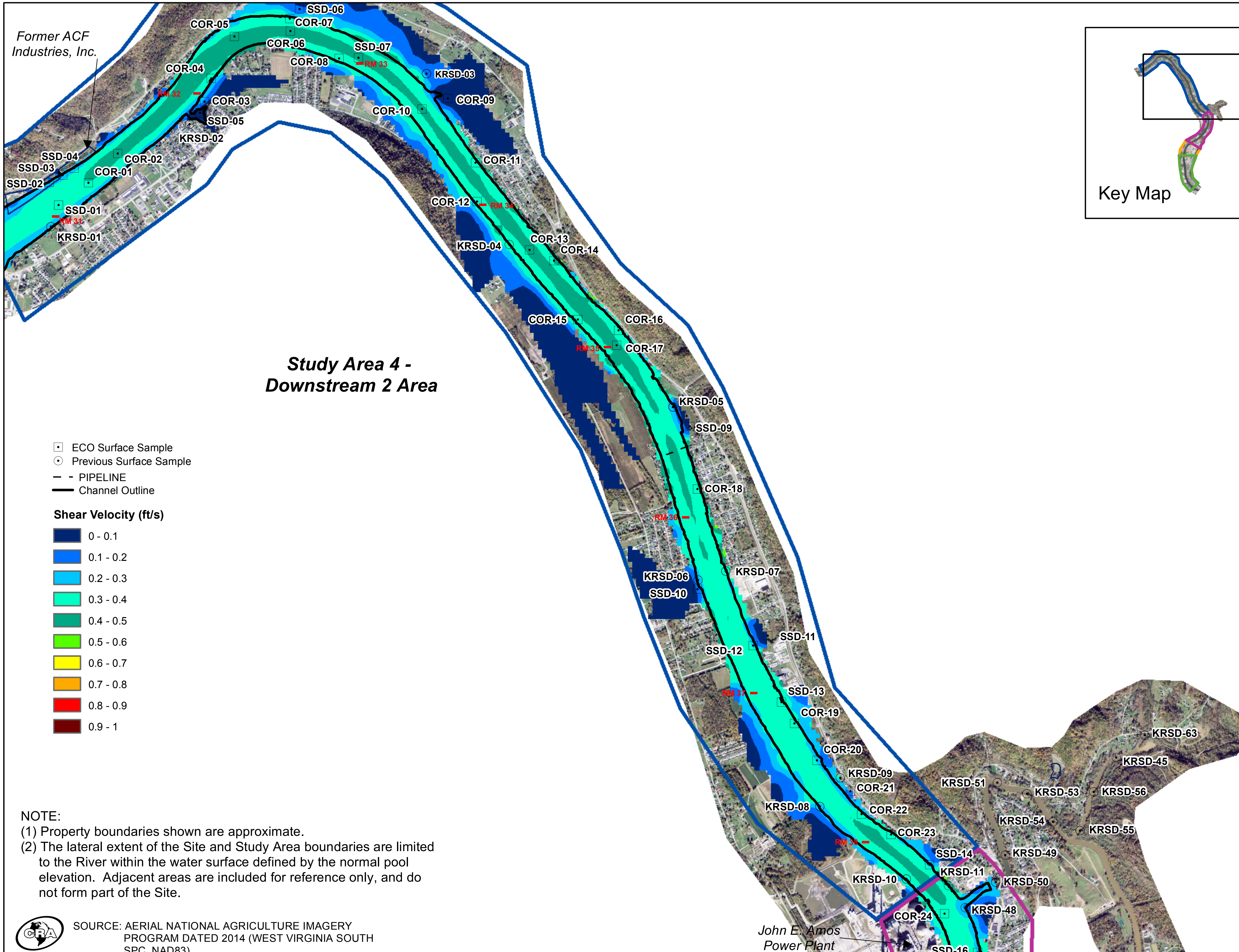
SOURCE: AERIAL NATIONAL AGRICULTURE IMAGERY PROGRAM DATED 2014 (WEST VIRGINIA SOUTH SPC, NAD83)

figure L.15

100 YEAR FLOOD – STUDY AREA 3
SHEAR VELOCITY
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA



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SOURCE: AERIAL NATIONAL AGRICULTURE IMAGERY PROGRAM DATED 2014 (WEST VIRGINIA SOUTH SPC, NAD83)

figure L.16

100 YEAR FLOOD – STUDY AREA 4
SHEAR VELOCITY
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

031884-00(REP051)GIS-WA049 February 25, 2015

AR101322

APPENDIX M

GROUNDWATER TMDL CALCULATIONS FOR FORMER FLEXSYS FACILITY

M.1 DIOXIN TMDL DEVELOPMENT FOR KANAWHA RIVER, POCATALICO RIVER, AND ARMOUR CREEK, WEST VIRGINIA (LIMNO-TECH INC, SEPTEMBER 14, 2000)

M.2 SOLUTIA GROUNDWATER LOADING CALCULATON

M.3 SOLUTIA POINT SOURCE DISCHARGE LOADING CALCULATION

APPENDIX M

GROUNDWATER TMDL CALCULATIONS FOR FORMER FLEXSYS FACILITY

KANAWHA RIVER
NITRO, WEST VIRGINIA

FEBRUARY 2015
REF. NO. 031884 (51) – APPENDIX M
This report is printed on recycled paper.

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<u>LIST OF ATTACHMENTS</u>

1.0 INTRODUCTION

As part of the Resource Conservation and Recovery Act (RCRA) Corrective Action (CA) for the Former Flexsys Facility, Potesta & Associates, Inc. (Potesta) was retained by Solutia Inc. (Solutia) to complete evaluations of current loading to the Kanawha River from groundwater discharge into the River as well as point source discharges (storm sewer outfalls).

It should be noted that the loading calculations presented herein represent 2,3,7,8-TCDD TEQ loading rather than 2,3,7,8-TCDD specific.

2.0 GROUNDWATER LOADING ASSESSMENT METHOD

The groundwater flux estimate completed as part of the TMDL in 2000 was on the order of 7 µg/day of 2,3,7,8-TCDD. The basis of this estimate was presented in a simplified manner utilizing very limited data for the Nitro Area, and the very conservative assumption that the entire observed increase in water column concentrations between RM 45.5 and RM 41.3 was due entirely to groundwater flux. This analysis was identified within the TMDL to contain a high degree of uncertainty. A copy of the TMDL calculations are included as Attachment M-1

Since the completion of the TMDL study, dismantling of the Former Flexsys Facility, and implementation of the EOC for the River, Solutia has completed additional groundwater sampling to determine the actual 2,3,7,8-TCDD TEQ loading to the River via the groundwater pathway from the Former Flexsys Facility. This work was completed as part of the ongoing RCRA closure process and reviewed as part of the EE/CA completion. This analysis was completed utilizing much more accurate and current Site-specific data. High volume groundwater sampling from wells sited specifically to support this analysis was completed to provide groundwater concentration data. Gradients measured at the Former Flexsys Facility, and hydraulic conductivity data from testing of Former Flexsys Facility soils were employed to generate water volume estimates reflective of Former Flexsys Facility conditions. To be conservative, no attenuation of 2,3,7,8-TCDD TEQ concentrations between monitoring wells and the River was assumed. The calculated loading to the River from groundwater was approximately 0.0083 µg/day 2,3,7,8-TCDD TEQ (less than 0.1-percent of the loading calculated in the TMDL). A copy of the most current evaluation was transmitted via email from Mr. Michael Light (Potesta) to Mr. Randy Cooper (Monsanto Company) on October 27, 2009. A copy of this information is presented in Attachment M-2. This analysis was developed as part of the RCRA CA for the Former Flexsys Facility and has been submitted to WV DEP and U.S. EPA.

3.0 2,3,7,8-TCDD LOAD FROM POINT SOURCES (OUTFALLS)

Source investigation results indicate that residual 2,3,7,8-TCDD contamination in the outfalls draining the area in and around the Former Flexsys Facility could have historically added a significant 2,3,7,8-TCDD load to the River. These outfalls have since been closed and no longer represent a pathway for ongoing releases. Based on the evaluation completed as part of the RCRCA CA for the Former Flexsys Facility, a maximum loading under current conditions of 2.445 μg/day from surface water was calculated. The proposed construction of a clean permeable cover system, abandonment and replacement of the sewer system, and consolidation/capping of designated areas of impacted material will further reduce loading from surface water.

A copy of the most current evaluation was transmitted via email from Mr. Michael Light (Potesta) to Mr. Randy Cooper (Monsanto Company) on October 27, 2009. A copy of this information is presented in Attachment M-3. This analysis was developed as part of the RCRA CA for the Former Flexsys Facility and has been submitted to WV DEP and U.S. EPA.

ATTACHMENT M.1

DIOXIN TMDL DEVELOPMENT FOR KANAWHA RIVER, POCATALICO RIVER, AND ARMOUR CREEK, WEST VIRGINIA (LIMNO-TECH INC, SEPTEMBER 14, 2000)

Decision Rationale

Total Maximum Daily Load for Total 2,3,7,8-TCDD for the Kanawha River, Pocatalico River and Amour Creek

I. Introduction

This document will set forth the Environmental Protection Agency's (EPA) rationale for establishing the Total Maximum Daily Load (TMDL) for total 2,3,7,8- TCDD (dioxin) for the Kanawha River and two tributaries of the Kanawha River: Pocatalico River and Amour Creek, which were sent out for public comment on July 5, 2000. Our rationale is based on the determination that the TMDL meets the following 8 regulatory conditions pursuant to 40 CFR §130.

1. The TMDLs are designed to implement applicable water quality standards.
2. The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3. The TMDLs consider the impacts of background pollutant contributions.
4. The TMDLs consider critical environmental conditions.
5. The TMDLs consider seasonal environmental variations.
6. The TMDLs include a margin of safety.
7. The TMDLs have been subject to public participation.
8. There is reasonable assurance that the TMDLs can be met.

The Kanawha River, Pocatalico River and Armour Creek were placed on the State of West Virginia's 303(d) list of water quality impaired water bodies for dioxin. The applicable State standards specify that the maximum allowable concentration of dioxin shall not exceed 0.014 pg/L in the Kanawha River, and 0.013 pg/L in the Pocatalico River and Armour Creek. Water quality data collected in support of this study show that dioxin concentrations routinely exceed the State water quality standard.

The Kanawha River segment of concern extends 45.5 miles from the confluence of the Coal River near Nitro, West Virginia to where the Kanawha enters the Ohio River. The Pocatalico River and Armour Creek segments of concern each extend two miles upstream of their respective confluences with the Kanawha. A review of available monitoring data indicates that observed water column dioxin concentrations in the Kanawha River routinely exceed the water quality standard. No suitable water column data are available for the Pocatalico River or Armour Creek. Fish tissue data for all three systems also commonly exceed the water quality standard. The water column water quality standard was used as the endpoint of the TMDL for all three systems.

A mass balance dilution model was applied to define the maximum allowable dioxin load that will achieve compliance with water quality standards for the entire range of flow conditions that may occur in each river. Analyses indicate that a TMDL designed to achieve compliance with the water column concentration standard will also achieve compliance with the fish tissue standard, after the system has time to respond to the reduced loadings.

No direct dioxin loading data were available from any sources for any of the water bodies of concern. Dioxin loads were estimated from available information, and attributed to four source categories: 1) contaminated groundwater [1], 2) in-place river sediments, 3) surface erosion of contaminated soils in the watershed, and 4) upstream sources. Reductions from these sources will be required in order to achieve compliance with water quality standards.
Future monitoring activities are described that are designed to further identify sources and conditions contributing to dioxin impairment in the Kanawha River, the Pocatalico River, and Armour Creek.

II. Background

Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting designated uses under technology-based controls. The TMDL process establishes the allowable loading of pollutants or other quantifiable parameters for a water body based on the relationship between pollution sources and instream conditions. By following the TMDL process, states can establish water quality-based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (EPA, 1991b).

The West Virginia Division of Environmental Protection (DEP) has identified the Kanawha River, Pocatalico River, and Armour Creek as being impaired by dioxins, as reported on the 1998 303(d) list of water quality limited waters (WVDEP, 1998). The consent decree established in conjunction with the West Virginia TMDL lawsuit has identified the Kanawha River as a priority watershed, with a TMDL for dioxin to be completed by September, 2000.

2,3,7,8-TCDD (dioxin) is most commonly encountered as an unwanted by-product of incineration, production of chlorinated pesticides and herbicides, and the bleaching step of the papermaking process. Industrial activities in the study area, especially near the city of Nitro, West Virginia have resulted in several contaminated sites. Dioxin in the study area likely originated with the production of industrial solvents and the herbicide 2,4,5-T at facilities in and around Nitro. Disposal practices earlier in the century, including burial of drums, dumping of dioxin-contaminated liquid wastes, and incineration of dioxin-contaminated material, spread dioxin throughout the Nitro area. Areas downstream of Nitro likely became contaminated through the release and transport of dioxin into the Kanawha River and its tributaries. The Kanawha River and two of its tributaries, the Pocatalico River and Armour Creek, are the focus of this TMDL because of their noncompliance with water quality and fish tissue standards.

The Kanawha River is located in western West Virginia. The Kanawha River segment of concern (Figure 1) extends 45.5 miles from the confluence of the Coal River near Nitro, West Virginia

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[1] Appendix B of the Kanawha River, Pocatalico River and Armour Creek TMDL for dioxin contains an exposition on the meaning of the term " contaminated Groundwater".

(Kanawha River Mile (RM) 45.5) downstream to its confluence with the Ohio River (Kanawha RM 0.0). The Kanawha River watershed covers a total of 518 square miles, with a land use primarily (>90%) of forest. The segments of concern for the Pocatalico River and Armour Creek each extend 2 miles upstream from their respective confluences with the Kanawha River (Figure 1). The Pocatalico River watershed spans 359 square miles, also primarily of forest. The Armour Creek watershed covers 9 square miles, and is the most highly developed, with over 20% of the land use listed as developed.

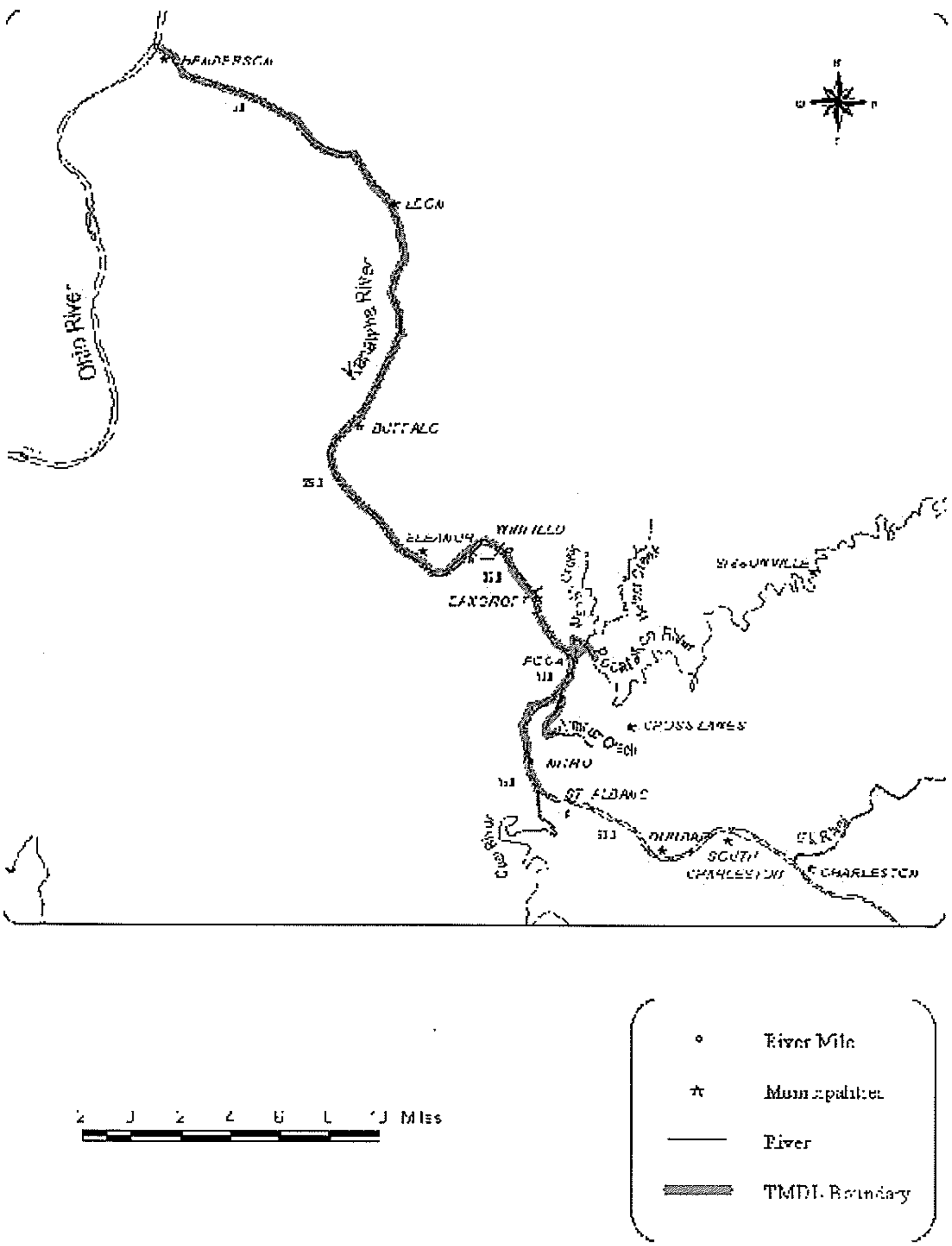

Figure 1. Kanawha River, Pocatalico River, Armour Creek Study Area

III. Discussion of Regulatory Conditions

EPA finds that sufficient information has been provided to meet all of the 8 basic regulatory requirements for establishing dioxin TMDLs on the Kanawha River, Pocatalico River and Armour Creek.

1) The TMDL is designed to meet the applicable water quality standards.

All waters of West Virginia are designated for the propagation and maintenance of fish and other aquatic life and for water contact recreation as part of State water quality standards (WV 46-1-6.1). In addition, the tributaries to the Kanawha River have been designated as Water Use Category A – public water supply (WV 46-1-7.2.a) and must be protected for this use. The Kanawha River mainstem is exempt from this designation (WV 46-1-7.2.d.19.1). The applicable water quality standards for water column concentrations of TCDD are:

Pocatalico River and Armour Creek – 0.013 pg/L

Kanawha River mainstem – 0.014 pg/L

West Virginia standards has contained limitations on the maximum dioxin concentration allowed in edible tissues of fish. The maximum fish tissue concentration of dioxin is 6.4 pg/g (8.22.2 of Appendix E cited in WV-1-8.1). (This has just been removed from the WV regulations, but this change has not been submitted to EPA for Approval.)

West Virginia water quality standards are written to apply at all times when flows are equal to or greater than the minimum mean seven consecutive day drought flow with a ten year return frequency (7Q10) (WV 46-1-7.2.b), with the exception of the Kanawha River, where the minimum flow shall be 1,960 cfs at the Charleston gauge (WV 46-1-7.2.d.19.2). EPA (1991a) guidance suggests that the average condition represented by the harmonic mean flow is the appropriate design condition for carcinogens such as dioxins. West Virginia water quality standards (WV 46-1-8-2.b) defer a specific decision on critical design flows for carcinogens, so the default approach of requiring compliance with standards for all flows above a minimum critical value is taken for this TMDL.

For the Kanawha River, Pocatalico River and Armour Creek TMDLs, the applicable endpoints and associated target values can be determined directly from the West Virginia water quality regulations. The in-stream dioxin targets are based on the water use designation of the water body. The Kanawha River is not designated as a public water supply and has a dioxin target of 0.014 pg/L. The tributaries to the Kanawha River are designated as public water supplies and have a dioxin target of 0.013 pg/L. As stated in the West Virginia water quality regulations, dioxin and the dioxin targets refer specifically to the 2,3,7,8-TCDD congener. While other dioxin congeners exist, they are not the subject of this TMDL.

The back-calculated, water column concentration from the fish tissue concentration is much higher than the applicable water column standard of 0.014 pg/L (0.013 pg/L for the tributaries), and indicates that a TMDL that achieves the water column standard will also be protective of the fish tissue standard. For that reason, the water column standard will be used as the TMDL endpoint. It should be recognized, however, that the procedure for relating fish tissue concentration to water column concentrations implicitly assumes steady state conditions between the water column and sediments. As a result, the actual response time of fish tissue to changes in water column concentration may be driven by the amount of time required for sediment concentrations to decrease in response to changes in the water column.

2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.

TMDLs are comprised of the sum of individual waste load allocations (WLAs) for point sources, load allocations (LAs) for non-point sources, and natural background levels. In addition, the TMDL must include a Margin of Safety (MOS), either implicitly or explicitly, that accounts for uncertainty in the relation between pollutant loads and the quality of the receiving water body. Conceptually, this definition is denoted by the equation:

$$LC = TMDL = \Sigma WLAs + \Sigma LAs + MOS \qquad (1)$$

The term LC represents the Loading Capacity, or maximum loading that can be assimilated by the receiving water while still achieving water quality standards. The overall loading capacity is subsequently allocated into the TMDL components of waste load allocations (WLAs) for point sources, load allocations (LAs) for non-point sources, and the Margin of Safety (MOS).

Results of the allocation process are summarized in Table 1, which shows the individual TMDL allocations for each of the three systems. The TMDL changes as a function of river flow, so allocations are listed for a range of flows.

In order to determine the 2,3,7,8-TCDD reductions needed to achieve water quality and fish tissue standards and to allocate 2,3,7,8-TCDD inputs among the sources, it is necessary to consider the existing and potential 2,3,7,8-TCDD sources. The TMDL divides allowable loading into separate categories corresponding to point sources (which enter the river from a well-defined source location) and nonpoint (diffuse) sources. The TMDL defines allowable point source permit limits (called wasteload allocations) and necessary reductions in non-point and background sources (called load allocations). These sources must be characterized so that the waste load and load allocations can be assigned to ensure compliance with the TMDL.

Table 1. Summary of Allocations (ug/day) for a Range of Flow Conditions

Kanawha River	1960 cfs	5000 cfs	10000 cfs	20,000 cfs	50,000 cfs
WLA					
Point Sources	0.82	0.82	0.82	0.82	0.82
LA					
Upstream Sources	43	110	220	440	1100
Groundwater	16.5	16.5	16.5	16.5	16.5
In-place Sediments	0	20	64	152	416
Runoff	0	10.25	10.25	10.25	10.25
MOS					
Explicit MOS	6.7	17	34	69	171
Pocatalico River	**0.32 cfs**	**500 cfs**	**1000 cfs**	**2000 cfs**	**5000 cfs**
WLA					
Point Sources	0	0	0	0	0
LA					
Upstream Sources	0	0	0	0	0
Groundwater	0.0092	0.0092	0.0092	0.0092	0.0092
In-place Sediments	0	12	26	55	141
Runoff	0	5.91	5.91	5.91	5.91
MOS					
Explicit MOS	0.001	1.6	3.2	6.4	16
Armour Creek	**0 cfs**	**200 cfs**	**400 cfs**	**600 cfs**	**800 cfs**
WLA					
Point Sources	0	0	0	0	0
LA					
Upstream	0	0	0	0	0
Groundwater	0	0	0	0	0
In-place Sediments	0	1.4	7.1	13	19
Runoff	0	4.34	4.34	4.34	4.34
MOS					
Explicit MOS	0	0.64	1.3	1.9	2.5

LOADING CAPACITY

Because a simple dilution model is being used to describe dioxin fate and transport, the loading capacity for each TMDL segment can be calculated as a function of stream flow using a simple equation, i.e.

$$LC = Q_{riv} \times C_{WQS} \qquad (2)$$

Where:

LC = Loading Capacity (M/T)
Q_{riv} = River flow (L^3/T)
C_{WQS} = Water Quality Standard concentration (M/L^3)

The loading capacity defined in Equation 2 applies to all river flows for which water quality standards apply. This corresponds to flows above the minimum stream flow of 1960 cfs in the Kanawha River, and flows above the 7Q10 flows of 0.32 cfs in the Pocatalico River and 0.0 cfs in Armour Creek. The resulting loading capacities for the three systems are shown in Figures 2 through 4.

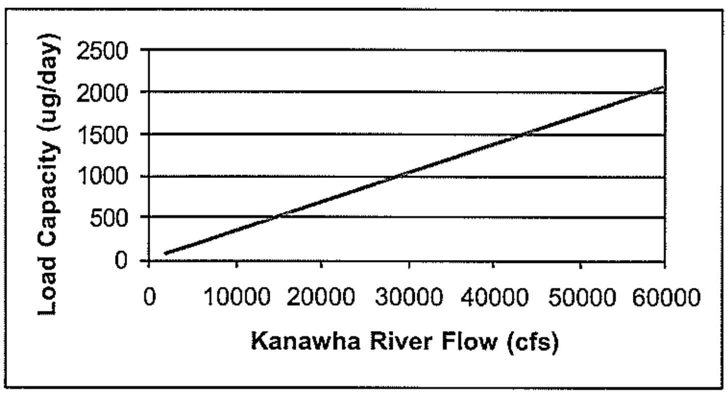

Figure 2. Kanawha River Loading Capacity

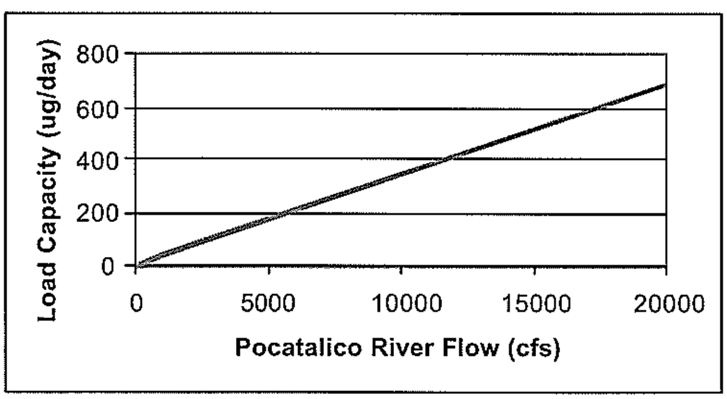

Figure 3. Pocatalico River Loading Capacity

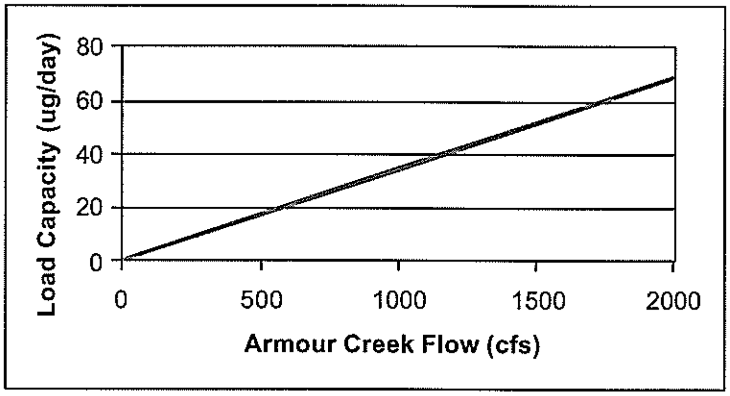

Figure 4. Armour Creek Loading Capacity

WASTE LOAD ALLOCATION

Point sources within the watershed discharging at their current levels were considered negligible in their impact on instream dioxin levels. An allocation is given to the Nitro WWTP in response to their treatment of runoff from the Fike Chemical Co. site. The magnitude of the allocation is set to the required pretreatment limit, which is 0.82 ug/day. The allocation to remaining point sources is set to zero. It is noted here that due to the lack of data within the study area concerning point source contribution of dioxin to the waterbodies, the actual loading of dioxin maybe significantly greater than 0.82 ug/ per day, and hence significant reductions in dioxin loading to the waterbodies may be possible.

Table 2. Wasteload Allocations to Point Sources

Point Sources	Existing Load (ug/day)	Allocated Load (ug/day)	Percent Reduction
Kanawha River	0.82	0.82	0
Pocatalico River	0	0	NA
Armour Creek	0	0	NA

LOAD ALLOCATIONS

Discussion of load allocations to nonpoint sources is divided into categories of upstream sources, contaminated groundwater, in-place sediments, and contaminated soil. A wide range of reduction alternatives could theoretically meet the loading capacity limitations in Figures 2 through 4. The overall allocation strategy can be constrained by considering two conditions:

Drought, or minimum, flow conditions, where the predominant sources contributing to contamination are upstream sources and contaminated groundwater.

High flow, erosional conditions, where the additional sources of in-place sediment resuspension and erosion of surface contamination become important.

Consideration of drought conditions places an upper bound on allowable upstream source and contaminated groundwater allocations. Additional loading capacity at flows above drought flow can be allocated to erosion of in-place sediments and contaminated soil.

Upstream sources

The Ohio River Valley Water Sanitation Commission (ORSANCO) conducted field sampling in May, 1999 to provide a measurement of the dioxin concentration entering the study area at the upstream boundary. The dioxin concentration determined in that sample, 0.009 pg/L, is being used as the upstream boundary concentration for the TMDL. The draft TMDL assumes that the upstream boundary concentration will remain constant at this concentration for all river flows. The uncertainty inherent in this assumption will be reflected in the Margin of Safety.

No evidence exists of dioxin contamination upstream of the Pocatalico River and Armour Creek segments of concern, so upstream boundary concentrations for these segments were assumed to be zero.

Table 3. Load Allocations to Upstream Sources

River	Existing Load (ug/day)	Allocated Load (ug/day)	Percent Reduction
Kanawha	0.009 pg/L x Flow (cfs) x 2.447 = 43 ug/day @ 1960 cfs = 110 ug/day @ 5000 cfs = 440 ug/day @ 20000 cfs	0.009 pg/L x Flow (cfs) x 2.447 = 43 ug/day @ 1960 cfs = 110 ug/day @ 5000 cfs = 440 ug/day @ 20000 cfs	0%
Pocatalico	0	0	NA
Armour	0	0	NA

Contaminated groundwater[2]

Contaminated groundwater was identified as a major contributor of dioxin to the Kanawha River. The upper bound of the maximum allowable groundwater load to the Kanawha can be calculated by performing a mass balance calculation at the location where the groundwater enters the Kanawha (and assuming no loss of dioxin between the upstream boundary and this location) during minimum river flow. The mass balance equation calculates the maximum load that just achieves compliance with the water quality standard, assuming no source other than upstream.

[2]Appendix B of the Kanwaha River, Pocatalico River and Armour Creek TMDL for Dioxin contains a discussion on the meaning of the term "contaminated groundwater".

The resulting equation is:

$$LA_{GW} \leq Q_{min} \times (C_{WQS} - C_{up}) \quad (3)$$

Where

LA_{GW} = Load Allocation to contaminated groundwater (M/T)
Q_{min} = Minimum stream flow at which water quality standards apply (L^3/T)
C_{WQS} = Water Quality Standard concentration (M/L^3)
C_{up} = Dioxin concentration at upstream boundary of segment (M/L^3)

Equation 3 is expressed as an inequality, because the LA must be set less than or equal to this value to ensure compliance with water quality standards at minimum flow. The potential reasons for setting the LA less than (as opposed to equal to) this upper bound value include providing allowance for a Margin of Safety and/or achieving greater than absolutely necessary reductions in one source category in order to lessen the amount of reductions required in another source category.

The maximum possible LA for contaminated groundwater in the Kanawha River was determined from application of Equation 3 to be 24 ug/day. The upper bound LAs for contaminated groundwater in the Pocatalico River and Armour Creek are 0.0102 and 0.0 ug/day, respectively.

For purposes of this TMDL, 16.5 ug/day is provided as an allocation to contaminated groundwater in the Kanawha River. This allocation is based upon providing the fullest allocation possible to this source (24 ug/day), minus the wasteload allocation (0.82 ug/day) and minus 10% of the Loading Capacity (6.7 ug/day) which will be allocated to the Margin of Safety as discussed below. This corresponds to a 99% reduction in the estimated existing load.

The LA for contaminated groundwater to the Pocatalico River is 0.0092 ug/day. This allocation is also based upon providing the fullest allocation possible to this source, minus 10% of the Loading Capacity which will be allocated to the Margin of Safety. No allocation is given to Armour Creek, because the 7Q10 flow is zero. No explicit reductions are expected to be required for these sources, based upon the conclusion of Kanetsky (1987) that the primary source of dioxin impairment to these streams is caused by backflow from the Kanawha, which will be corrected through source loading reduction to the Kanawha River.

Table 4. Load Allocations to Contaminated Groundwater

River Segment	Existing Load (ug/day)	Allocated Load (ug/day)	Percent Reduction
Kanawha	3324	16.5	99%
Pocatalico	NA	0.0092	NA
Armour	NA	0.0	NA

Contaminated soils

Once loads have been allocated to the sources described above that must be controlled in order to meet water quality standards during low flow conditions, the remainder of the loading capacity (except for the Margin of Safety) can be allocated to the wet weather/higher flow categories. The first of these to be considered is erosion from contaminated soils in the watershed. Remediation efforts are planned to control the soil contamination at Heizer Creek landfill. This load allocation assumes that soils will be cleaned to a Removal Action Level dioxin concentration of 1.0 ppb (units of TEQ, but treated for allocation purposes as TCDD), resulting in an allowable load of 4.53 ug/day to the Pocatalico River. This same allocation is given to the Kanawha River, because runoff delivered to the Pocatalico River will eventually reach the Kanawha. Additional runoff load of 1.38 ug/day is calculated for the Pocatalico River and subsequently to the Kanawha River from contaminated soils near the Manila Creek landfill. No additional remediation is assumed in allocating this load. Runoff of 4.34 ug/day is calculated for Armour Creek and subsequently to the Kanawha River from contaminated soils at the Midwest Steel site. No additional remediation is assumed in allocating this load.

Table 5. Load Allocations to Contaminated Soils (wet weather)

River Segment	Existing Load (ug/day)	Allocated Load (ug/day)	Percent Reduction
Kanawha	88 ug/day	10.25 ug/day	88%
Pocatalico	83 ug/day	5.91 ug/day	93%
Armour	4.34 ug/day	4.34 ug/day	0%

In-place sediment

The final remaining source category is contaminated in-place sediments. With load reductions assigned to all other loading categories, the allowable load for this source category can be calculated from the difference between load capacity and the other allocated sources (plus the Margin of Safety). The resulting allocation is a function of river flow, and is calculated as:

$$LA_{\text{in-place, Kanawha}} = \text{Load Capacity} - WLA - LA_{\text{Upstream, Kanawha}} - LA_{\text{GW, Kanawha}} - LA_{\text{Soils, Kanawha}} - MOS$$
$$= 0.00881 \times \text{Kanawha River flow (cfs)} - 27.6 \quad (4)$$

$$LA_{\text{in-place, Pocatalico}} = \text{Load Capacity} - LA_{\text{GW, Pocatalico}} - LA_{\text{Soils, Pocatalico}} - MOS$$
$$= 0.0286 \times \text{Pocatalico River flow (cfs)} - 5.92 \quad (5)$$

$$LA_{\text{in-place, Armour}} = \text{Load Capacity} - MOS$$
$$= 0.0286 \times \text{Armour Creek flow (cfs)} - 4.34 \quad (6)$$

Table 6. Load Allocations to in-place Sediments (wet weather)

River Segment	Existing Load	Allocated Load	Percent Reduction
Kanawha	See Table 3-4	See Equation 5-4 = 0 ug/day @1960 cfs = 16 ug/day @5000 cf	>90 %

		= 149 ug/day @20000 cfs	
Pocatalico	NA	See Equation 5-5 = 0 ug/day @0.3 cfs = 8.4 ug/day @500 cfs = 51 ug/day @2000 cfs	NA
Armour	NA	See Equation 5-6 = 0 ug/day @0 cfs = 1.4 ug/day @200 cfs = 13 ug/day @600 cfs	NA

Hazardous Waste Sites

A list of sites that could be potential sources of dioxin loading to the Kanawha River, Pocatalico River and Armour Creek was compiled with input from the WVDEP, EPA Region III and internal investigation. These sites are listed below:
Armour Creek/Solutia Landfill
Clark Property*
Don's Disposal*
Dupont Belle Plant*
Fike Chemical, Inc.
Fleming Landfill*
George's Creek Landfill*
Heizer Creek Landfill
Holmes and Madden Landfill*
Old Avtex Landfill
Landfill adjacent to Midwest Steel/Nitro Landfill
Manila Creek
Flexsys Property
Old Nitro Landfill/Monsanto Dump 1929-1956
Kanawha County Lanfill
Poca Strip Mines/Poca Drum Dump*
South Charleston Landfill*
Union Carbide Plant at Institute*
Western Kanawha Landfill*
*indicates landfills up-watershed of the TMDL study reaches

These sites were researched using three of the EPA's databases for hazardous waste sites: the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS); Record of Decision System (RODS); and No Further Response Action Planned (NFRAP) database. EPA has categorized sites within its CERCLIS database to one of three lists. List 8T includes all sites that were previously listed as contaminated or were suspected of being contaminated, but have been subsequently cleared of contamination or are no longer suspected of contamination. These sites can also be found in the NFRAP database, indicating that Superfund has completed its assessment of a site and has determined that no further steps will be taken to list that site on the National Priority List. The SCAP 11 list includes all sites/incidents on the Superfund National Priority List (NPL). The SCAP 12 list includes all Superfund sites/incidents that are not on the NPL but have planned or actual remedial/removal activities. Most of the sites in question were on one of these three lists.

3) The TMDL considers the impacts of background pollution.

The Ohio River Valley Water Sanitation Commission (ORSANCO) conducted field sampling in May, 1999 to provide a measurement of the dioxin concentration entering the study area at the upstream boundary. The dioxin concentration determined in that sample, 0.009 pg/L, is being used as the upstream boundary concentration for the TMDL. The draft TMDL assumes that the upstream boundary concentration will remain constant at this concentration for all river flows. The uncertainty inherent in this assumption will be reflected in the Margin of Safety.

No evidence exists of dioxin contamination upstream of the Pocatalico River and Armour Creek segments of concern, so upstream boundary concentrations for these segments were assumed to be zero

4) The TMDL considers critical environmental conditions.

EPA regulations at 40 CFR 130.7 (c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the Kanawha River Watershed is protected during times when it is most vulnerable.

Concurrent with the selection of a numeric concentration endpoint, TMDL development must also define the environmental conditions that will be used when defining allowable loads. The critical condition is defined as the set of environmental conditions which, if controls are designed to protect, will ensure attainment of objectives for all other conditions. For example, the critical condition for control of a continuous point discharge is the drought stream flow. Pollution controls designed to meet water quality standards for drought flow conditions will ensure compliance with standards for all other conditions. The critical condition for a wet weather-driven sources may be a particular rainfall event.

Dioxin sources to the Kanawha River study area are believed to arise from a mixture of continuous and wet weather-driven sources, and there may be no single critical condition that is protective for all other conditions. For example, contaminated groundwater loading is assumed to be relatively constant over time, and its control will be most critical during low stream flow conditions. Resuspension of contaminated in-place sediments, on the other hand, will be most critical during high river flow periods. For this reason, the TMDL will examine the entire range of flow conditions and will define load allocations that will be protective for all conditions.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flow normally occurs during the colder period of winter and in early spring from snow melt and spring rain, while seasonally low flow typically occurs during the warmer summer and early fall drought periods. Seasonality in this TMDL is addressed by expressing the TMDL in terms of river flow, as changes in flow will be the dominant seasonal environmental factors affecting the TMDL.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. Incorporation of a margin of safety (MOS) in the TMDL analysis. The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can either be implicit (e.g., incorporated into the TMDL analysis through conservative assumptions) or explicit (e.g., expressed in the TMDL as a portion of the loadings). This TMDL uses both explicit and implicit components of the Margin of Safety.

An implicit MOS is provided through the use of a conservative dilution model for allocation purposes. This implicit MOS is as protective as possible for modeling purposes as it assumes complete conservation of mass. Another component of the implicit margin of safety is the State requirement that the water quality standard for dioxin be met for all flow conditions above the critical minimum flow. This will result in an allowable load much smaller than would be derived using the EPA-recommended harmonic mean flow conditions as the design condition.

An additional explicit Margin of Safety is also provided, to account for uncertainty in loading entering each system across the upstream boundary, as well as other potential dioxin sources not identified during the source assessment. The explicit Margin of Safety is set at 10% of the LA.

7) The TMDLs have been subject to public participation.

This TMDL was subject to a number of public meetings. The meetings started in March 1999. All the meetings listed below were held at the Nitro Senior Center, in Nitro West Virginia:

July 26, 1999 7:00 pm -9:00 pm with court reporter

November 5/1999 (2 meetings) 2:30 to 5:00 pm and 7:00 pm to 9: 00pm

January 11, 2000 (2 meetings) 2:30 to 5:00 pm and 7:00 pm to 9: 00pm

March 14, 2000 (2 meetings) 2:00 to 4:00 pm and 7:00 pm to 9: 00pm

May 11, 2000 (2 meetings) 2:00 to 4:00 pm and 7:00 pm to 9: 00pm

July 25, 2000 public hearing from 7:00pm to 9:00 pm with hearing officer and court reporter.

Information repository locations in Nitro West Virginia, with all site information was available to the public. Recently collected data at various sites in the Kanawha River Valley were also available at each of the meetings stated above. This information was presented and supplied at the public meetings. At each meeting, various offices of EPA and state DEP were represented, including: Water Protection Division; EPA Superfund; EPA Site Assessment, Superfund; EPA RCRA program; Agency for Toxics Disease Registry(ATSDR); USGS and Ohio River Sanitary Commission (ORSANCO).

During these meetings EPA's technical approach for the development of this TMDL was presented and discussed. The document was also subject to a 45-day public comment period. The TMDL was public noticed on July 5, 2000 and closed on August 18, 2000.

8) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

The Kanawha River/Pocatalico River/Armour Creek TMDL site data confirm that dioxin concentrations exceed water quality standards. However, additional data are needed to define many of the sources of dioxin entering these systems. For this reason, implementation activities must first focus on better identifying existing sources in order to control them.

EPA has initiated activity at over 16 sites throughout the watershed with the intent of collecting the data necessary to define the magnitude of dioxin loading from each site and/or identify necessary control actions. In addition to the land sites, monitoring is recommended to define the contribution of the ambient air as a source to the watershed.

Armour Creek/Solutia

EPA HSCD will be conducting a Preliminary Assessment (PA) under CERCLA at the site in Summer 2000.

Clark Property

EPA HSCD will be reviewing (PA) available site information in Summer 2000 to determine if any further reassessment of the site is necessary.

Don's Disposal

EPA HSCD will be reviewing (PA) available site information in Summer 2000 to determine if any further reassessment of the site is necessary.

DuPont Belle Plant

EPA's Hazardous Site Cleanup Division's Site Assessment Program will review the current conditions at this property to determine whether it is a possible source or contributor of dioxin to the Kanawha River, Armour Creek or the Pocatalico River. This review will be based on EPA's existing information and new data collected in September 1999.

Fike Chemical Co.

EPA HSCD will be conducting a sampling assessment of stormwater sewers of the Nitro WV area in Summer 2000. Sampling will include collection of sediment and surface water from drainages used by the old CST.

Fleming Landfill

EPA HSCD will be reviewing (PA) available site information in Fall 2000 to determine if any further reassessment of the site is necessary.

George's Creek Landfill

EPA HSCD will be reviewing (PA) available site information in Fall 2000 to determine if any further reassessment of the site is necessary.

Heizer Creek Landfill

EPA HSCD conducted a CERCLA site inspection at the site in May 2000 and is currently awaiting the results of the sampling event. EPA HSCD will determine future remedial actions at the site pending receipt of the SI data.

Kanawha Western Landfill

EPA's Hazardous Site Cleanup Division's Site Assessment Program will review the current conditions at this property to determine whether it is a possible source or contributor of dioxin to the Kanawha River, Armour Creek or the Pocatalico River. This review will be based on EPA's existing information, which had earlier resulted in a Superfund "No Further Response Action Planned" (NFRAP) classification, plus additional information as needed.

Landfill adjacent to Midwest Steel

EPA HSCD will be conducting a sampling assessment (SI) at the site in Fall 2000 to further characterize potential migration of dioxin from the site to Armour Creek.

Manila Creek Landfill

EPA HSCD conducted an Expanded Site Investigation (ESI) at the site in May 2000 which included the installation of four off-site groundwater monitoring wells and collection of samples to determine if dioxin and other contaminates are migrating off site. EPA will determine what actions, if any are necessary upon receipt of the data.

Flexsys Plant Property

EPA HSCD is currently in the process of negotiating a consent order with Solutia to address the removal of drums and dioxin contamination at the part of the facility, formerly owned by AES.

Old Nitro Landfill

EPA HSCD will be conducting a PA of the site in Summer 2000 to determine if any further assessment of the site is necessary.

Poca Strip Mines/Poca Drum Dump

EPA HSCD will be reviewing (PA) available site file information in the Fall 2000 to determine if any further reassessment of the site is necessary.

South Charleston Landfill

EPA HSCD is currently awaiting a health consultation by ATSDR on data collected at the site in September 1999, before determining what future actions if any are necessary at the site.

Union Carbide (Rhone Poulanc) Institute Plant

EPA HSCD will be reviewing (PA) available site file information in the Fall 2000 to determine if any further reassessment of the site is necessary

CONTROL OF IN-PLACE SEDIMENTS

Resuspension of contaminated in-place sediments has been identified as contributing to violations of water quality standards for dioxin during high flow events. The primary implementation options under consideration are natural attenuation and physical removal of contaminated sediments (e.g. dredging). Natural attenuation processes can include burial of contaminated sediments as cleaner sediments are deposited upon them, and/or the flushing of contaminated sediments out of the system during high flows. Since the data to adequately characterize the site contamination, and dioxin fate and transport pathways in the river, is inadequate the preferred course of action to control in-place sediments is not evident. Additional monitoring activities are needed to better define the benefits of natural attenuation compared to physical removal of contaminated sediments.

Dioxin TMDL Development for Kanawha River, Pocatalico River, and Armour Creek, West Virginia

Prepared for:

U.S. EPA Region III
Philadelphia, PA

Under Subcontract to:
Tetra-Tech, Inc.
Fairfax, VA

September 14, 2000

Limno-Tech, Inc.
Excellence in Environmental Solutions Since 1975
Ann Arbor, Michigan

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EXECUTIVE SUMMARY

The Kanawha River, Pocatalico River and Armour Creek were placed on the State of West Virginia's 303(d) list of water quality impaired water bodies for 2,3,7,8-TCDD (dioxin). The applicable State standards specify that the maximum allowable concentration of dioxin shall not exceed 0.014 pg/L in the Kanawha River, and 0.013 pg/L in the Pocatalico River and Armour Creek. Water quality data collected in support of this study show that dioxin concentrations routinely exceed the State water quality standard.

The Kanawha River segment of concern extends 45.5 miles from the confluence of the Coal River near Nitro, West Virginia to where the Kanawha enters the Ohio River. The Pocatalico River and Armour Creek segments of concern each extend two miles upstream of their respective confluences with the Kanawha. A review of available monitoring data indicates that observed water column dioxin concentrations in the Kanawha River routinely exceed the water quality standard. No suitable water column data are available for the Pocatalico River or Armour Creek. Fish tissue data for all three systems also commonly exceed the water quality standard. The water column water quality standard was used as the endpoint of the TMDL for all three systems.

A mass balance dilution model was applied to define the maximum allowable dioxin load that will achieve compliance with water quality standards for the entire range of flow conditions that may occur in each river. Analyses indicate that a TMDL designed to achieve compliance with the water column concentration standard will also achieve compliance with the fish tissue standard, after the system has time to respond to the reduced loadings.

No direct dioxin loading data were available from any sources for any of the water bodies of concern. Dioxin loads were estimated from available information, and attributed to four source categories: 1) contaminated groundwater[1], 2) in-place river sediments, 3) surface erosion of contaminated soils in the watershed, and 4) upstream sources. Reductions from these sources will be required in order to achieve compliance with water quality standards.
Future monitoring activities are described that are designed to further identify sources and conditions contributing to dioxin impairment in the Kanawha River, the Pocatalico River, and Armour Creek.

[1] Appendix B contains an exposition on the meaning of the term "contaminated groundwater".

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1.0 INTRODUCTION

1.1 BACKGROUND

Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting designated uses under technology-based controls. The TMDL process establishes the allowable loading of pollutants or other quantifiable parameters for a water body based on the relationship between pollution sources and instream conditions. By following the TMDL process, states can establish water quality-based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (EPA, 1991b).

The West Virginia Division of Environmental Protection (DEP) has identified the Kanawha River, Pocatalico River, and Armour Creek as being impaired by dioxins, as reported on the 1998 303(d) list of water quality limited waters (WVDEP, 1998). The consent decree established in conjunction with the West Virginia TMDL lawsuit has identified the Kanawha River as a priority watershed, with a TMDL for dioxin to be completed by September, 2000.

The Kanawha River is located in western West Virginia. The Kanawha River segment of concern (Figure 1-1) extends 45.5 miles from the confluence of the Coal River near Nitro, West Virginia (Kanawha River Mile (RM) 45.5) downstream to its confluence with the Ohio River (Kanawha RM 0.0). The Kanawha River watershed covers a total of 518 square miles, with a land use primarily (>90%) of forest. The segments of concern for the Pocatalico River and Armour Creek each extend 2 miles upstream from their respective confluences with the Kanawha River (Figure 1-1). The Pocatalico River watershed spans 359 square miles, also primarily of forest. The Armour Creek watershed covers 9 square miles, and is the most highly developed, with over 20% of the land use listed as developed.

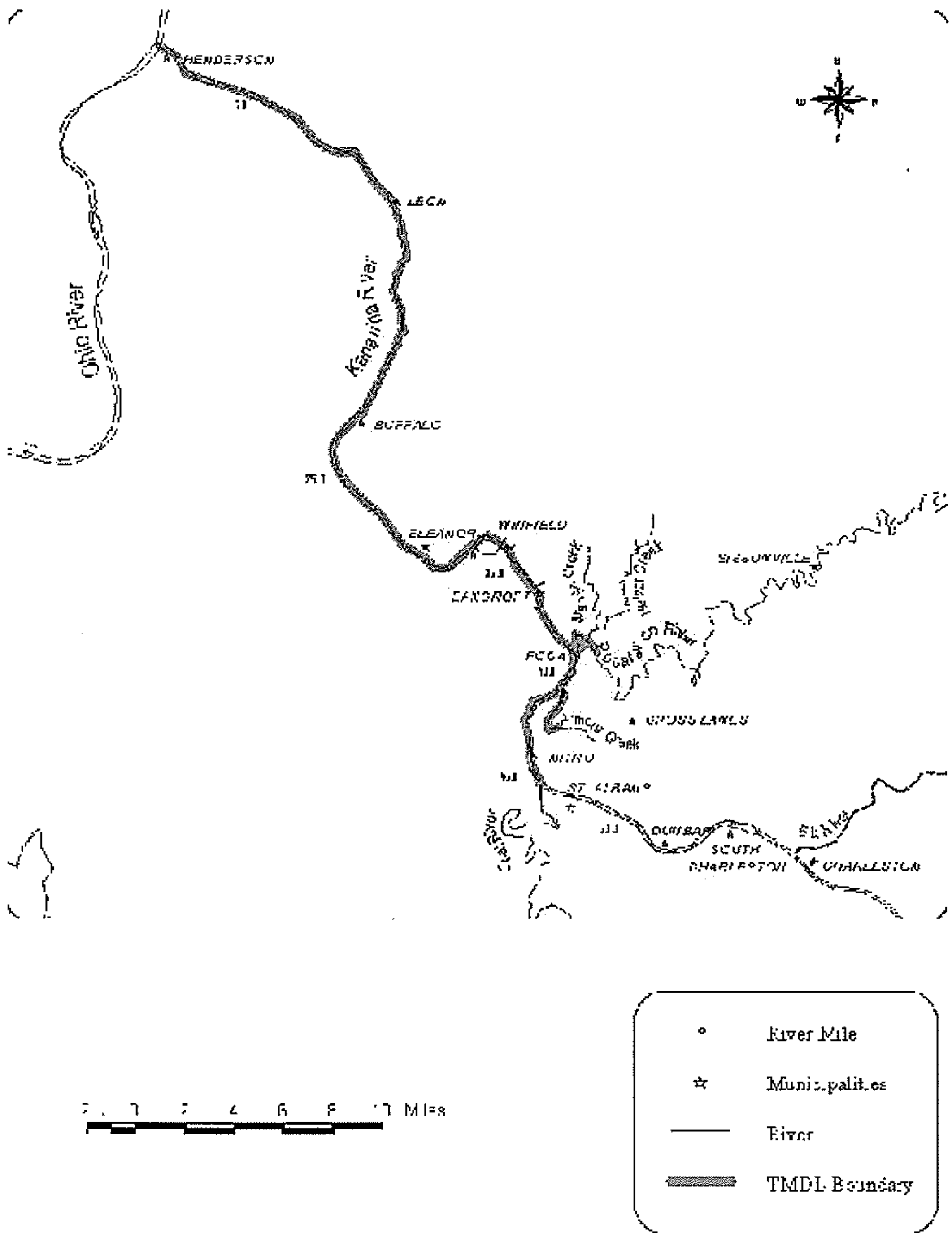
1.2 APPLICABLE WATER QUALITY STANDARDS

All waters of West Virginia are designated for the propagation and maintenance of fish and other aquatic life and for water contact recreation as part of State water quality standards (WV 46-1-6.1). In addition, the tributaries to the Kanawha River have been designated as Water Use Category A – public water supply (WV 46-1-7.2.a) and must be protected for this use. The Kanawha River mainstem is exempt from this designation (WV 46-1-7.2.d.19.1). The applicable water quality standards for water column concentrations of TCDD are:

Pocatalico River and Armour Creek – 0.013 pg/L

Kanawha River mainstem – 0.014 pg/L

Figure 1-1. Kanawha River, Pocatalico River, Armour Creek Study Area


HENDERSON
LEON
Ohio River
Kanawha River
BUFFALO
ELEANOR
WINFIELD
BANCROFT
POCA
CROSS LANES
NITRO
ST ALBANS
DUNBAR
SOUTH CHARLESTON
CHARLESTON
River Mile
Municipalities
River
TMDL Boundary
Miles

West Virginia standards also contain limitations on the maximum dioxin concentration allowed in edible tissues of fish. The maximum fish tissue concentration of dioxin is 6.4 pg/g (8.22.2 of Appendix E cited in WV-1-8.1).

West Virginia water quality standards are written to apply at all times when flows are equal to or greater than the minimum mean seven consecutive day drought flow with a ten year return frequency (7Q10) (WV 46-1-7.2.b), with the exception of the Kanawha River, where the minimum flow shall be 1,960 cfs at the Charleston gauge (WV 46-1-7.2.d.19.2). EPA (1991a) guidance suggests that the average condition represented by the harmonic mean flow is the appropriate design condition for carcinogens such as dioxins. West Virginia water quality standards (WV 46-1-8-2.b) defer a specific decision on critical design flows for carcinogens, so the default approach of requiring compliance with standards for all flows above a minimum critical value is taken for this TMDL. It should be recognized that this approach provides a significant additional safety factor beyond use of harmonic mean flow conditions, resulting in an allowable load much smaller than would be derived using the average flows as the design condition.

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2.0 TMDL ENDPOINT AND WATER QUALITY ASSESSMENT

2.1 SELECTION OF A TMDL ENDPOINT

One of the major components of a TMDL is the establishment of in-stream numeric endpoints, which are used to evaluate the attainment of acceptable water quality. In-stream numeric endpoints, therefore, represent the water quality goals that are to be achieved by implementing the load reductions specified in the TMDL. The endpoints allow for a comparison between observed in-stream conditions and conditions that are expected to restore designated uses. The endpoints are usually based on either the narrative or numeric criteria available in state water quality standards. For the Kanawha River, Pocatalico River and Armour Creek TMDLs, the applicable endpoints and associated target values can be determined directly from the West Virginia water quality regulations. The in-stream dioxin targets are based on the water use designation of the water body. The Kanawha River is not designated as a public water supply and has a dioxin target of 0.014 pg/L. The tributaries to the Kanawha River are designated as public water supplies and have a dioxin target of 0.013 pg/L. As stated in the West Virginia water quality regulations, dioxin and the dioxin targets refer specifically to the 2,3,7,8-TCDD congener. While other dioxin congeners exist, they are not the subject of this TMDL. The fish tissue standard of 6.4 pg/g also applies throughout the study area, and serves as a potential endpoint for the TMDL.

Two potential endpoints exist in terms of numeric criterion, the water column standard and the fish tissue standard. Application of a bioaccumulation factor relating fish tissue to water column concentrations (EPA, 1995) using parameter values representative of the Kanawha River indicates that the fish tissue standard of 6.4 pg/g corresponds to a water column dioxin concentration of about 0.1 to 0.2 pg/L. This back-calculated water column concentration is much higher than the applicable water column standard of 0.014 pg/L (0.013 pg/L for the tributaries), and indicates that a TMDL that achieves the water column standard will also be protective of the fish tissue standard. For that reason, the water column standard will be used as the TMDL endpoint. It should be recognized, however, that the procedure for relating fish tissue concentration to water column concentrations implicitly assumes steady state conditions between the water column and sediments. As a result, the actual response time of fish tissue to changes in water column concentration may be driven by the amount of time required for sediment concentrations to decrease in response to changes in the water column.

2.1.1 Selection of Critical Condition

Concurrent with the selection of a numeric concentration endpoint, TMDL development must also define the environmental conditions that will be used when defining allowable loads. Many TMDLs are designed around the concept of a "critical condition." The critical condition is defined as the set of environmental conditions which, if controls are designed to protect, will ensure attainment of objectives for all other conditions. For example, the critical condition for control of a continuous point discharge is the drought stream flow. Pollution controls designed to meet water quality standards for drought flow conditions will ensure compliance with standards for all other conditions. The critical condition for a wet weather-driven sources may be a particular rainfall event.

Dioxin sources to the Kanawha River study area are believed to arise from a mixture of continuous and wet weather-driven sources, and there may be no single critical condition that is protective for all other conditions. For example, contaminated groundwater loading is assumed to be relatively constant over time, and its control will be most critical during low stream flow conditions. Resuspension of contaminated in-place sediments, on the other hand, will be most critical during high river flow periods. For this reason, the TMDL will examine the entire range of flow conditions and will define load allocations that will be protective for all conditions.

2.2 DISCUSSION OF INSTREAM WATER QUALITY

2.2.1 Inventory of Available Water Quality Monitoring Data

This section provides an inventory and analysis of available dioxin data in the water column and fish of the Kanawha River, Pocatalico River, and Armour Creek. The main sources of data for the Kanawha River and its tributaries were:

- ORSANCO High Volume Water Sampling
- STORET
- EPA

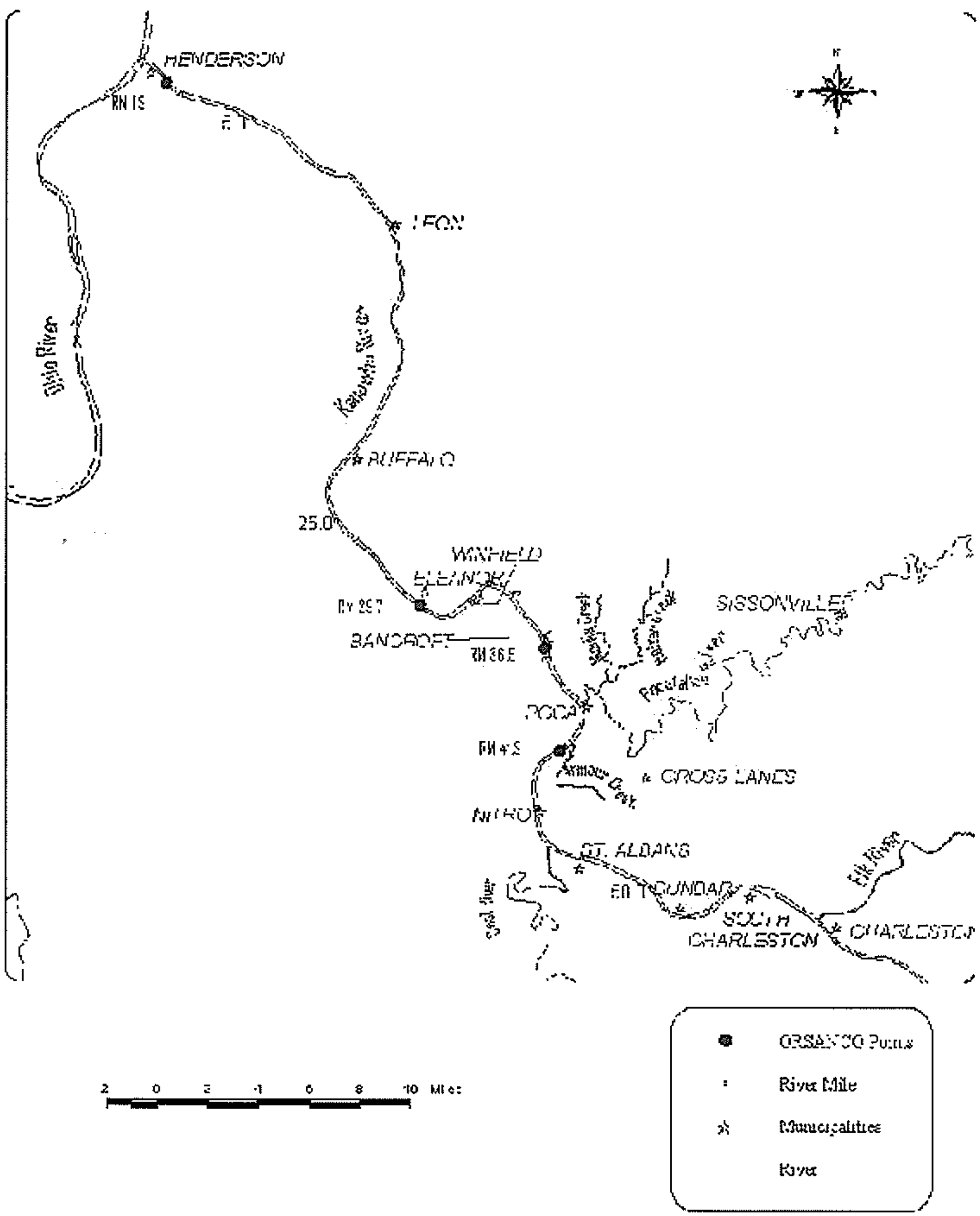
ORSANCO High Volume Water Sampling

The Ohio River Valley Water Sanitation Commission (ORSANCO) conducted high volume water sampling at one location on the Kanawha River in 1997 and at four locations during 1998. Station locations are shown in Figure 2-1. The high-volume sampling technique filters and extracts dioxins from a large volume of water, typically 1000 liters. The sample water is passed through a 1 um glass fiber filter which separates and collects the particulate phase dioxin adsorbed onto the suspended solids. The dissolved phase dioxin is extracted from the sample water by passing the water through an XAD-2 resin column. The filters and columns are analyzed separately to quantify the dioxin concentration in the particulate and dissolved phases, respectively. Approximately 1,000 liters of water were collected at nine locations along the cross section of each station and analyzed for total suspended solids (TSS), 2,3,7,8-TCDD (dioxin), and dioxin TEQ. This study provided the majority of the dioxin water column concentrations used for this TMDL. ORSANCO also conducted bimonthly sampling of TSS at one location.

STORET

Historical data were available from EPA's database for the STOrage and RETrieval of chemical, physical and biological data (STORET) for numerous stations along the Kanawha River and its tributaries. This database contains data collected by the West Virginia Division of Environmental Protection (WVDEP), the United States Geological Survey (USGS) and the United States Army Corps of Engineers (COE). Data from the 1970s through 1998 are collected in this database. Parameters of interest to this study include water column dioxin, fish tissue dioxin, % lipids, TSS, organic carbon, and flow.

Figure 2-1. ORSANCO Sampling Points



The U. S. Environmental Protection Agency (EPA) conducted a sediment and fish survey in 1986, a sediment survey in 1987 and another sediment and fish survey in 1998. The 1986 survey was a collaborative effort between EPA Region III and the West Virginia Department of Natural Resources (WVDNR) to study TCDD contamination in this region of the Kanawha in response to the U.S. Food and Drug Administration (FDA, 1983) advisory regarding the consumption of fish containing 50 pg/g or more of TCDD (Smith and Ruggero, 1986). The 1987 sediment survey was a follow-up study to the 1986 survey and focused on the sediments of the tributaries to the Kanawha River (Kanetsky, 1986). The objective of the 1998 sediment and fish survey was to assess the levels of dioxin coming from four landfills in the Nitro area and their impact on the local fish population (SATA, 1999). Data collected by the EPA included sediment dioxin concentration, percent moisture, fish tissue dioxin concentration, and percent lipids. Several stations along the Kanawha River and its tributaries were monitored.

2.2.2 Analysis of Instream Water Quality Monitoring Data

Water column dioxin concentrations

A limited number of total, particulate, and dissolved water column dioxin measurements were available from ORSANCO for the Kanawha River. No water column dioxin measurements were available for the Kanawha River tributaries. A summary of the available Kanawha River water column dioxin data is given in Table 2-1.

Table 2-1. Kanawha River Water Column TCDD

Station	Analysis Type	Maximum (pg/L)	Minimum (pg/L)	Average (pg/L)	Number	Dates
R.M. 1.3	Total	0.463	0.094	0.181	7	6/97 – 11/98
	Particulate	0.447	0.087	0.1667	7	6/97 – 11/98
	Dissolved	0.020	0.008	0.014	7	6/97 – 11/98
R.M. 29.7	Total	0.306	0.245	0.270	3	6/97 – 11/98
	Particulate	0.275	0.222	0.243	3	6/97 – 11/98
	Dissolved	0.031	0.023	0.027	3	6/97 – 11/98
R.M. 36.5	Total	0.376	0.235	0.329	3	6/97 – 11/98
	Particulate	0.351	0.202	0.293	3	6/97 – 11/98
	Dissolved	0.051	0.024	0.036	3	6/97 – 11/98
R.M. 41.3	Total	0.412	0.130	0.294	3	6/97 – 11/98
	Particulate	0.365	0.115	0.264	3	6/97 – 11/98
	Dissolved	0.047	0.015	0.030	3	6/97 – 11/98

The data were compared to the Kanawha River dioxin WQS of 0.014 pg/L and show exceedances of the standard throughout the sampling area (Figure 2-). All of the total dioxin concentrations exceed the standard, by an average factor of five. The West Virginia standard for dioxin is expressed in terms of total chemical; Figure 2-2 indicates exceedances even if the standard were expressed in terms of dissolved concentrations.

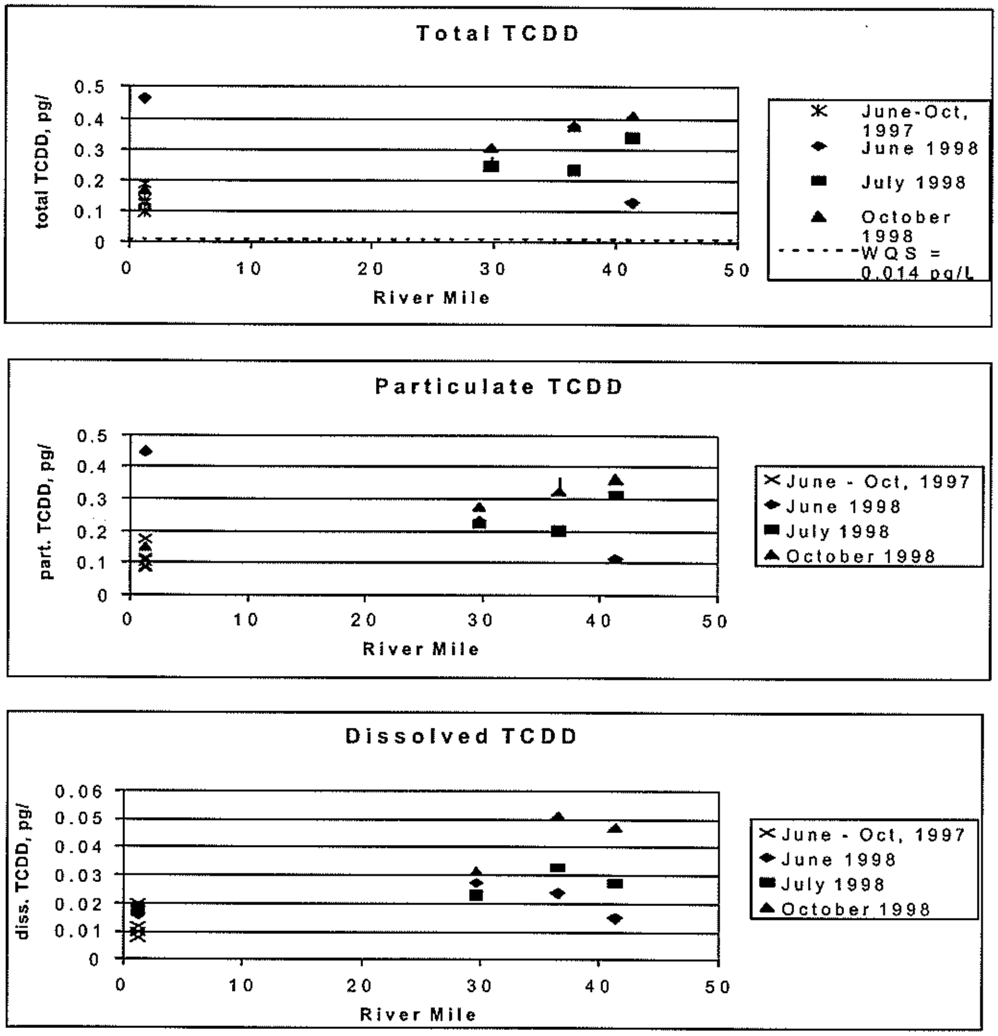


Figure 2-2. Comparison of Observed Kanawha River Water Column Dioxin Concentration to Water Quality Standard

No recent water column dioxin measurements exist for the Pocatalico River and Armour Creek; however, the available fish tissue data can also be used to infer water column concentrations. Application of a bioaccumulation factor (BAF) relating fish tissue to water column concentrations (EPA, 1995), using parameter values representative of the Kanawha River, indicates that all of the Pocatalico River and Armour Creek fish tissue samples correspond to water column dioxin concentrations that exceed the water quality standard. Back-calculated Pocatalico River water column dioxin concentrations exceed the water quality standard by a factor of 6.1 to 540. Back-calculated Armour Creek water column dioxin concentrations exceed the water quality standard by a factor of 2.8 to 93. While application of this BAF involves numerous simplifying assumptions, its results conclusively demonstrate the existence of a problem. The specific back-calculation procedure, the required assumptions, and the resulting data are provided in Appendix A.

2.3 FISH TISSUE DIOXIN CONCENTRATIONS

Dioxin was measured in fish tissues by several agencies at many locations throughout the Kanawha River, Armour Creek and the Pocatalico River beginning in the early seventies and continuing through 1998. These data are summarized in Table 2-2.

Table 2-2. Summary of Available Fish Tissue TCDD Data

Receiving Water	Max., pg/g	Min., pg/g	Avg., pg/g	Number	Dates
Kanawha River	172.0	0.6	21.4	121*	9/74 – 11/98
Armour Creek	62.6	1.5	17.2	13	4/86 – 11/98
Pocatalico River	21.9	3.4	9.2	14	4/86 – 11/98

* Collected RM 2 to RM 87.2

A comparison of the data to the applicable fish tissue criterion of 6.4 pg/g shows exceedances in all three of the receiving waters (Figure 2-3 through Figure 2-6). 105 fish samples were collected in the Kanawha River study area ranging from RM 2 to RM 44. 73.5% of these fish samples had concentrations above the 6.4 pg/g standard. 50% of the 14 fish samples collected in the Pocatalico River exceeded the 6.4 pg/g criterion. However, fish taken from the Pocatalico River show a decreasing trend in dioxin concentration and the most recent fish data are compliant with the state standard. 53.8% of the 13 fish samples collected in Armour Creek exceeded the 6.4 pg/g criterion. It must be noted that the fish tissue database contains a mixture of whole fish samples, edible fillets, and unidentified portions. All of these data are shown in Figures 2-3 through 2-6.

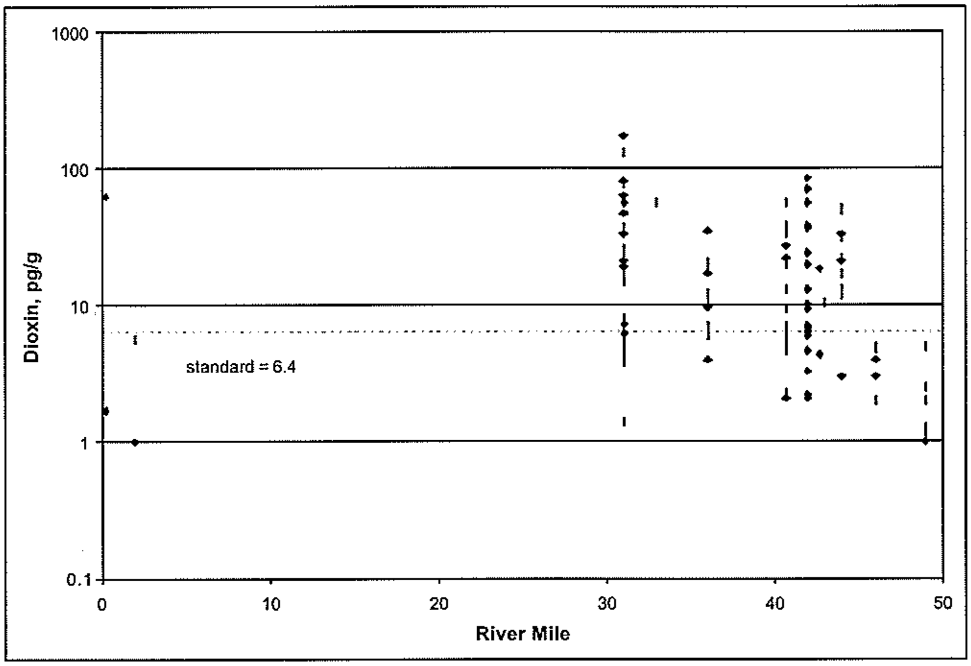
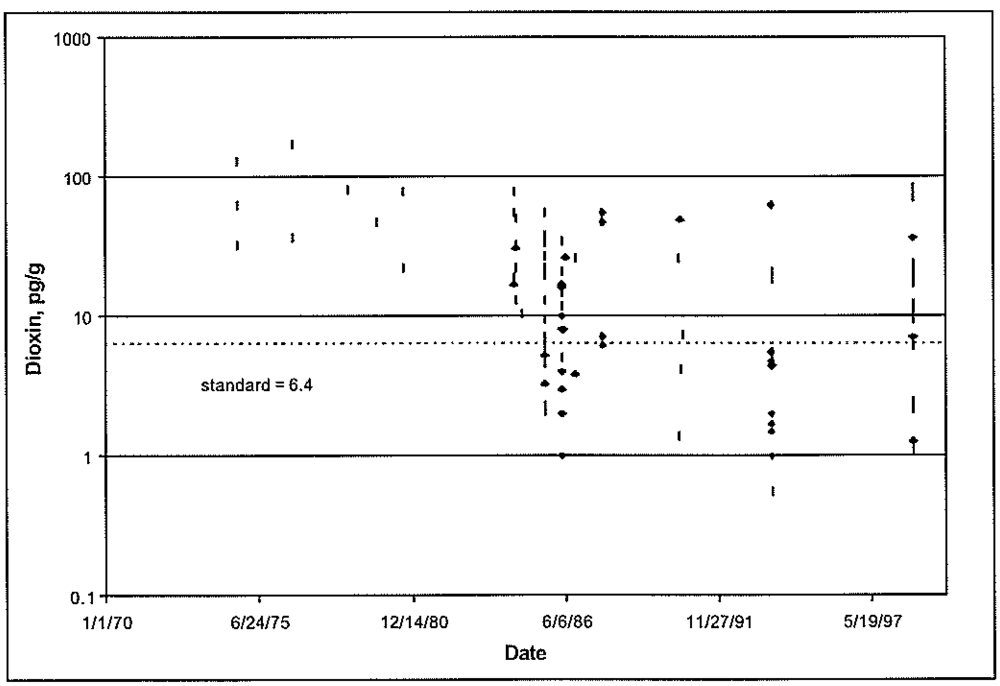


Figure 2-3. Comparison of Observed Kanawha River Fish Tissue Dioxin to Water Quality Standard by River Mile

Figure 2-4. Comparison of Observed Kanawha River Fish Tissue Dioxin to Water Quality Standard by Date



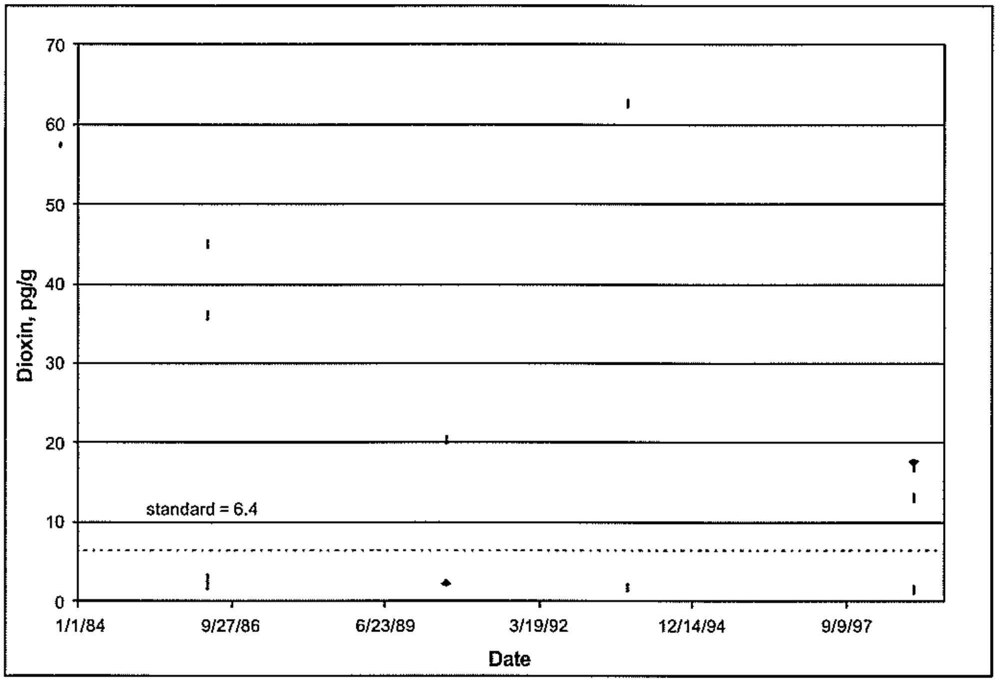
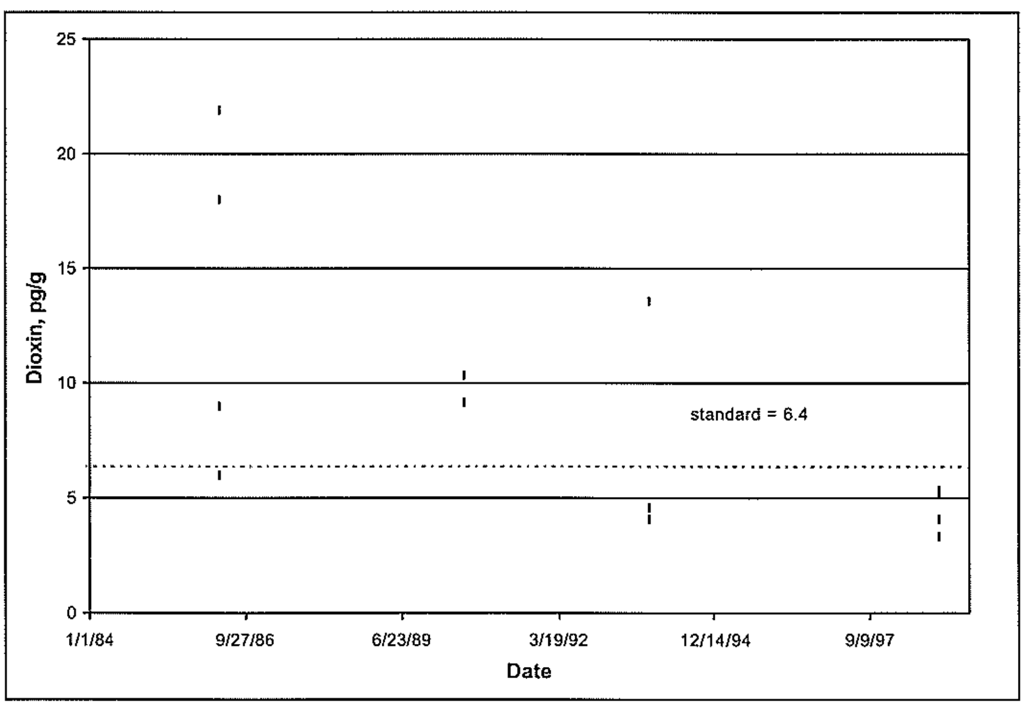


Figure 2-5. Comparison of Observed Armour Creek Fish Tissue Dioxin to Water Quality Standard by Date

Figure 2-6. Comparison of Pocatalico River Observed Fish Tissue Dioxin to Water Quality Standard by Date



3.0 SOURCE ASSESSMENT

3.1 INTRODUCTION

In order to determine the 2,3,7,8-TCDD reductions needed to achieve water quality and fish tissue standards and to allocate 2,3,7,8-TCDD inputs among the sources, it is necessary to consider the existing and potential 2,3,7,8-TCDD sources. The TMDL divides allowable loading into separate categories corresponding to point sources (which enter the river from a well-defined source location) and nonpoint (diffuse) sources. The TMDL defines allowable point source permit limits (called wasteload allocations) and necessary reductions in non-point and background sources (called load allocations). These sources must be characterized so that the waste load and load allocations can be assigned to ensure compliance with the TMDL.

2,3,7,8-TCDD (dioxin) is most commonly encountered as an unwanted by-product of incineration, production of chlorinated pesticides and herbicides, and the bleaching step of the papermaking process. Industrial activities in the study area, especially near the city of Nitro, West Virginia have resulted in several contaminated sites. Dioxin in the study area likely originated with the production of industrial solvents and the herbicide 2,4,5-T at facilities in and around Nitro. Disposal practices earlier in the century, including burial of drums, dumping of dioxin-contaminated liquid wastes, and incineration of dioxin-contaminated material, spread dioxin throughout the Nitro area. Areas downstream of Nitro likely became contaminated through the release and transport of dioxin into the Kanawha River and its tributaries. The Kanawha River and two of its tributaries, the Pocatalico River and Armour Creek, are the focus of this TMDL because of their noncompliance with water quality and fish tissue standards.

Determining the dioxin load that these industrial and landfill/dump sites have contributed to the Kanawha River, Pocatalico River, and Armour Creek is a formidable task; no direct dioxin loading data to any of these systems exist. Consequently, historical reports from the EPA's Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) and the West Virginia Department of Environmental Protection (WVDEP) as well as the best available (anecdotal) information were used to identify these sites. Available water, sediment, soil and fish monitoring data and literature values were used to estimate the magnitude of their load contribution to the Kanawha, Pocatalico, and Armour. This section documents the available information and interpretation for the modeling analysis.

3.2 ASSESSMENT OF POINT SOURCES

A search of the Permit Compliance System (PCS) database revealed that there are no permitted discharges of dioxin to the Kanawha River, the Pocatalico River or to Armour Creek. Conversations with officials from the WVDEP Office of Water confirmed this.

A potential point source could exist with the City of Nitro wastewater discharge to the Kanawha River. This facility has been receiving on-site treated surface runoff from the Fike Chemical Company Superfund site. This site has documented dioxin contamination in its surface soils. The site is permitted to discharge up to 144,000 gallons per day of pretreated wastewater to the City of Nitro wastewater treatment plant. Pretreatment discharge limits are imposed on the City of Nitro at 1.5 pg/L for dioxin based on a quarterly monitoring frequency. Dioxin has not been detected in any of the samples monitored under this requirement from 1996 to 1998 (however, the method detection limit is 5.6 pg/L). The City of Nitro discharges its treated effluent to the Kanawha River at River Mile 41.

Using the conservative assumptions that the Fike/Artel wastewater contains 1.5 pg/L of dioxin and that all of the dioxin passes through the City of Nitro system, the maximum daily load to the

Kanawha River is 0.82 ug/day, which is less than one percent of the estimated total daily load received by the Kanawha. However, it is more likely that a large portion of any dioxin in the pretreated Fike/Artel wastewater will be tied up in the biological sludge generated in the City of Nitro's wastewater treatment process, thereby reducing the load to the Kanawha River. The current practice of land applying the biological sludge at various farms throughout the valley may need to be re-evaluated.

EPA HSCD is currently in the process of collecting high-volume water samples from various points within the Kanawha River, Pocatalico River, and Armour Creek as well as a select few NPDES outfalls, e.g., Flexsys/Solutia WWTP, Nitro WWTP, PB&S/Kincaid as well as sampling surface water and sediments from approximately 70 point discharges (storm water and permitted outfalls) to assess potential point sources of dioxin to these waterbodies. Until this data is obtained, it is premature to definitely state that the only possible source of dioxin in the area is from the Nitro WWTP.

3.3 NONPOINT SOURCE ASSESSMENT

Nonpoint loadings to surface water can occur via a number of mechanisms: contaminated groundwater or base flow, surface runoff of contaminated soil, diffusion from contaminated sediments in the river, and scouring or resuspension of contaminated sediments. Two categories of nonpoint sources were identified: nonpoint sources originating within the river itself, which includes contaminated sediment, and nonpoint sources which are land based, such as contaminated landfills, that may contribute dioxin loading to the river through contaminated groundwater or surface runoff of contaminated soil. Two tasks were required to complete the nonpoint source assessment: source identification and source quantification.

3.3.1 Source Identification

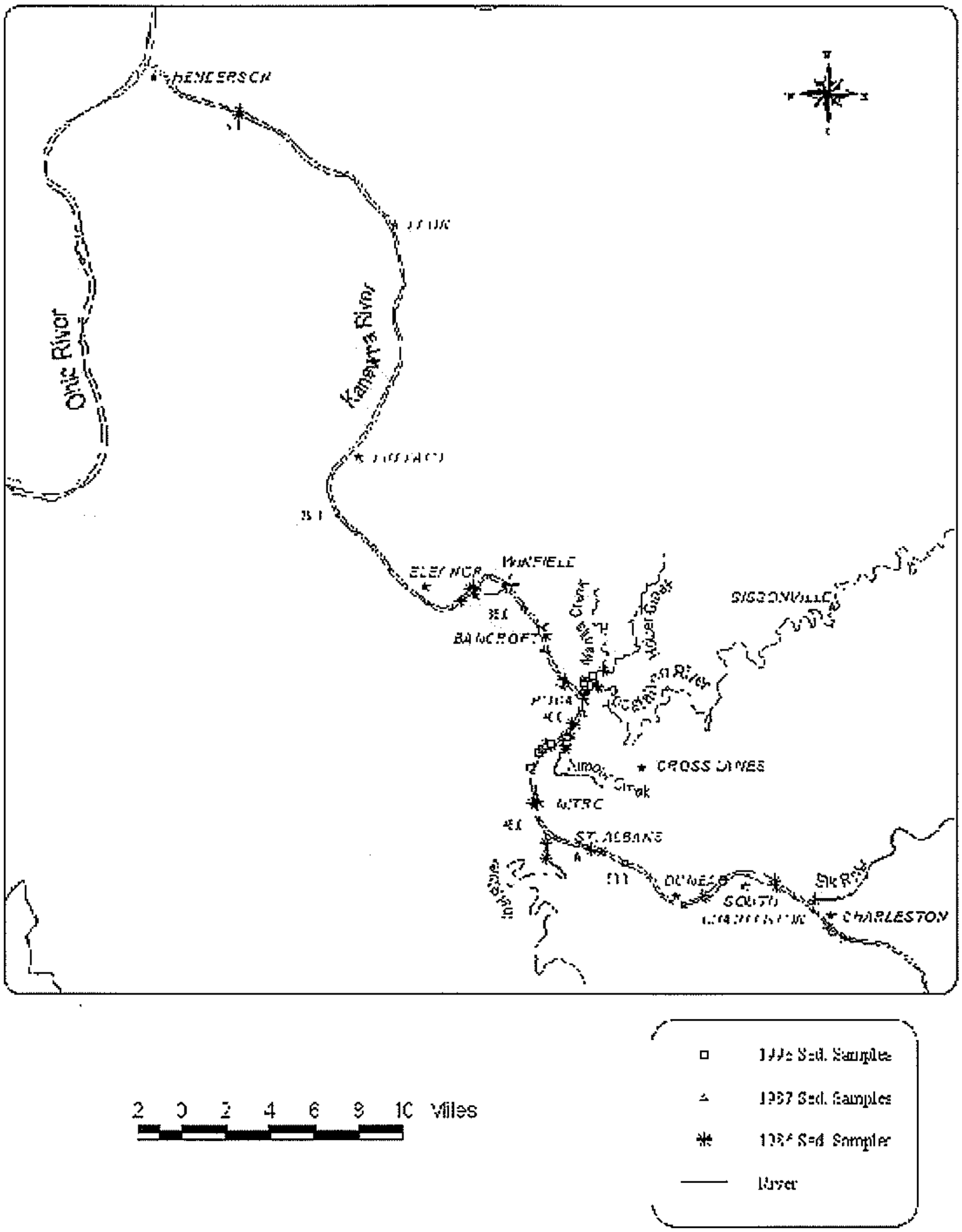
This section describes the data available to identify existing nonpoint sources, and is divided into categories discussing in-place sediments and hazardous waste sites.

In-Place Sediments

The extent and magnitude of contaminated sediment in the Kanawha River, Pocatalico River and Armour Creek were assessed by reviewing the available sediment monitoring data. EPA collected sediment samples in these three systems in 1986, 1987 and 1998. Concentrations of dioxin in the sediment ranged from non-detected to approximately 1600 ng/Kg in the Kanawha, 3000 ng/Kg in the Pocatalico, and 2000 ng/Kg in Armour Creek. Sediment sampling locations for each survey are shown in Figure 3-1. The magnitude of these data indicates that in-place sediments could be a major source of dioxin to the water. EPA conducted sampling in 1998 in response to public concern that four landfills in the area, Armour Creek landfill, Poca Drum Dump, Manilla Creek Dump, and the Heizer Creek landfill, were still actively contributing dioxin to the Pocatalico River and to Armour Creek. Results from this survey indicate that the sediments within the TMDL study area in the Pocatalico River, the Kanawha River and Armour Creek have concentrations of dioxin ranging from non-detect to several thousand nanograms per kilogram. Details of this survey's results are also discussed in the Hazardous Waste Sites section, which specifically discusses the aforementioned landfills.

Sampling by the EPA during 1986 and 1987 attempted to determine the origin of contaminated sediment around the mouths of the tributaries draining into the Kanawha River. The high sediment concentrations near the mouths of the Pocatalico River and Armour Creek could have been the result of deposition of contaminated solids entering these streams upstream of the mouth or the result of contaminated solids from the Kanawha depositing in these areas during low flow periods. Discussions with area consultants and USGS personnel familiar with the flow patterns of the Kanawha River indicate that under low flow conditions, flow in the Kanawha River and its tributaries is almost stagnant, which could allow contaminated solids in the Kanawha to be deposited in the tributaries. Sediment sampling results from 1987 also supported the hypothesis that the contaminated solids from the Kanawha River were being deposited in tributaries (Kanetsky, 1987). Nevertheless, the viability of sources other than the Kanawha River to potentially load dioxin to the Pocatalico River and Armour Creek was assessed.

Figure 3-1. Sediment Sampling Locations



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Hazardous Waste Sites

A list of sites that could be potential sources of dioxin loading to the Kanawha River, Pocatalico River and Armour Creek was compiled with input from the WVDEP, EPA Region III and internal investigation. These sites are listed below:

Armour Creek/Solutia Landfill
Clark Property*
Don's Disposal*
Dupont Belle Plant*
Fike Chemical, Inc.
Fleming Landfill*
George's Creek Landfill*
Heizer Creek Landfill
Holmes and Madden Landfill*
Old Avtex Landfill
Landfill adjacent to Midwest Steel/Nitro Landfill
Manila Creek
Flexsys Property
Old Nitro Landfill/Monsanto Dump 1929-1956
Kanawha County Lanfill
Poca Strip Mines/Poca Drum Dump*
South Charleston Landfill*
Union Carbide Plant at Institute*
Western Kanawha Landfill*

*indicates landfills up-watershed of the TMDL study reaches

These sites were researched using three of the EPA's databases for hazardous waste sites: the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS); Record of Decision System (RODS); and No Further Response Action Planned (NFRAP) database. EPA has categorized sites within its CERCLIS database to one of three lists. List 8T includes all sites that were previously listed as contaminated or were suspected of being contaminated, but have been subsequently cleared of contamination or are no longer suspected of contamination. These sites can also be found in the NFRAP database, indicating that Superfund has completed its assessment of a site and has determined that no further steps will be taken to list that site on the National Priority List. The SCAP 11 list includes all sites/incidents on the Superfund National Priority List (NPL). The SCAP 12 list includes all Superfund sites/incidents that are not on the NPL but have planned or actual remedial/removal activities. Most of the sites in question were on one of these three lists. Table 3-1 lists these identified sites and summarizes currently available information on 2,3,7,8-TCDD contamination at these sites.

Interviews with WVDEP staff, EPA staff and an EPA Superfund consultant were conducted to gather more information about dioxin contaminated sites in the study area. This was followed by a qualitative attempt to assess whether each site is currently contributing a dioxin load to the river by one of the mechanisms cited above.

Research on potential sites was hindered by the fact that several of the landfills/sites have been referred to by various names over the years. Figure 3-2 shows the locations of the identified sites. Table 3-1 contains a summary of the information gathered for each site.

Armour Creek/Solutia Landfill:

The Armour Creek Landfill is operated by Flexsys Corporation (a joint venture between Solutia and Akzo Nobel corporations in Nitro, West Virginia). The site is approximately 45 acres in size and is located north of Nitro along State Route 25 and drains into Armour Creek. The landfill has been under closure since 1994 with no additional disposal since that period (Randy Sovic, WVDEP).

The sediments in Armour Creek were sampled in November 1998 in response to public concern that this landfill was contributing to the persistent dioxin problem in Armour Creek (Pam Hayes, WVDEP Office of Environmental Remediation). No dioxin was detected at the site (soils, surface water and groundwater) though dioxin was detected in nearby soil. This detection of dioxin may not be attributable to the landfill itself. EPA's Removal Program revisited the site in the spring of 1999 for a subsequent round of sampling. Data from this survey are included in summary table 3-1. EPA HSCD will be conducting a Preliminary Assessment (PA) under CERCLA at the site in the summer of 2000.

Clark Property:

The Clark property is approximately 20 acres in size and is located upstream of the TMDL study area near the intersection of State Route 62 and Dutch Hollow Road in Kanawha County. The WVDNR conducted a preliminary assessment of the site in March 1985 and observed leaking and broken containers of several materials, including unspecified herbicides. Soil and water were also contaminated with pesticides and herbicides. In August 1985 a removal action was initiated by the EPA, resulting in the removal of 442 tons of contaminated soils and bulk waste by May 1986. Sampling performed in October 1988 indicated that there was no evidence of off-site migration of any contaminants. The EPA has included this site on its NFRAP 8T list. This site is not believed to contribute a dioxin load to the Kanawha.

Table 3-1. Summary of Dioxin (2, 3, 7, 8-TCDD) Information Available by Site

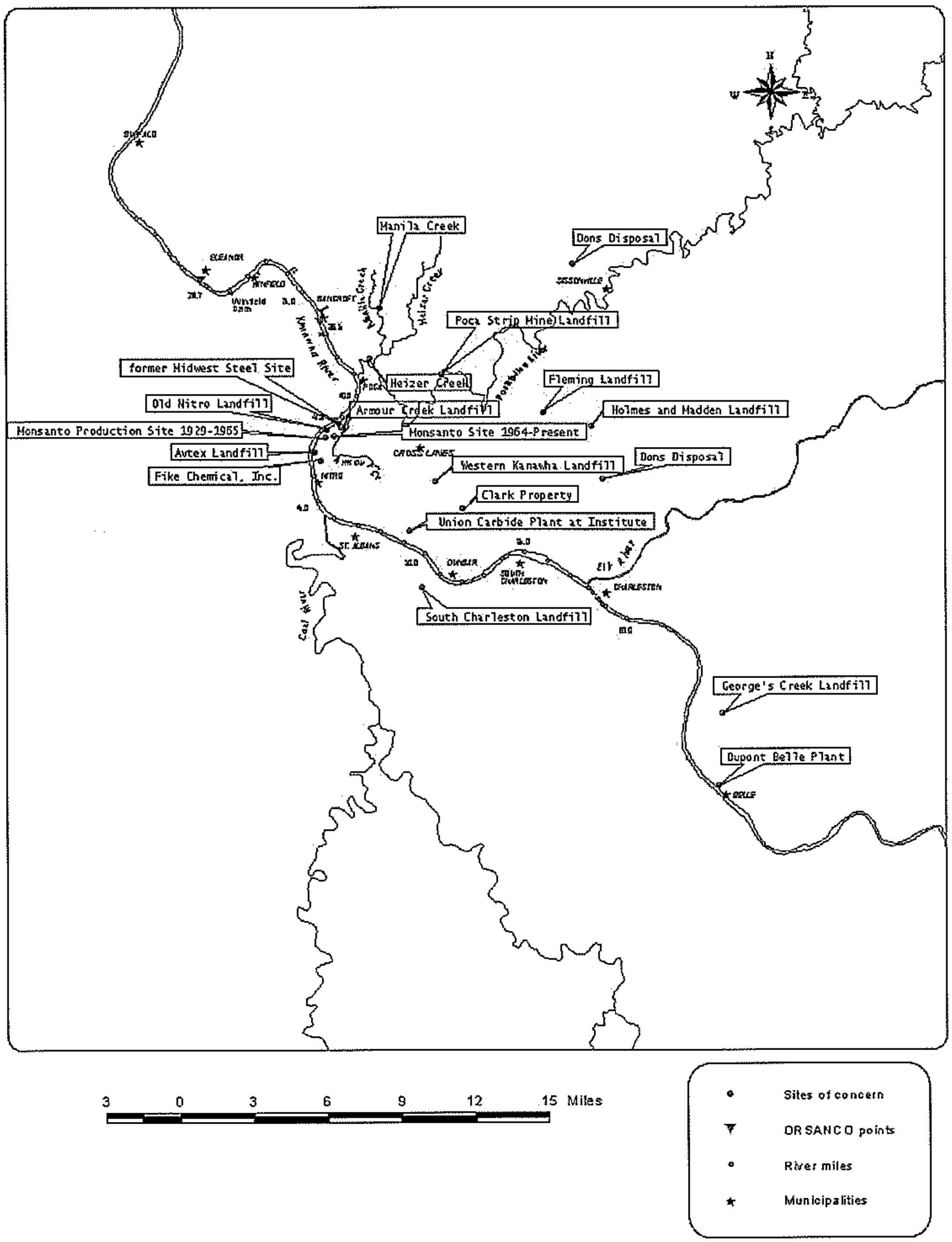
Site Name	Receiving Water	Accepted/Stored Dioxin Material?	Dioxin Detected in Soil on-site?	Conc. (pg/g)	Dioxin Detected in Surface Water on-site?	Conc. (pg/L)	Dioxin Detected in Groundwater on-site?	Conc. (pg/L)	Dioxin Detected nearby (stream or soil)?	Conc. (pg/g or pg/L)	Most Recent Sampling Date
Armour Creek Landfill [1]	Armour Creek	Unknown	No		N/D		N/D		Yes (1998)	17 (nearby soil)	1998
former Avtex Landfill Site [1]	Kanawha River	Unknown	N/D		N/D		N/D		Yes (1998)	0-1,598 (Kanawha sediment)	1998
Clark Property [1,3]	Kanawha River	Unknown	N/D		N/D		N/D		N/D		1988
Don's Disposal [2,3]	Pocatalico River	Unknown	N/D		N/D		N/D		N/D		1981
Dupont Belle Plant [1,3]	Kanawha River	Unknown	No (1983)		Yes (1999)	0-0.10	N/D		Yes (Sediment)	0-0.212 pg/g	1999
Fike Chemical Company [1] (Production Area and WWTP)	Kanawha River	Yes	Yes (1999)	0-14,000	Yes (1993) Yes (1998)	n/a 20.5 (tank near WWTP)	Yes (1993)	n/a	No		1999
Fleming Landfill [2,3]	Pocatalico River	Unknown	N/A		No		N/D		Yes	0-2.2 pg/g	1999
George's Creek Landfill [2,3]	Kanawha River	Unknown but used by Monsanto-1959-1960	N/A		N/D		N/D		N/D		
Heizer Creek Site Landfill [1]	Pocatalico River	Yes (Monsanto-1958-1959)	Yes (1984) Yes (1998)	1,000-3,720 18,325	N/D		N/D		N/D		1998 2000 N/A
Holmes and Madden Landfill [1,3]	Pocatalico River	Unknown but used by Fike Chemical	Yes (1999)	0-63.5	Yes	0-3.4	N/D		Yes	0-2.2 pg/g	1999
Manila Creek Landfill [1]	Pocatalico River	Yes (Monsanto-1956-1957)	Yes (1983) Yes (1999)	3720 22-385 0-767	Yes (1999)	0-1.1	Yes (1999)	Waste: 0 - 170,000 ng/Kg GW: 0 - 1,628	Yes (1999)	5.751 (creek) 0-46.8 pg/g	1999 2000 N/A
former Midwest Steel Site [1]	Armour Creek	Unknown	Yes (1999)	0-36.30	N/D		N/D		Yes (1999)	5.92 (sediment in Armour Creek) 6-123 (soil along railroad line)	1999
Flexsys Property [1] (including WWTP)	Kanawha River	Yes	Yes (1983) No (1999)	100-1,080,000	N/D		Yes (1998)-kerosene layer only	313.6	Yes (1998)	0-1,598 (Kanawha sediment)	1999 (area near WWTP)
Nitro Landfill [2]	Armour Creek	Unknown	N/D		N/D		N/D		Yes (1998)	17 (nearby soil)	
Old Nitro Landfill/Monsanto Dump (1929-1956) /Nitro Sanitation Landfill [2]	Kanawha River	Unknown but used by Monsanto-1929-1956	N/D		N/D		N/D		Yes (1998)	0-1,598 (Kanawha sediment)	Kanawha County Landfill [2]Kanawha RiverUnknown but possibly used for wastes from MonsantoYes (1985) only 1 sampleN/DN/DN/DN/D1985
Poca Strip Mine Pits/Poca Drum Dump/Nitro City Dump/Poca Landfill/Putnam County Drum Dump [2,3]	Pocatalico River	Yes (Monsanto-1959-1960)	No	0	N/D		N/D		N/D		
South Charleston Landfill [2,3]	Kanawha River	Unknown but used by Monsanto-1961-1964	Yes	0-92	Yes	0-0.4	N/D		Yes	0-24 pg/g	1999

Site Name	Receiving Water	Accepted/Stored Dioxin Material?	Dioxin Detected In Soil on-site?	Conc. (pg/g)	Dioxin Detected In Surface Water on-site?	Conc. (pg/L)	Dioxin Detected In Groundwater on-site?	Conc. (pg/L)	Dioxin Detected nearby (stream or soil)?	Conc. (pg/g or pg/L)	Most Recent Sampling Date
Union Carbide Plant @ Institute [3]	Kanawha River	No	No (1983)		N/D		N/D		N/D		1983
Western Kanawha Landfill [2,3]	Kanawha River	Unknown	No (1980)		N/D		N/D		N/D		

N/D = Not Determined
N/A = Not Available

[1] = Cited as potential concern by EPA
[2] = Cited as potential concern by WVDAP
[3] = Not within TMDL Study Area

Figure 3-2. Location of Potentially Contributing Landfill Sites



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Don's Disposal:

Both locations of Don's Disposal are located upstream of the 2-mile TMDL study reach of the Pocatalico River. The WVDEP initially identified this site as a potential source, although subsequent conversations indicate that the active site accepts municipal waste only (Sudhir Patel, WVDEP Office of Waste Management). The second location for Don's Disposal, now inactive, may have accepted some chemical wastes prior to closing. The site was evaluated as a CERCLIS site in 1981 and has been placed on the NFRAP 8T list. It is not believed to be contributing a dioxin load to the Pocatalico River. Results of recent sampling conducted in July 1999 are awaited. EPA HSCD will be reviewing (Preliminary Assessment) available site file information in summer 2000 to determine if any further reassessment of the site is necessary.

DuPont Belle Plant:

DuPont Belle plant was used for the disposal of organic and inorganic waste materials from 1926-1977. The site is located on the Kanawha River near Belle West Virginia upstream of the TMDL area. A preliminary assessment and site inspection were complete in the mid-1980's as part of a CERCLIS evaluation. Samples collected from the site initially indicated the presence of dioxin. However, the subsequent reanalysis of these samples using a dioxin - specific protocol did not detect dioxin. The EPA has archived this site to it NFRAP 8T list. In 1999 HSCD collected samples from the surface waters and sediments from the Kanawha River and Simmons Creek upstream from, adjacent to and downstream from the facility. At this time, it would appear dioxin (TEQs) levels upstream of the DuPont Belle Facility are similar to dioxin levels adjacent to and downstream of the facility. Only one water sample (out of eight samples taken) showed any detectable level of 2,3,7,8- TCDD (at an estimated level of 0.1 pg/L) and a duplicate sample taken at the same location at the same time showed not detectable level of 2,3,7,8-TCDD.

Based on 1999 data no dioxin "hot spots" in the area of the DuPont Belle facility have been identified . EPA will be conducting a study to determine background levels of dioxin in the Kanawha River area. This study will help to further identify whether areas of elevated dioxin contamination exist in the area.

Fike Chemical Co.:

The Fike Chemical site, located in Nitro, West Virginia, consists of an 11-acre parcel used to produce custom chemicals and a one-acre parcel containing a treatment plant which treated stormwater and wastewater generated at the plant. The site was placed on the EPA's National Priority List in 1983 and is identified in the CERCLIS database on their SCAP11 list. The EPA's Superfund at Work publication characterized the site as follows: "The site contamination is extensive. The groundwater, surface water and soil contain a variety of volatile organic compounds, dioxin, and PCBs (polychlorinated biphenyls). The Kanawha River is contaminated as well." (EPA520-F-93-010, Summer, 1993).

The hazards posed by the materials were addressed through a series of removal actions and RODs (records of decision) that began in 1988 and were completed in 1997 by the EPA and the responsible parties. The EPA is currently conducting an investigation to determine the extent of contamination in soils and groundwater (Mark Slusarski, WVDEP Office of Waste Management; Kate Lose, EPA). Approximately 40 on-site surface soil samples were collected and analyzed for dioxin in early 1999. Most of the samples revealed low levels of 2,3,7,8-TCDD (Kate Lose, EPA). No 2,3,7,8-TCDD was detected in the single 1999 sample analyzed for dioxins. A final remedial action is expected to be selected and completed in the next four years.

Until remediation begins, all surface runoff from the 11 acre portion of the site is contained by berms, treated at a new (1996) on-site treatment plant, and released to the city of Nitro's sewer system (Mark Slusarski, WVDEP Office of Waste Management). There is a less than one acre portion of the site, where the surface water is not treated. The on-site wastewater treatment plant has a permit limiting the concentration of 2,3,7,8-TCDD to 1.5 pg/L. The detection limit for 2,3,7,8-TCDD is 5.6 pg/L. Effluent samples taken quarterly to date have been non-detect. In turn, the facility is considered to be in compliance at a non-detect level (Kate Lose, EPA).

Prior to the operation of the waste water treatment plant, surface run-off from the site was either treated and discharged via the old Cooperative Sewage Treatment Plant (CST) or other drainage to the Kanawha River. There is a possibility that both of these old sources contained dioxin contaminated surface water and acted as both point and nonpoint sources. The CST plant was decommissioned in March 1997 (Kate Lose, EPA). Because remedial actions at the site are not complete, the Fike Chemical site may be a source of dioxin load to the Kanawha River.

This site was sampled twice recently in June and October of 1999. Analytical results from these sampling surveys are included in summary table 3-1. EPA HSCD will also be conducting a sampling assessment of stormwater sewers in the Nitro, WV area in summer 2000. Sampling will include collection of sediment and surface water from drainages used by the old CST.

Fleming Landfill:

The Fleming landfill drains to the Pocatalico River, although it is located upstream of the 2-mile TMDL study reach. This site was identified as a possible source by the WVDEP. The EPA and WVDNR evaluated the site in 1985 and archived it on the NFRAP 8T list. Conversations with an official in the WVDEP Office of Waste Management (Sudhir Patel, WVDEP Office of Waste Management) indicate that this landfill is currently operating as a municipal landfill. Because there is no direct evidence of dioxin contamination, this site is not believed to be a source of dioxin loading to the Pocatalico River. Results of sampling conducted in September 1999 are included in summary Table 3-1. EPA HSCD will be reviewing (Preliminary Assessment) available site file information in fall 2000 to determine if any further reassessment of the site is necessary.

George's Creek Landfill:

George's Creek landfill is located upstream of Charleston near Malden, West Virginia. It drains to George's Creek, which then feeds into the Kanawha River, but upstream of the TMDL study area. George's Creek landfill accepted waste from Monsanto from 1959-1960 (Eckhardt survey, ca. 1977). It is not known if the Monsanto waste contained dioxin. There is no direct evidence of dioxin contamination at this site. EPA and WVDEP conducted a preliminary assessment in 1980 and put the site on its NFRAP 8T list. EPA's Removal Program visited and sampled this site for off-site migration of dioxin contaminated soils in the spring of 1999. The results of this survey are included in summary Table 3-1. In addition, EPA's Hazardous Site Cleanup Division's Site Assessment Program will review the "No Further Response Action Planned" (NFRAP) determination for this site. Based upon the sample results and NFRAP review, EPA will determine whether any additional assessment work or cleanup should be performed. Results of sampling conducted in July 1999 are included in summary Table 3-1. EPA HSCD will be reviewing (Preliminary Assessment) available site file information in fall 2000 to determine if any further reassessment of the site is necessary.

Heizer Creek Landfill:

Heizer Creek Landfill is located northeast of the town of Poca and drains to the Pocatalico River within the 2-mile TMDL study reach. The one-acre landfill was owned and operated by the City of Nitro from the late 1950s to the early 1960s (EPA Site Inspection Report, 1985). Monsanto Company disposed of approximately 170,000 cubic feet of unknown plant trash and wastes from 1958 to 1959, which may have included 2,4,5-T-manufacturing wastes and floor sweepings (EPA Site Inspection Report, 1985). Wastes were also burned at this landfill. A preliminary assessment and site inspection completed in the mid-1980s revealed dioxin-contaminated soil in the range of less than 1 to 3.72 parts per billion (ppb) (WVDEP Site Investigation & Response, date unknown). In 1987, Monsanto removed several drums of contaminated soil (EPA Removal Response Section Trip Report, 1998). The Removal Action Level is 1.0 parts per billion.

The sediments in Heizer Creek and the Pocatalico River were sampled in November 1998 in response to public concern that this landfill was contributing to the persistent dioxin problem in the Pocatalico River (Pam Hayes-WVDEP Office of Environmental Remediation). Although the site has been archived on the EPA's NFRAP 8T list, EPA HSCD team sampled an ash pile on the site in 1998 and discovered that it was contaminated with approximately 18 ppb of dioxin. Based on this result, it appears that surface runoff of contaminated soil from this site could be a source of dioxin loading to the Pocatalico River. Data from recent sampling surveys conducted in 1999 are included in summary table 3-1. The site is currently undergoing a potentially responsible party (PRP) lead removal action under a consent order. Dioxin contaminated soil will be removed to 1 ppb (TEQ). EPA HSCD also conducted a CERCLA Site Inspection at the site in May 2000 and is currently awaiting the results of the sampling event. EPA HSCD will determine future remedial actions at the site pending receipt of the SI data and site conditions upon the removal action.

Holmes and Madden Landfill:

This landfill is a five acre inactive facility located approximately 5 miles north of Charleston, West Virginia. From 1970 until its closure in 1975, the facility operated as a nonpermitted landfill receiving industrial, municipal, and hospital wastes from the surrounding area.

EPA HSCD is currently awaiting a health consultation by the Agency for Toxic Substance and Disease Registry (ATSDR) on data collected at the site in September 1999 before determining what future actions, if any are necessary at the site. While the report does indicate that the site could be a minor source of dioxin to the Pocatalico River, it is doubtful that the site could even be a minor source of 2, 3, 7, 8- TCDD in consideration of the small amount of 2, 3, 7, 8- TCDD (3.77 ppt) and distance to the waterway (5 miles). Closer evaluation of the sample results indicate that heptachlorodibenzodioxin (H_pCDD) and octachlorodibenzodioxin (OCDD) congeners were found in the highest concentration. The presence of these dioxin congeners are often associated with open burning activities. The site inspection report for the site acknowledges that the sample exhibiting the highest dioxin TEQ (63.5 ppt) and 2, 3, 7, 8- TCDD (3.77 ppt) concentration was located in close proximity to a residential burning area. The SI report also indicates that due to local area topography, it is unlikely that dioxins would travel from the Site to the water body in which this sample was collected. Based on this data and observations, the site is not a likely source of dioxins to the Pocatalico River.

Avtex Landfill:

The old Avtex Landfill site is located on a portion of property owned by PAR Industrial Corporation in Nitro, Putnam County, WV. The site encompasses 10 acres and is located in an industrial area. Included within the site is a landfill and a subsurface drainage system that eventually drains into the Kanawha River. This site was referred to EPA HSCD by WVDEP in Fall 1999 as a potential disposal area which may contain dioxin contaminated wastes. EPA HSCD conducted a CERCLA PA in January 2000 which recommended further assessment of the site. EPA HSCD anticipates conducting a sampling SI at the site in Summer 2000 and will determine what further actions if any are necessary at the site based upon that information.

Landfill Adjacent to Midwest Steel (Nitro Landfill):

The Midwest Steel and 20-acre adjacent landfill are located in Nitro, West Virginia and drain to Armour Creek. According to officials at WVDEP, this site was used by the City of Nitro and called the Nitro Landfill (Steve Stutler, WVDEP Office of Water Resources). Monsanto, the city of Nitro and FMC used this site to dispose of hazardous and nonhazardous waste from approximately 1954 until approximately 1974 (Tetra-Tech Site Inspection Report, date unknown). Although PCBs were detected at this site, it is not known if the waste contained dioxin. It has been mentioned anecdotally as a possible source of dioxin loading to Armour Creek, although no dioxin sampling has been done at the site (Perry Gaughan, Roy F. Weston). EPA's Removal Program sampled the site in spring 1999. The results are included in summary table 3-1. EPA HSCD will be conducting a sampling assessment (SI) at the site in fall 2000 to further characterize potential migration of dioxin from the site to Armour Creek.

Former Midwest Steel Site:

This site is located north of the Armour Creek Landfill along State Route 25 in Nitro, Putnam County, West Virginia. The Kanawha River flows along the northwest edge of the property and Armour Creek is located northeast of the site. During the mid 1990s EPA entered into a consent agreement with owners of Midwest Steel to clean up PCB and heavy metal contamination from the site. Cleanup activities were completed in 1996. No dioxin sampling was conducted as part of that cleanup effort. Four samples collected in 1998 showed soils contaminated at levels ranging from 0.19 to 128.88 pg/g. A further round of sampling was conducted in May 1999. In this round 11 of 14 samples detected 2,3,7,8-TCDD at levels ranging from 5.92 to 123 pg/g. 2,3,7,8-TCDD was non-detect at the remaining three samples. Surface runoff from this site is a likely contributor of dioxin to the Kanawha River and Armour Creek. EPA HSCD will be conducting a sampling assessment (SI) at the site in fall 2000 to further characterize potential migration of dioxin from the site to Armour Creek.

Manila Creek Landfill:

The Manila Creek Landfill is approximately 0.5 acres in size and is located in Putnam County, West Virginia. It drains to Manila Creek, which then drains into the Pocatalico and is within the 2-mile TMDL study reach. The site was closed over 30 years ago. Monsanto Company used the site for disposal from 1956-1957 to dispose of general organic waste (Eckhardt survey, ca. 1977). A site inspection in 1983 revealed the presence of dioxin at approximately 3.7 parts per billion (ppb) in one of the surface soils. Nineteen samples collected in September, 1984 revealed 2,3,7,8-TCDD concentrations ranging from zero to 57.2 ppb. EPA and Monsanto entered a Consent Agreement in April, 1987 that called for Monsanto to dewater the landfill, block off an underground seep and to cap and fence the landfill. EPA is not aware of sampling of monitoring wells installed at the site by Monsanto.

The sediments in Manila Creek and the Pocatalico River were sampled in November 1998 in response to public concern that this landfill was contributing to the persistent dioxin problem in the Pocatalico River (Pam Hayes-WVDEP Office of Environmental Remediation). The results from this sampling revealed some potential off-site migration of dioxin contaminated soils. A subsequent round of sampling was conducted in September 1999 and revealed contamination of soils and groundwater at the site. The soil samples ranged from 0-385 pg/g TCDD. Groundwater sampling revealed dioxin concentrations ranging from 197 to/1,470 pg/L. These reported results are from water collected from monitoring wells installed within the waste layer at the landfill. The creek sediments are also contaminated in this region (0-38 pg/g TCDD).

In the three sediment samples collected downstream of the site TCDD was detected in only one sample at concentration of 2.22 pg/g. While the site can definitely be considered a potential source of dioxin, further sampling is required to determine whether dioxin is migrating from the site. EPA HSCD conducted an Expanded Site Investigation (ESI) at the site in May 2000 which included installation of four (4) off-site groundwater monitoring wells and collection of additional soil, sediment, surface water and groundwater samples to determine if dioxin and other contaminants are migrating off-site. EPA will determine what actions, if any are necessary upon receipt of the data.

Flexsys Property:

Flexsys' Nitro plant is located just north of the city of Nitro along the east bank of the Kanawha River. Part of the site was used (under the ownership of Monsanto) for the production of 2,4,5-T from 1948 until 1969 (Final Report, NUS, 1993). The soils in the area around the production facility were contaminated with dioxin, as was the area near the treatment plant, which was constructed over demolition debris from the production area (Final Report, NUS, 1993). EPA issued a Removal Order to Monsanto, which completed the work around 1986-1987 (Martin Kotsch, EPA RCRA Project Manager). The available detection limit for cleanup was approximately 1 ppb (Martin Kotsch, EPA RCRA Project Manager).

Groundwater beneath the former production facility was discovered to be contaminated with kerosene. Analysis of the kerosene layer indicates that there is some dioxin contamination in the kerosene. Solutia, under a joint Flexsys/Solutia corrective action permit, has been using a skimmer pump to remove the kerosene from the groundwater, which is contaminated with dioxins. The kerosene that is removed is then stored in drums until a sufficient quantity is collected before it is sent off site for disposal. The pumping action will continue until such time that the kerosene is either removed or concentrations fall below a health based risk level (Martin Kotsch, EPA RCRA Project Manager). Since a Notice of Violation issued by WVDEP is pending resolution the facility may no longer be removing the dioxin contaminated kerosene.

Badly deteriorated drums containing dioxin were recently discovered on land that had been sold to a real estate development company called AES (Ken Ellison/Pam Hayes, WVDEP).

This part of the facility was formerly owned by Monsanto and then Solutia. The drums were excavated and placed in overpacks for removal (Ken Ellison/Pam Hayes, WVDEP). Solutia has suggested that the drums were accidentally buried during the removal activities initiated under Superfund. Although Solutia is currently addressing this situation, this site may be a source of dioxin loading to the Kanawha River. EPA HSCD is currently in the process of negotiating a consent order with Solutia to address the removal of drums and dioxin contamination at this part of the facility.

Old Nitro Landfill//Monsanto Dump:

This landfill is located near the AES/Solutia property next to the Kanawha River. Part of it was used for the bridge of I-64 over the Kanawha River (Martin Kotsch, EPA RCRA Project Manager). The Eckhardt survey from the mid-1970s indicates that Monsanto had a dump near this location that was used from 1929-1956. Conversations with the WVDEP indicate that this landfill may also have been referred to as Nitro Sanitation Landfill (Steve Stutler, WVDEP Office of Water Resources) and "Monsanto-Old Landfill". The landfill has been capped and is no longer in use. There were two very high Kanawha River sediment sample dioxin results near this landfill in the 1998 sampling survey. EPA will determine if any additional assessment or cleanup is required at this site based on assessments conducted in October 1999. The sampling targeted drainage pathways at the site. The results are included in summary table 3-1. EPA HSCD will be conducting a PA of the site in Summer 2000 to determine if any further assessment of the site is necessary.

Kanawha County Landfill:

The site is an 14-acre inactive municipal landfill which operated from 1947 to 1970. This site was brought to EPA's attention by WVDAP in Fall 1999, but is not listed as a potential source of dioxin of the Kanawha River. WVDAP was concerned that wasted from Monsanto has been deposited in the landfill and requested that the site be assessed as a potential source of dioxin to the Kanawha River. It was alleged by a former employee that the landfill accepted drums and containers of hazardous waste and buried them on-site. WVDEP conducted a PA and SI at the site in 1984. No containers or drums were observed. EPA conducted a t dioxin screening assessment at the site in 1985. Dioxin was detected in only one (1) sample. EPA conducted a subsequent dioxin sampling event in 1985 focusing on the area of the previous positive hit for dioxin. All samples in this subsequent sampling event were negative for dioxin. EPA HSCD will be conducting a sampling SI at the site in Summer 2000 to reassess the site based upon current site conditions.

Poca Strip Mine Landfill/Putnam County Drum Dump/Nitro City Dump/Poca Landfill:

The Poca Strip Mine Landfill is located approximately 3 miles east of Poca, West Virginia and drains to the Pocatalico River, although it is outside of the 2-mile TMDL study reach. The site was used by the City of Nitro, FMC Corporation, Ohio Apex, and Monsanto Chemical Company from 1962-1963. A hazardous waste survey completed by Monsanto shows that the site was also utilized in 1959-1960 for open drummed hazardous waste and uncontained hazardous wastes (Preliminary Assessment Report, WVDNR, 1984). Open burning of wastes at the site also occurred.

Investigations by both EPA and Monsanto from approximately 1983-1985 revealed the presence of dioxin at the site. Monsanto entered into a Consent Agreement in 1986 to conduct a remedial investigation to determine the extent of dioxin contamination, to clean up the dioxin contamination and to cap the landfill. These activities were completed in the late 1980s (EPA Removal Response Section Trip Report, 1999). The EPA has archived this site on its NFRAP 8T list.

However, the sediments in the Pocatalico River were sampled in November 1998 in response to public concern that this landfill was contributing to the persistent dioxin problem in the Pocatalico River (Pam Hayes, WVDEP Office of Environmental Remediation). The results of this sampling did not reveal any off-site migration of dioxin contaminated soils. EPA will determine if any additional assessment or cleanup is required based on an analysis of the most recent sampling (May 1999). These results are included in summary table 3-1. EPA HSCD will be reviewing (PA) available site file information in Fall 2000 to determine if any further reassessment of the site is necessary.

South Charleston Landfill:

This landfill is located west of the Kanawha River off of Route 12 in Kanawha County, West Virginia. The site is approximately 30 acres and has been inactive since the mid-1970s. Records indicate that this site was used by Monsanto Corporation, Union Carbide Corporation, and the city of South Charleston for the disposal of hazardous and non-hazardous wastes from approximately 1949 until 1972 (Tetra-Tech Site Inspection Report, 1993). The Eckhardt report indicates that Monsanto used the site from 1961-1964. Although samples were collected as part of the site inspection, there is no mention of dioxin being detected. The site has been archived by the EPA on the NFRAP 8T list. It is not believed that this site is a source of dioxin loading to the Kanawha River. Results of sampling conducted in September 1999 are included in summary table 3-1. EPA HSCD is currently awaiting a health consultation by the Agency for Toxic Substances and Disease Registry (ATSDR) on data collected at the site in September 1999 before determining what future actions, if any are necessary at the site.

Union Carbide Plant at Institute:

The Union Carbide Plant is located near the Kanawha River in Institute, West Virginia, which is upstream of the TMDL study reach. Because this site was known to have handled 2,4-dichlorophenol (which can react to form dioxin), a dioxin sampling survey was conducted in 1983. Results of those analyses revealed no evidence of dioxin contamination at this site (NUS Site Inspection Report, 1983). It is not believed that this site is a source of dioxin loading to the Kanawha River. Results of new sampling conducted in October 1999 are included in summary table 3-1. EPA HSCD will be reviewing (PA) available site file information in Fall 2000 to determine if any further reassessment of the site is necessary.

Western Kanawha Landfill:

This landfill is located east of Nitro, West Virginia and is currently operating as a municipal landfill (Sudhir Patel, WVDEP Office of Waste Management). It was evaluated under CERCLIS in 1980 and reevaluated in 1986 by the state and placed on the EPA's NFRAP 8T list. A copy of the preliminary assessment and site inspection reports have been requested for this site but currently it is not believed that this site is contributing a dioxin load to the Kanawha River. Results from sampling conducted in July 1999 are included in summary table 3-1.

3.3.2 Source Quantification

Dioxin originating from nonpoint sources can enter a river in several ways: through contaminated groundwater, surface runoff of contaminated soil, diffusion from contaminated sediments in the river and scouring or resuspension of contaminated sediments. The magnitudes of these processes were estimated using the available data and literature values.

Contaminated Groundwater

The ORSANCO water quality data show an increase in water dioxin concentration downstream at RM 41.3, relative to the upstream boundary at RM 45.5. The increase in concentration occurs even at the lowest flows. This loading is assumed to be attributable to contaminated groundwater entering the Kanawha River near this area, due to the absence of any other known sources. It is recognized that, in the absence of organic solvents, dioxin has very low solubility in water and would not normally be expected to be present in significant quantities in groundwater. Given the heavily industrialized nature of the area and past presence of groundwater contamination, it is quite plausible that dioxin is in solution with contaminated groundwater moving as base flow. An estimate of the dioxin load from the groundwater was made using a mass balance between the upstream boundary water concentration (RM 45.5) and the most upstream ORSANCO sampling station (RM 41.3) as follows:

$$W_{gw} = [(C_{downstream} * Q_{Kanawha}) - (C_{upstream} * Q_{Kanawha})] * 2.447 \qquad (3\text{-}1)$$

where

W_{gw} = dioxin load from the groundwater, ug/day
$C_{downstream}$ = dioxin concentration measured at RM 41.3, pg/L
$Q_{Kanawha}$ = Kanawha River flow cfs
$C_{upstream}$ = dioxin concentration estimated at RM 45.5, pg/L

2.447 = unit conversion factor

Kanawha River flows were estimated using data and empirical equations provided by the USGS (Ron Evaldi, USGS). Equation 3-1 was applied for each of the ORSANCO data values collected at RM 41.3, and assuming that the upstream concentration was constant at the only measured value of 0.009 pg/L. Application of Equation 3-1 using the available data is shown in Table 3-2, an average dioxin groundwater load of 3324 ug/day.

It is noted here that data on groundwater concentrations of dioxin is extremely limited. Thus the observed increases in the surface water concentrations could also arise from as yet, unidentified point sources in the area, as well as from contaminated ground water.

Table 3-2. Groundwater Loading Calculation

Date	**Kanawha River Flow (cfs)**	**RM 41.3 Dioxin Concentration** (pg/l)	Back-Calculated Dioxin Mass Load (ug/day)
6/9/98	9160	0.123	2707
7/21/98	5479	0.340	4429
10/27/98	2878	0.412	2836

Contaminated surface erosion

The Heizer Creek landfill, the Manila Creek landfill, and the Midwest Steel site have been identified as sites that could contribute dioxin load to the TMDL study areas by surface erosion of contaminated soil. The magnitudes of these loads were estimated using the Universal Soil Loss Equation (USLE). This is an empirical equation that will predict the average annual soil loss by sheet and rill erosion from source areas. The equation is (Wischmeier and Smith, 1978):

$$X = E * K * ls * C * P \tag{3-2}$$

where

X = soil loss, in tons/acre/year
E = rainfall/runoff erosivity index (10^2 m-tonne-cm/ha-hr)
K = soil erodibility (tons/acre per unit of E)
ls = topographic factor, unitless
C = cover/management factor, unitless
P = supporting practice factor, unitless

The Soil Conservation Service in the Capital district supplied values for the Heizer Creek landfill site, which are: E = 150, K = 0.32, ls = 10, and C = 0.038. P is assumed to be 1.0 in the absence of specific erosion control practices. The USLE predicts that the total amount of soil lost due to erosion is 18.24 tons/acre/year or 16,550 kg/acre/year. This value was also applied for the Manila Creek and Midwest Steel sites.

The total annual dioxin loading is estimated by multiplying the annual amount of soil erosion by the average concentration of dioxin in the soil. For Heizer Creek, assuming that the contaminated area covers 10% of the landfill, this results in an annual dioxin loading of 30,000 ug/year. Converting to a daily basis, this works out to 82 micrograms of dioxin loaded to the Pocatalico per day. While the units for loading are listed as ug/day, it should be noted that this is based on an annual loading rate and significant day to day variations occur. For Manila Creek, based on an average concentration of 305 pg/g for duplicate samples taken on the southern boundary of the landfill and an estimated 0.1 acres of area between the landfill and the receiving water, 1.38 ug/day of dioxin is estimated to be loaded to the Pocatalico River. For the Midwest Steel site, based on an average concentration of 19.15 pg/g for five samples and an estimated 5 acres of area, 4.34 ug/day of dioxin is estimated to be loaded into Armour Creek.

The dioxin loading due to contaminated surface erosion at the three identified sites are rough estimates at best because they are based upon very few biased sampling points. Sampling conducted at these sites are biased towards finding hot spots of contamination, therefore the average dioxin concentration values used for these sites to determine the dioxin load from each site is possibly overestimated considering the actual average concentration of dioxin present in surface soils at these sites is much lower.

In-Place Sediment Diffusion:

The contribution of dioxin to the water column attributable to diffusion from the contaminated river sediment was estimated for three reaches of the TMDL study area: the Kanawha from RM 45.5 to RM 42.25, the Kanawha from RM 42.25 to RM 39 (the confluence of the Pocatalico), and the Kanawha from RM 39 to the mouth. The net diffusive flux from the sediment to the water column was calculated at each sediment sampling location within a reach, then calculating an average net diffusive flux for the reach area.

Sediment percent moisture data, typical literature values for density and fraction organic carbon, and guidance from EPA (EPA, 1995) were used to estimate the fraction of the sediment bed contamination in the dissolved phase according to the equation:

$$\text{Dissolved bed fraction} = 1/(1 + (\ _d * k_{ow} * (f_{oc}/ \ )) \quad (3\text{-}3)$$

where

$_d$ = dry bulk density = ($_s$* $_w$) / [($_w$ + $_s$*(% moisture / %dry))]
$_s$ = density of the solids, assumed at 2.5 gm/cm^3
$_w$ = density of water, assumed at 1.0 gm/cm^3
k_{oc} = organic carbon partitioning coefficient for dioxin = k_{ow} = $10^{7.02}$
f_{oc} = fraction organic carbon, assumed to be 0.01
= porosity = [(1- $_d$)/ $_s$]

For this analysis, the assumption was made that k_{oc}, the organic carbon partitioning coefficient for dioxin can be approximated by k_{ow}, the octanol-water partitioning coefficient.

The concentration of dioxin in the pore water was estimated from the sediment dioxin concentration using the following equation:

$$C_{pw} = C_{sed} * \ _d * DBF * 1000 \quad (3\text{-}4)$$

where

C_{pw} = pore water dioxin concentration, pg/L
C_{sed} = measured sediment dioxin concentration, ng/kg
$_d$ = dry bulk density, gm/cm^3
DBF = dissolved bed fraction as calculated in Equation 3-3

The diffusion velocity from the sediment pore water to the overlying water column was estimated using the equation:

$$k_L = [(D_{eff} * 86{,}400) / (100*(H_2/2))] \quad (3\text{-}5)$$

where

k_L = diffusion velocity, m/day
D_{eff} = effective diffusion constant, cm^2/s, = (D_m * ^{2} * MEF)
Dm = molecular diffusion constant, cm^2/s
= $(1.326*10^{-4})*(\ _w^{-1.14})*(MW^{-0.589})$
$_w$ = viscosity of water = 1.002 (20°C)
MW = molecular weight = 321.97
= porosity
MEF = mixing enhancement factor associated with bioturbation, assumed = 10
H_2 = active bed depth, cm, assumed = 5

The average diffusive velocity calculated as 0.006 m/day and was based on 108 data points.

The mass flux of dioxin from the sediment pore water to the overlying water column, in pg/m^2/day, was estimated using the pore water dioxin concentration, the porosity of the sediment and the (sample specific) diffusive velocity in the following equation:

$$\text{flux} = C_{pw} / (\ * 1000 * k_L) \quad (3\text{-}6)$$

The fluxes ranged from 0.088 pg/m^2/day to 369.4 pg/m^2/day. This range in values is reflective of sediment data that had dioxin concentrations greater than the detection limit. To correct for this high bias, the calculated fluxes were adjusted by the ratio of number of sediment results with positive dioxin concentrations (47) to the total number of samples analyzed for dioxin (108). The average flux in reach one, from RM 45.5 to RM 42.25 was assumed to be zero as there were no detectible dioxin measurements. In reach two, from RM 42.25 to RM 39, the flux was calculated to be 6.21 pg/m^2/day. In reach three, from RM 39 to the mouth, the flux was calculated to be 0.435 pg/m^2/day.

The mass flux of dioxin from the water column to the sediment pore water or "back diffusion", in pg/m^2/day, can be estimated in a similar fashion using the water quality standard as the water column dioxin concentration:

$$\text{flux} = k_L * C_{H2O} * f * 1000 \qquad (3\text{-}7)$$

where

C_{H2O} = water column concentration, assumed = 0.014 pg/L
f = fraction of dioxin in the water column in the dissolved state, assumed = 0.10
1000 = conversion factor

The back diffusion was calculated to be 0.008 pg/m^2/day. This value is negligible in comparison to the flux from the sediment to the water column and can be ignored. Thus, the sediment to water flux is representative of the net diffusive mass flux in the system.

The overall mass loading to the water column due to diffusive mass flux can be calculated from the area of the sediment bed for each reach. The results of the calculation used to estimate the diffusive flux are summarized below in Table 3-3.

Table 3-3. Mass Flux Calculation for Sediment Porewater Diffusion

Reach	**Upstream River Mile**	**Downstream River Mile**	**Surface Area (m^2)**	**Avg. net diffusive flux** (pg/m^2/day)	Mass loading (ug/day)
1	45.5	42.25	1.33×10^6	0	0
2	42.25	39	1.34×10^6	6.206	8.3
3	39	0	1.45×10^7	0.435	6.3

In-Place Sediment Resuspension

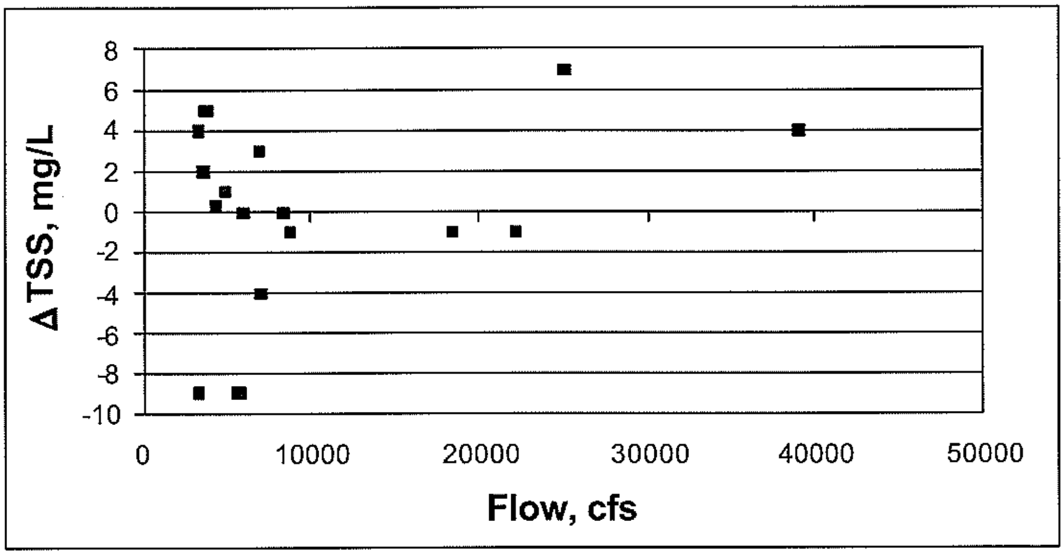
The final nonpoint source category to be quantified is resuspension of contaminated in-place sediments. Existing loading rates in the Kanawha were estimated by combining two data sources:

Observed downstream increases in Kanawha River total suspended solids (TSS) data, used to empirically estimate sediment resuspension as a function of river flow;

Observed Kanawha River sediment dioxin concentrations.

The historical water quality database was examined to define the synoptic sampling events that collected TSS data along the length of the TMDL segment. Three locations were found to have multiple observations, corresponding to St. Albans (RM 46.1), Winfield Lock and Dam (RM 31.1), and Point Pleasant (RM 1.3). These three locations allowed separate analyses to be conducted for the segments upstream and downstream of Winfield Lock and Dam.

Figure 3-3 displays the downstream increase in observed TSS concentrations (i.e. TSS at RM 31.1 – TSS at RM 46.1) for the segment upstream of Winfield Lock and Dam. No statistically significant increase in TSS was observed for any range of flows for this segment, and



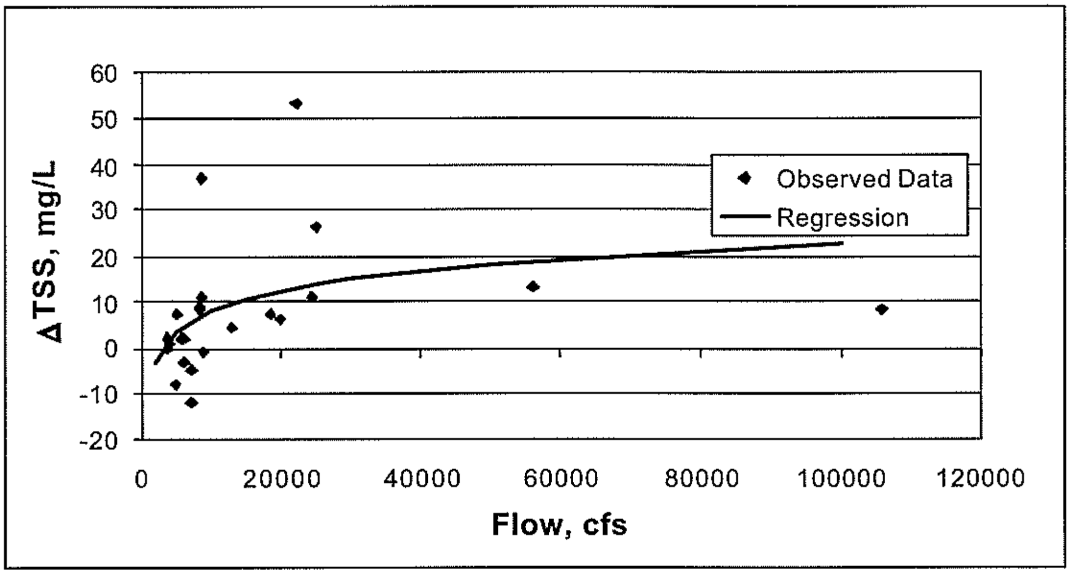
resuspension was deemed to be an insignificant component of the solids budget (for purposes of a screening-level estimate).

Figure 3-3. Increase in Observed TSS Concentration between St. Albans and Winfield Lock and Dam as a Function of River Flow

The same analysis was conducted using the downstream increase in observed TSS concentrations (i.e. TSS at RM 1.3 – TSS at RM 31.1) for the segment downstream of Winfield Lock and Dam. These data, shown in Figure 3-4, indicate a significant correlation between increase in TSS and Kanawha River flow. This correlation was described mathematically by the equation:

$$DTSS = -53.7 + \ln(\text{Kanawha River flow})*6.66 \qquad (3\text{-}8)$$

The effect of this sediment resuspension, in conjunction with an average sediment dioxin concentration in this segment of 27 pg/g, is shown in Table 3-4 for a range of Kanawha River flows. It is recognized that this empirical sediment resuspension analysis is only a rough approximation that ignores components such as tributary loading of solids to the study reach. Nonetheless, results from this analysis are roughly consistent with the only high flow dioxin measurement for the Kanawha River. During the June, 1998 survey on the Kanawha River, the dioxin measured at Point Pleasant was 0.46 pg/L during a river flow of 45,000 cfs. This



measurement represents an increase in dioxin of 0.21 pg/L over the lower stretch of river, compared to a predicted resuspension-induced concentration of 0.48 pg/L.

Figure 3-4. Increase in Observed TSS Concentration between Winfield Lock and Dam and Point Pleasant as a Function of River Flow

Table 3-4. Mass Flux Calculation for Sediment Resuspension

Kanawha River Flow (cfs)	Net Increase in TSS (mg/l)	Dioxin mass load (ug/day)	Predicted increase in dioxin concentration (pg/l)
3200	0	0	0
10000	7.6	5,020	0.205
50000	18.3	60,400	0.494
100000	23.0	152,000	0.621

4.0 MODELING PROCEDURE: LINKING THE SOURCES TO THE ENDPOINT

Modeling procedures are used to create a direct predictive relationship between system boundary conditions, external loadings, and in-stream processes and the resulting water quality condition, e.g. dioxin concentration. Once the model is developed, load allocations and wasteload allocations can then be selected to define the conditions under which predicted water quality will meet water quality standards. Available modeling techniques include empirical relationships, analytical equations, and numerical (computer) models of a wide range of complexity. This section discusses model selection, some aspects of model process representation, and the ranges of stream conditions covered.

4.1 MODELING FRAMEWORK SELECTION

4.1.1 Consideration of Model Type

A wide range of model frameworks are available to predict the relationship between external loadings and resulting concentration, covering a wide range of complexity. The most appropriate model for a given situation is chosen as a function of site characteristics, model objectives, and available resources. Relevant characteristics of this modeling application that affect model selection are:

The model must be capable of predicting the relationship between external dioxin loadings and maximum in-stream dioxin concentrations.

No direct dioxin loading data are available, and only a single measurement of upstream boundary concentrations.

The primary loading sources are the upstream boundary, contaminated groundwater loading near the upstream boundary, and (at high river flows only) resuspension of contaminated in-place sediments.

Downstream boundary conditions should be consistent with, and provide a loading input to the Ohio River TMDL.

The above characteristics led to the selection of a conservative dilution model, as described below.

4.1.2 Model Selection

Application of a spatially variable, deterministic model requires the explicit specification of the location and magnitude of all source loads. The model typically then undergoes a calibration process, whereby site-specific chemical fate process coefficients are estimated, and model credibility established, based upon the ability of the model to describe observed in-stream concentration data. The absence of upstream boundary and source loading data would provide too many degrees of freedom to allow for a credible calibration of a model of this type for the Kanawha River. Simply put, the model calibration process would be driven strictly by the assumptions made regarding un-measured inputs, and would provide little information on process coefficients or model reliability. It was therefore concluded that application of a spatial model such as SMPTOX4 or WASP was not appropriate, given the available data.

The approach that has been chosen is to use an analytical dilution model (Equation 4-1).

$$C_{Total} = (C_{Upstream} * Q_{Upstream} + \text{Load}) / Q_{total} \qquad (4\text{-}1)$$

where C_{Total} is the resulting concentration after loading, $C_{Upstream}$ is the upstream concentration, $Q_{Upstream}$ is the upstream flow, SLoad is the total loading, and Q_{Total} is the resulting flow after loading.

This simple model framework assumes that dioxin loss processes are insignificant, and that the sole factor controlling dioxin concentration is dilution. The biggest potential limitation to this approach is that, by ignoring loss processes, the model may over-predict the dioxin concentration resulting from a given set of loads. Fortunately, the characteristics of the Kanawha River site are such that loss processes appear to have relatively little impact on *peak* dioxin concentrations, which are the desired endpoint of the TMDL analysis.

The appropriateness of the analytical dilution model is discussed below, categorized into two types of flow conditions:

Low flow (non-eroding) conditions: Where peak concentrations occur in the immediate vicinity of loading sources. The low flow loading sources are located closely together, such that insufficient time of travel exists to allow loss processes to greatly affect peak concentrations.

High flow (eroding) conditions: When sediment erosion occurs, and the most potentially significant loss process, settling, is negligible. In these cases, peak concentrations are expected to occur near the mouth of the Kanawha.

The resulting TMDL must be protective of both of these flow conditions, as the high volume sampling data has shown violations of water quality standards during both low and high flow.

4.1.3 Suitability of Dilution Model under Low Flow

Under low flow conditions (i.e. 1960 cfs in the Kanawha River as specified in West Virginia water quality standards), the highest dry weather dioxin concentrations in the Kanawha River are typically located at the most upstream ORSANCO monitoring station. The relatively short travel time between the upstream boundary and this location limits the potential effect of loss processes. The peak concentration will then be governed by the combination of steady dry weather sources and the low flow.

The same rationale of short river stretches limiting travel time and therefore limiting losses will apply to the Pocatalico River and Armour Creek tributaries to the Kanawha River. For each of these water bodies, the study area includes the 2 mile stretch above their confluence with the Kanawha River.

Loss processes considered include decay (such as biodegradation or hydrolysis), settling, volatilization, and photolysis. Process considerations included consistency with the ongoing ORSANCO (1999) modeling, although this was not maintained in all cases. Dioxin modeling performed by Limno-Tech for a TMDL for the Columbia River (Oregon/Washington) was also referenced. Each of these processes is discussed below.

Dioxin decay processes are generally considered to be insignificant (LTI, 1992; ORSANCO, 1999), and were assumed to be zero in this study.

Using limited synoptic solids survey data for the Kanawha River above Winfield Dam, under low flow conditions the settling velocity was roughly estimated at 0.07 m/day. A settling velocity of 0.5 m/day was selected as a reasonable under bound value consistent with the limited site specific data and values reported for other systems. Using a particulate dioxin fraction of 0.9 (which is generally consistent with both sampling results and partitioning calculations), the equivalent upper bound decay rate for total concentration (assuming only particulate-bound dioxin is affected by particle settling) is 0.05/day.

Estimation of settling losses at low flow also requires definition of the time of travel between the upstream boundary and suspected source area. Modeling of the physical river system (i.e. stream geometry, water surface elevation, and velocity) was performed for the Kanawha River using the HEC2 model. Model input files for two river reaches 1) Mouth to Winfield Dam, and 2) Winfield Dam to the study area upstream boundary, were run substantially as received from the U.S. Army Corps of Engineers, Huntington District Office, except for modeling the study low flow condition (1960 cfs). HEC2 model results were used in support of contaminant modeling. Selected results are shown in Table 4-1.

Table 4-1. Selected HEC2 Model Results

HEC2 Model Result	Value	Units
Average Depth	8.73	m
Average Width, Coal River to Pocatalico River	249.10	m
Average Width, Pocatalico River to Ohio River	230.80	m
Average Velocity	0.04	m/s

This velocity in conjunction with the upper bound settling rate, indicates that up to 9% of the instream dioxin could settle between the upstream boundary and location of peak concentration.

Volatilization was estimated using the same procedure as used by ORSANCO (1999). Physical constants and input values are shown in Table 4-2.

Table 4-2. Volatilization Inputs

Constant	Value	Units
Molecular Weight	321.97	g/g-mol
Wind Speed	2	m/s
Henry's Constant	$2.1x10^{-6}$	atm-m³/mol
Water Temperature	20	Celcius
Average Water Velocity	0.043	m/s
Average Depth	8.73	m/s

The mass transfer coefficient is estimated to be 0.0074 m/day. The equivalent dissolved concentration volatilization decay rate is 0.00085/day, which is negligible.

Photolysis rates were assumed to be zero by ORSANCO. The Columbia River study found photolysis rates to range from 0.00023 to 0.001/day. Rates in the Kanawha would differ due to the factors listed in Table 4-3.

Table 4-3. Photolysis Factors

Factor	Likely Effect
Latitude (39N vs. 45N)	Higher decay rate
Cloud cover	Variable
Depth	Higher decay rate (at low flow)
Light attenuation	Variable
Indirect photolysis	Unknown

Based on this analysis, the high end of the Columbia River study range was chosen: 0.001/day. This decay rate is similar to the volatilization decay rate, and is also considered negligible.

The primary conclusion from the loss process analysis is that settling is the dominant process, and that it is responsible for at most a 9% decrease in predicted peak dioxin concentrations at low flow. This analysis demonstrates that a dilution model approach will not be overly conservative, as the 9% level of safety will serve as a component of the margin of safety.

4.1.4 Suitability of Dilution Model Under High Flow (Eroding) System Condition

Under high flow conditions, several additional factors will influence dioxin concentrations in the Kanawha River, Pocatalico River, and Armour Creek. First, settling of suspended solids becomes negligible, because the same shear stresses that resuspend bottom sediments prevents deposition of suspended solids. Dioxin in the water column can be considered to behave as a conservative substance all the way to the Ohio River under these conditions, because its primary loss process has been negated. Second, two additional sources of dioxin appear: resuspension of contaminated bottom sediments due to flow-induced shear stress, and erosion of contaminated watershed soils.

The dilution model will be capable of describing the maximum allowable dioxin loading to each of the streams under high flow conditions, due to the insignificance of loss processes. The dilution model will not, however, be capable of predicting the amount of contaminated sediment that will be resuspended during a given flow period. Significant additional information would need to be collected in order to support a model with this capability, as discussed below in the implementation and future monitoring section. As such, the model will be suitable for defining the TMDL for these systems but will not be suitable for predicting the time required for natural attenuation of sediment contamination to occur, nor the efficacy of the physical removal of sediments.

4.2 SELECTION OF REPRESENTATIVE MODELING PERIOD

The discussion above demonstrates the appropriateness of the dilution model for predicting peak dioxin concentrations under two sets of river flow conditions: low flow (non-eroding) and high flow (eroding) conditions. Because these two sets of conditions span the entire spectrum of flows, the analytical model can provide predictions under all conditions. The TMDL allocation process, as discussed in the subsequent section, will therefore define allowable loading rates for all possible river flows.

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5.0 ALLOCATION

Total maximum daily loads (TMDLs) are comprised of the sum of individual waste load allocations (WLAs) for point sources, load allocations (LAs) for non-point sources, and natural background levels. In addition, the TMDL must include a Margin of Safety (MOS), either implicitly or explicitly, that accounts for uncertainty in the relation between pollutant loads and the quality of the receiving water body. Conceptually, this definition is denoted by the equation:

$$\mathrm{LC} = \mathrm{TMDL} = \mathrm{SWLAs} + \mathrm{SLAs} + \mathrm{MOS} \qquad (5\text{-}1)$$

The term LC represents the Loading Capacity, or maximum loading that can be assimilated by the receiving water while still achieving water quality standards. The overall loading capacity is subsequently allocated into the TMDL components of waste load allocations (WLAs) for point sources, load allocations (LAs) for non-point sources, and the Margin of Safety (MOS).

Results of the allocation process are summarized in Table 5–1, which shows the individual TMDL allocations for each of the three systems. The TMDL changes as a function of river flow, so allocations are listed for a range of flows.

This section contains allocations to the identified point and nonpoint sources within the watershed. The section begins with a description of the loading capacity of the three waterbodies of concern, then proceeds to quantify the individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint and background sources necessary for attainment of water quality standards. This section also discusses the incorporation of a margin of safety in the TMDL analysis and the consideration of seasonality.

Table 5-1. Summary of Allocations (ug/day) for a Range of Flow Conditions

Kanawha River	**1960 cfs**	**5000 cfs**	**10000 cfs**	**20,000 cfs**	**50,000 cfs**
WLA					
Point Sources	0.82	0.82	0.82	0.82	0.82
LA					
Upstream Sources	43	110	220	440	1100
Groundwater	16.5	16.5	16.5	16.5	16.5
In-place Sediments	0	20	64	152	416
Runoff	0	10.25	10.25	10.25	10.25
MOS					
Explicit MOS	6.7	17	34	69	171
Pocatalico River	**0.32 cfs**	**500 cfs**	**1000 cfs**	**2000 cfs**	**5000 cfs**
WLA					
Point Sources	0	0	0	0	0
LA					
Upstream Sources	0	0	0	0	0
Groundwater	0.0092	0.0092	0.0092	0.0092	0.0092
In-place Sediments	0	12	26	55	141
Runoff	0	5.91	5.91	5.91	5.91
MOS					
Explicit MOS	0.001	1.6	3.2	6.4	16
Armour Creek	**0 cfs**	**200 cfs**	**400 cfs**	**600 cfs**	**800 cfs**
WLA					
Point Sources	0	0	0	0	0
LA					
Upstream	0	0	0	0	0
Groundwater	0	0	0	0	0
In-place Sediments	0	1.4	7.1	13	19
Runoff	0	4.34	4.34	4.34	4.34
MOS					
Explicit MOS	0	0.64	1.3	1.9	2.5

5.1 LOADING CAPACITY

Because a simple dilution model is being used to describe dioxin fate and transport, the loading capacity for each TMDL segment can be calculated as a function of stream flow using a simple equation, i.e.

$$LC = Q_{riv} \times C_{WQS} \qquad (5\text{-}2)$$

Where:

LC = Loading Capacity (M/T)
Q_{riv} = River flow (L^3/T)
C_{WQS} = Water Quality Standard concentration (M/L^3)

The loading capacity defined in Equation 5-2 applies to all river flows for which water quality standards apply. This corresponds to flows above the minimum stream flow of 1960 cfs in the Kanawha River, and flows above the 7Q10 flows of 0.32 cfs in the Pocatalico River and 0.0 cfs in Armour Creek. The resulting loading capacities for the three systems are shown in Figures 5-1 through 5-3.

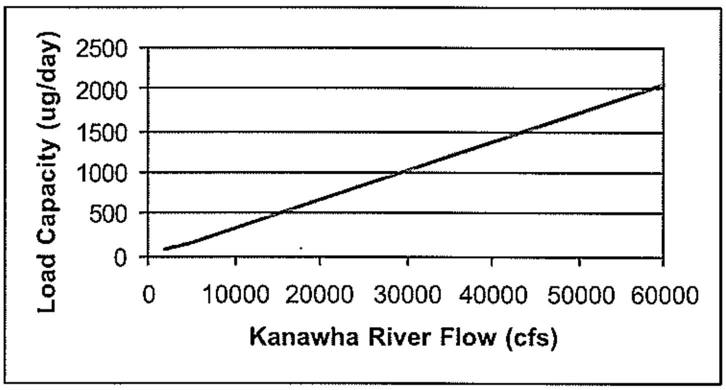

Figure 5-1. Kanawha River Loading Capacity

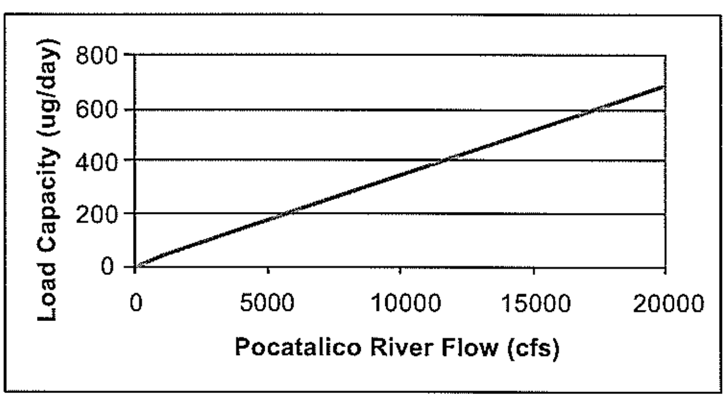

Figure 5-2. Pocatalico River Loading Capacity

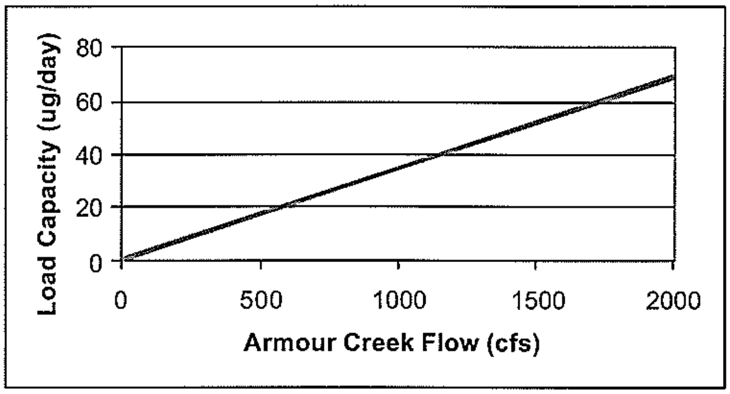

Figure 5-3. Armour Creek Loading Capacity

5.2 WASTE LOAD ALLOCATION

Point sources within the watershed discharging at their current levels were considered negligible in their impact on instream dioxin levels. An allocation is given to the Nitro WWTP in response to their treatment of runoff from the Fike Chemical Co. site. The magnitude of the allocation is set to the required pretreatment limit, which is 0.82 ug/day. The allocation to remaining point sources is set to zero. It is noted here that due to the lack of data within the study area concerning point source contribution of dioxin to the waterbodies, the actual loading of dioxin maybe significantly greater than 0.82 ug/ per day, and hence significant reductions in dioxin loading to the waterbodies may be possible.

Table 5-2. Wasteload Allocations to Point Sources

Point Sources	Existing Load (ug/day)	Allocated Load (ug/day)	Percent Reduction
Kanawha River	0.82	0.82	0
Pocatalico River	0	0	NA
Armour Creek	0	0	NA

5.3 LOAD ALLOCATIONS

Discussion of load allocations to nonpoint sources is divided into categories of upstream sources, contaminated groundwater, in-place sediments, and contaminated soil. A wide range of reduction alternatives could theoretically meet the loading capacity limitations in Figures 5-1 through 5-3. The overall allocation strategy can be constrained by considering two conditions:

Drought, or minimum, flow conditions, where the predominant sources contributing to contamination are upstream sources and contaminated groundwater.

High flow, erosional conditions, where the additional sources of in-place sediment resuspension and erosion of surface contamination become important.

Consideration of drought conditions places an upper bound on allowable upstream source and contaminated groundwater allocations. Additional loading capacity at flows above drought flow can be allocated to erosion of in-place sediments and contaminated soil.

5.3.1 Upstream sources

The Ohio River Valley Water Sanitation Commission (ORSANCO) conducted field sampling in May, 1999 to provide a measurement of the dioxin concentration entering the study area at the upstream boundary. The dioxin concentration determined in that sample, 0.009 pg/L, is being used as the upstream boundary concentration for the TMDL. The draft TMDL assumes that the upstream boundary concentration will remain constant at this concentration for all river flows. The uncertainty inherent in this assumption will be reflected in the Margin of Safety.

No evidence exists of dioxin contamination upstream of the Pocatalico River and Armour Creek segments of concern, so upstream boundary concentrations for these segments were assumed to be zero.

Table 5-3. Load Allocations to Upstream Sources

River	Existing Load (ug/day)	Allocated Load (ug/day)	Percent Reduction
Kanawha	0.009 pg/L x Flow (cfs) x 2.447 = 43 ug/day @ 1960 cfs = 110 ug/day @ 5000 cfs = 440 ug/day @ 20000 cfs	0.009 pg/L x Flow (cfs) x 2.447 = 43 ug/day @ 1960 cfs = 110 ug/day @ 5000 cfs = 440 ug/day @ 20000 cfs	0%
Pocatalico	0	0	NA
Armour	0	0	NA

5.3.2 Contaminated groundwater

Contaminated groundwater was identified as a major contributor of dioxin to the Kanawha River. The upper bound of the maximum allowable groundwater load to the Kanawha can be calculated by performing a mass balance calculation at the location where the groundwater enters the Kanwha (and assuming no loss of dioxin between the upstream boundary and this location) during minimum river flow. The mass balance equation calculates the maximum load that just achieves compliance with the water quality standard, assuming no source other than upstream. The resulting equation is:

$$LA_{GW} \leq Q_{min} \times (C_{WQS} - C_{up}) \tag{5-3}$$

Where

LA_{GW} = Load Allocation to contaminated groundwater (M/T)
Q_{min} = Minimum stream flow at which water quality standards apply (L^3/T)
C_{WQS} = Water Quality Standard concentration (M/L^3)
C_{up} = Dioxin concentration at upstream boundary of segment (M/L^3)

Equation 5-3 is expressed as an inequality, because the LA must be set less than or equal to this value to ensure compliance with water quality standards at minimum flow. The potential reasons for setting the LA less than (as opposed to equal to) this upper bound value include providing allowance for a Margin of Safety and/or achieving greater than absolutely necessary reductions in one source category in order to lessen the amount of reductions required in another source category.

The maximum possible LA for contaminated groundwater in the Kanawha River was determined from application of Equation 5-3 to be 24 ug/day. The upper bound LAs for contaminated groundwater in the Pocatalico River and Armour Creek are 0.0102 and 0.0 ug/day, respectively.

For purposes of this TMDL, 16.5 ug/day is provided as an allocation to contaminated groundwater in the Kanawha River. This allocation is based upon providing the fullest allocation possible to this source (24 ug/day), minus the wasteload allocation (0.82 ug/day) and minus 10% of the Loading Capacity (6.7 ug/day) which will be allocated to the Margin of Safety as discussed below. This corresponds to a 99% reduction in the estimated existing load.

The LA for contaminated groundwater to the Pocatalico River is 0.0092 ug/day. This allocation is also based upon providing the fullest allocation possible to this source, minus 10% of the Loading Capacity which will be allocated to the Margin of Safety. No allocation is given to Armour Creek, because the 7Q10 flow is zero. No explicit reductions are expected to be required for these sources, based upon the conclusion of Kanetsky (1987) that the primary source of dioxin impairment to these streams is caused by backflow from the Kanawha, which will be corrected through source loading reduction to the Kanawha River.

Table 5-4. Load Allocations to Contaminated Groundwater

River Segment	Existing Load (ug/day)	Allocated Load (ug/day)	Percent Reduction
Kanawha	3324	16.5	99%
Pocatalico	NA	0.0092	NA
Armour	NA	0.0	NA

5.3.3 Contaminated soils

Once loads have been allocated to the sources described above that must be controlled in order to meet water quality standards during low flow conditions, the remainder of the loading capacity (except for the Margin of Safety) can be allocated to the wet weather/higher flow categories. The first of these to be considered is erosion from contaminated soils in the watershed. Remediation efforts are planned to control the soil contamination at Heizer Creek landfill. This load allocation assumes that soils will be cleaned to a Removal Action Level dioxin concentration of 1.0 ppb (units of TEQ, but treated for allocation purposes as TCDD), resulting in an allowable load of 4.53 ug/day to the Pocatalico River. This same allocation is given to the Kanawha River, because runoff delivered to the Pocatalico River will eventually reach the Kanawha. Additional runoff load of 1.38 ug/day is calculated for the Pocatalico River and subsequently to the Kanawha River from contaminated soils near the Manila Creek landfill. No additional remediation is assumed in allocating this load. Runoff of 4.34 ug/day is calculated for Armour Creek and subsequently to the Kanawha River from contaminated soils at the Midwest Steel site. No additional remediation is assumed in allocating this load.

Table 5-5. Load Allocations to Contaminated Soils (wet weather)

River Segment	Existing Load (ug/day)	Allocated Load (ug/day)	Percent Reduction
Kanawha	88 ug/day	10.25 ug/day	88%
Pocatalico	83 ug/day	5.91 ug/day	93%
Armour	4.34 ug/day	4.34 ug/day	0%

5.3.4 In-place sediment

The final remaining source category is contaminated in-place sediments. With load reductions assigned to all other loading categories, the allowable load for this source category can be calculated from the difference between load capacity and the other allocated sources (plus the Margin of Safety). The resulting allocation is a function of river flow, and is calculated as:

$$LA_{in\text{-}place,\ Kanawha} = \text{Load Capacity} - WLA - LA_{Upstream,\ Kanawha} - LA_{GW,\ Kanawha} - LA_{Soils,\ Kanawha} - MOS$$
$$= 0.00881 \times \text{Kanawha River flow (cfs)} - 27.6 \qquad (5\text{-}4)$$

$$LA_{in\text{-}place,\ Pocatalico} = \text{Load Capacity} - LA_{GW,\ Pocatalico} - LA_{Soils,\ Pocatalico} - MOS$$
$$= 0.0286 \times \text{Pocatalico River flow (cfs)} - 5.92 \qquad (5\text{-}5)$$

$$LA_{in\text{-}place,\ Armour} = \text{Load Capacity} - MOS$$
$$= 0.0286 \times \text{Armour Creek flow (cfs)} - 4.34 \qquad (5\text{-}6)$$

Table 5-6. Load Allocations to in-place Sediments (wet weather)

River Segment	Existing Load	Allocated Load	Percent Reduction
Kanawha	See Table 3-4	See Equation 5-4 = 0 ug/day @1960 cfs = 16 ug/day @5000 cf = 149 ug/day @20000 cfs	>90 %
Pocatalico	NA	See Equation 5-5 = 0 ug/day @0.3 cfs = 8.4 ug/day @500 cfs = 51 ug/day @2000 cfs	NA
Armour	NA	See Equation 5-6 = 0 ug/day @0 cfs = 1.4 ug/day @200 cfs = 13 ug/day @600 cfs	NA

5.4 INCORPORATION OF A MARGIN OF SAFETY

This section addresses the incorporation of a margin of safety (MOS) in the TMDL analysis. The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can either be implicit (e.g., incorporated into the TMDL analysis through conservative assumptions) or explicit (e.g., expressed in the TMDL as a portion of the loadings). This TMDL uses both explicit and implicit components of the Margin of Safety.

An implicit MOS is provided through the use of a conservative dilution model for allocation purposes. This implicit MOS is as protective as possible for modeling purposes (yet not overly conservative, as discussed in Section 4), as it assumes complete conservation of mass. Another component of the implicit margin of safety is the State requirement that the water quality standard for dioxin be met for all flow conditions above the critical minimum flow. This will result in an allowable load much smaller than would be derived using the EPA-recommended harmonic mean flow conditions as the design condition.

An additional explicit Margin of Safety is also provided, to account for uncertainty in loading entering each system across the upstream boundary, as well as other potential dioxin sources not identified during the source assessment. The explicit Margin of Safety is set at 10% of the LA.

5.5 SEASONALITY

Seasonality in the TMDL is addressed by expressing the TMDL in terms of river flow, as changes in flow will be the dominant seasonal environmental factors affecting the TMDL.

6.0 ONGOING ACTIVITIES AND FUTURE MONITORING

The Kanawha River/Pocatalico River/Armour Creek TMDL site data confirm that dioxin concentrations exceed water quality standards. However, additional data are needed to define many of the sources of dioxin entering these systems. For this reason, implementation activities must first focus on better identifying existing sources in order to control them.

This section describes activities that are currently ongoing and/or planned, designed to ensure that the TMDL can be implemented. It is divided into separate sections describing:

Control of watershed sources

Control of contaminated in-place river sediments

Additional monitoring

6.1 CONTROL OF WATERSHED SOURCES

EPA has initiated activity at 16 sites throughout the watershed with the intent of collecting the data necessary to further define the magnitude of dioxin loading from each site and/or identify necessary control actions. In addition to the land sites, monitoring is recommended to define the contribution of the ambient air as a potential source to the watershed.

6.1.1 Armour Creek/Solutia

EPA HSCD will be conducting a Preliminary Assessment (PA) under CERCLA at the site in Summer 2000.

6.1.2 Clark Property

EPA HSCD will be reviewing (PA) available site information in Summer 2000 to determine if any further reassessment of the site is necessary.

6.1.3 Don's Disposal

EPA HSCD will be reviewing (PA) available site information in Summer 2000 to determine if any further reassessment of the site is necessary.

6.1.4 DuPont Belle Plant

EPA's Hazardous Site Cleanup Division's Site Assessment Program will review the current conditions at this property to determine whether it is a possible source or contributor of dioxin to the Kanawha River, Armour Creek or the Pocatalico River. This review will be based on EPA's existing information and new data collected in September 1999.

6.1.5 Fike Chemical Co.

EPA HSCD will be conducting a sampling assessment of stormwater sewers of the Nitro WV area in Summer 2000. Sampling will include collection of sediment and surface water from drainages used by the old CST.

6.1.6 Fleming Landfill

EPA HSCD will be reviewing (PA) available site information in Fall 2000 to determine if any further reassessment of the site is necessary.

6.1.7 George's Creek Landfill

EPA HSCD will be reviewing (PA) available site information in Fall 2000 to determine if any further reassessment of the site is necessary.

6.1.8 Heizer Creek Landfill

EPA HSCD conducted a CERCLA site inspection at the site in May 2000 and is currently awaiting the results of the sampling event. EPA HSCD will determine future remedial actions at the site pending receipt of the SI data.

6.1.9 Kanawha Western Landfill

EPA's Hazardous Site Cleanup Division's Site Assessment Program will review the current conditions at this property to determine whether it is a possible source or contributor of dioxin to the Kanawha River, Armour Creek or the Pocatalico River. This review will be based on EPA's existing information, which had earlier resulted in a Superfund "No Further Response Action Planned" (NFRAP) classification, plus additional information as needed.

6.1.10 Landfill adjacent to Midwest Steel

EPA HSCD will be conducting a sampling assessment (SI) at the site in Fall 2000 to further characterize potential migration of dioxin from the site to Armour Creek.

6.1.11 Manila Creek Landfill

EPA HSCD conducted an Expanded Site Investigation (ESI) at the site in May 2000 which included the installation of four off-site groundwater monitoring wells and collection of samples to determine if dioxin and other contaminates are migrating off site. EPA will determine what actions, if any are necessary upon receipt of the data.

6.1.12 Flexsys Plant Property

EPA HSCD is currently in the process of negotiating a consent order with Solutia to address the removal of drums and dioxin contamination at the part of the facility, formerly owned by AES.

6.1.13 Old Nitro Landfill

EPA HSCD will be conducting a PA of the site in Summer 2000 to determine if any further assessment of the site is necessary.

6.1.14 Poca Strip Mines/Poca Drum Dump

EPA HSCD will be reviewing (PA) available site file information in the Fall 2000 to determine if any further reassessment of the site is necessary.

6.1.15 South Charleston Landfill

EPA HSCD is currently awaiting a health consultation by ATSDR on data collected at the site in September 1999, before determining what future actions if any are necessary at the site.

6.1.16 Union Carbide (Rhone Poulanc) Institute Plant

EPA HSCD will be reviewing (PA) available site file information in the Fall 2000 to determine if any further reassessment of the site is necessary

6.2 CONTROL OF IN-PLACE SEDIMENTS

Resuspension of contaminated in-place sediments has been identified as contributing to violations of water quality standards for dioxin during high flow events. The primary implementation options under consideration are natural attenuation and physical removal of contaminated sediments (e.g. dredging). Natural attenuation processes can include burial of contaminated sediments as cleaner sediments are deposited upon them, and/or the flushing of contaminated sediments out of the system during high flows. Since the data to adequately characterize the site contamination, and dioxin fate and transport pathways in the river, is inadequate the preferred course of action to control in-place sediments is not evident.

Additional monitoring activities are needed to better define the benefits of natural attenuation compared to physical removal of contaminated sediments. These are discussed below.

6.3 ADDITIONAL MONITORING

The EPA and W.Va. will continue to support monitoring, as funds allow, to further identify sources and conditions contributing to dioxin impairments in the Kanawha River, Pocatalico River, and Armour Creek. Monitoring can support further identification of sources or inappropriate discharges, improved understanding of the delivery and transport of dioxin in the area of concern, and tracking of the changes in frequency of violations and degree of impairment. If monitoring information suggests that the TMDL requires revision, the West Virginia and EPA Region III may choose to revise the TMDL analysis or allocation as appropriate.

EPA Superfund Program conducted sediment and water sampling in the Kanawha River in May/June 2000 to further identify hot spots of contamination and to indicate potential source areas of dioxin. EPA anticipates sampling of storm water and industrial discharge outfalls to the Kanawha River in Fall 2000 in an attempt to identify current loading sources of dioxin to the Kanawha River.

Additional data are recommended in three areas to allow implementation of the TMDL and verification that water quality standards are being achieved in response to the TMDL. These areas are: watershed sources, upstream boundary loads, and instream conditions. Monitoring activities intended to identify and quantify watershed sources were discussed previously in the section on control of watershed sources. The remainder of this section discusses monitoring needs for upstream boundary loads and instream conditions.

6.3.1 Upstream Boundary Loads

The existing TMDL is based upon only a single data value describing dioxin concentrations at the upstream boundary of the Kanawha River study area. This data value indicated the presence of dioxin contamination, but provided no information on boundary concentrations in the Pocatalico River, Armour Creek, or the sources or variability in dioxin at the Kanawha upstream boundary. High volume dioxin sampling results in the Coal River, Armour Creek, Bill's Creek, and above Coal River are not yet available for incorporation into this TMDL report.

Additional monitoring could be conducted on a seasonal (e.g. quarterly) basis, and should be structured to include at least one high flow and one low flow period. This will better characterize the magnitude and seasonal variability of boundary concentrations.

With respect to identification of upstream sources, EPA's Removal Program collected a sediment sample in the Coal River for dioxin analysis in the Spring of 1999. EPA's Hazardous Site Cleanup Division's Site Assessment Program will search EPA's CERCLIS data base for any sites in this sub-basin. Based upon the sample results and data base review, EPA will determine whether any additional assessment work or cleanup is necessary.

6.3.2 Instream Conditions

Future data collection in the Pocatalico River, Armour Creek, and Kanawha River systems will be useful in order to monitor trends in dioxin concentration and verify that implementation of controls is leading to compliance with water quality standards. This monitoring could be conducted on a seasonal (e.g. quarterly) basis, and should be structured to include at least one high flow and one low flow period.

Additional monitoring efforts will also be useful in order to perform an assessment of the relative benefits of natural attenuation versus physical removal of contaminated sediments. Components of this monitoring include:

- Characterization of stream hydrology and geomorphology
- Sediment grain size analysis of suspended and bedded sediments
- Sediment core profiles of dioxins and moisture content
- Periodic sampling of dioxin and suspended sediment throughout the system
- High flow event monitoring
- Flume studies to evaluate sediment resuspension
- Sediment core dating

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APPENDIX A

Estimates of Water Column Dioxin Concentrations from Fish Tissue

Only a limited number of water column dioxin concentration measurements are available for the Kanawha River, Pocatalico River, and Armour Creek. A much larger data base of fish tissue dioxin measurements are available. Instream dioxin concentrations were estimated from the available fish tissue dioxin data using the following equation based on the Great Lakes Water Quality Initiative Technical Support Document for the Procedure to Determine Bioaccumulation Factors (EPA, 1995):

$$C_{total}\ pg/L = (10^9) \times (C_{fish\ tissue}\ ug/g) / f_{lipid} / BAF / f_{fd} \qquad (A\text{-}1)$$

Where

$$f_{fd} = 1 / [1 + (POC \times K_{ow} \times 10^{-6}) + (DOC \times K_{ow} / 10 \times 10^{-6})]$$

$$POC = 0.35\ mg/L$$

$$DOC = 2.43\ mg/L$$

$$\log_{10}(K_{ow}\ L/kg) = 7.02$$

$$BAF = 9360000\ L/kg$$

Fish tissue dioxin concentrations were available for 148 samples in the TMDL site. However, many of the other inputs to Equation A-1 were not available for individual samples and needed to be estimated. An average lipid fraction was calculated by specie and substituted where necessary. When the fish specie was not identified for the dioxin tissue concentration, an overall average lipid concentration was used. Average particulate and dissolved organic carbon values were calculated and used throughout the calculations.

The resulting back-calculated water column concentrations (i.e. an estimate of the water column concentration that would lead to the observed fish tissue dioxin concentration) are shown in Figures A-1 through A-3, and compared to the water quality standard. It is recognized that the calculation procedure requires many simplifying assumptions, and each estimate has a high degree of uncertainty associated with it. Nonetheless, the extent to which these back-calculated concentrations exceed the water quality standard strongly imply that the water column water quality standards for dioxin have been routinely exceeded in all three systems.

Figure A-1. Kanawha River Water Column Concentrations from Fish Tissue by Date

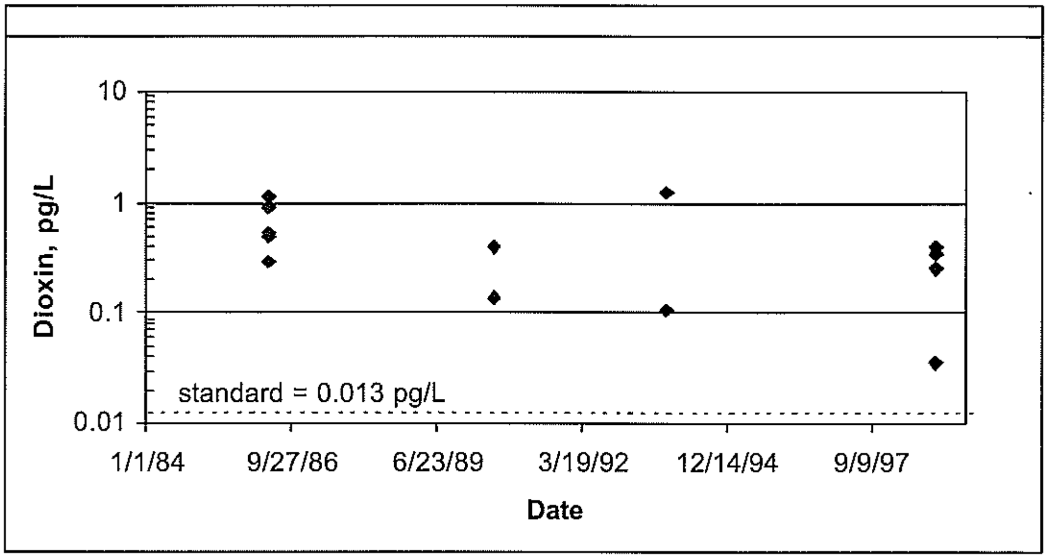

Figure A-2. Pocatalico River

Water Column Concentrations from Fish Tissue by Date

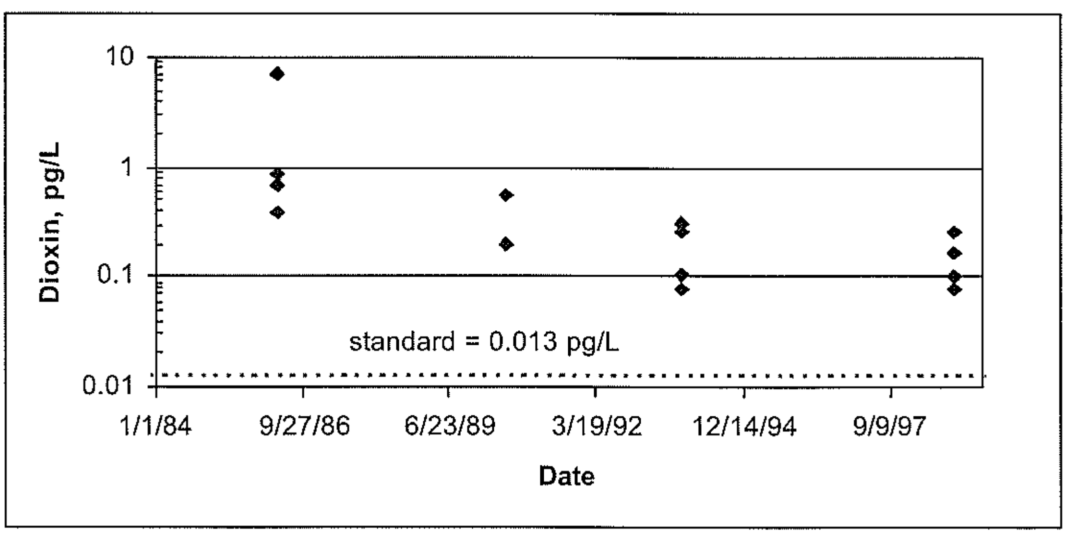

Figure A-3. Armour Creek Water Column Concentrations from Fish Tissue by Date

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APPENDIX B

CONTAMINATED GROUNDWATER

The primary source of dioxin to the Kanawha River at low flows has been preliminarily attributed in this report to contaminated groundwater. No direct data exist quantifying contaminated groundwater loading; rather, this source was selected through the process of elimination of other potential sources. The possibility exists that atmospheric deposition or upstream sources are significant contributors of dioxin. Additional data are required to better define the exact sources of dioxin. These additional data will not significantly change the TMDL, but will be used to better define the implementation plan required to reduce existing sources.

This addendum explains the decision process for selecting contaminated groundwater as a significant source, and potential impacts on the TMDL.

Decision Process

The facts leading to selection of contaminated groundwater are as follows:

1) A large increase in water dioxin concentration is observed at RM 41.3, relative to the upstream boundary at RM 45.5. A mass balance calculation shows that the magnitude of this load ranges from 2700 to 4400 ug/day.

2) Potential sources contributing to this increase include: direct point source discharge; runoff of contaminated soils; atmospheric deposition, diffusion from in-place contaminated sediments; upstream sources; and contaminated groundwater.

3) Direct point sources were eliminated from consideration because no known point sources of dioxin occur in this area.

4) Runoff of contaminated soils was eliminated from consideration because the increases in dioxin were observed during low flow, dry weather periods.

5) Atmospheric deposition was eliminated because the dioxin increase occurred over a localized area, while atmospheric deposition would be expected to have a more diffuse impact. Chapter 6 of this report calls for the need of monitoring studies to better quantify atmospheric deposition.

6) Preliminary mass balance calculations shown in Chapter 3 indicate that diffusion from in-place contaminated sediments could only account for a very small fraction of the observed increase in dioxin.

7) The one available dioxin measurement at the upstream boundary (River Mile 45.5) indicated dioxin concentrations significantly lower that those observed at River Mile 41.3. Because this one measurement may not be representative of overall Kanawha River conditions, Chapter 6 of this report calls for monitoring studies to better quantify upstream sources.

8) Contaminated groundwater was selected as the loading category via the process of elimination. It is recognized that, in the absence of organic solvents, dioxin has very low solubility in water and would not normally be expected to be present in significant quantities in groundwater. Given the heavily industrialized nature of the area and past presence of groundwater contamination, it is quite plausible that dioxin is in solution with contaminated groundwater moving as base flow.

Potential Impact on TMDL

The final TMDL will not be greatly affected whether contaminated groundwater is a major loading category or not. The implementation activities necessary to achieve the TMDL, however, will be highly dependent on the nature of the source.

Groundwater loading of dioxin must be maintained at a level less than or equal to that stated in the load allocation in order for water quality standards to be maintained at low river flows. If contaminated groundwater is not a source of water quality standards violations at low flow, its current magnitude will be less than the load allocation.

Additional data better defining the source of dioxin will directly impact the implementation measures necessary to achieve the TMDL. Source control activities must focus on those sources that are causing the water quality standards violations. Chapter 6 of this report, Ongoing Activities and Future Monitoring, lays out plans for collecting additional data to better define the sources and to guide future implementation activities.

DETERMINATION OF HYDRAULIC CONDUCTIVITY ESTIMATES

In order to determine reasonable estimates of the hydraulic conductivities at the Flexsys Nitro facility a number of historic resources were utilized along with the completion of Slug Tests in a number of the recently installed ERFI wells. In order to assess the sites groundwater resources, the generally accepted site model was adopted and followed. This model was proposed and established during the development of the initial 1995 Remedial Feasibility Investigation report prepared and submitted by Roux Associates, Inc. This model proposed the existence of two rather distinct aquifer units throughout the site. The shallow aquifer, extending from the phreatic surface to a depth averaging 35 feet beneath the ground surface was noted as the shallow unconsolidated unit. This shallow unit (A horizon) was composed primarily of a fine grained silty horizon with lower permeabilities. The lower unit (B horizon) extended from the base of the shallow aquifer to the underlying bedrock horizon (55 to 60 feet below the ground surface). This B horizon exhibited signs of higher permeabilities with unconsolidated strata composed of silty sands. The use of this model was developed primarily due to the drastic difference in the aquifer's hydraulic characteristics. The geology of each of the aquifers is discontinuous and fairly non-homogenous and non-isotropic as would be expected from an alluvial aquifer formed from fluvial deposition. These units are not distinct aquifers separated by impermeable horizons. Leakage and vertical migration of groundwater from the shallow unit likely occurs throughout the facility. The distinct and marked difference in average strata permeabilities requires that each of the horizons be modeled and considered as two separate aquifers.

In the early 1990's, Roux completed a number of slug tests in the existing monitoring wells which were installed throughout the site. This information was included as a appendix in the 1995 RFI report. POTESTA reviewed this information during the development of the ERFI document. Unfortunately, very little was known related to the geologic formations tested during these tests. The well drilling logs obtained for these wells provided very little description. Given the nature of this ERFI study and the site conceptual model developed for the site, additional slug test information was collected at the site.

POTESTA worked to collect additional slug test information utilizing the recently installed ERFI wells. These wells were installed using sonic drilling techniques which resulting in the collection of a continuous soil core sample. Detailed drilling logs from this work were developed which offered detailed insight into the subsurface geology of the site. Given the current use of these wells for the collection of analytical samples, the slug tests methodology was altered. Instead of introducing water, a potential source for cross contamination into the formations, formation water was extracted from each well utilizing the existing bladder pumps to establish a drawdown in each well. After reaching static conditions the pumps were shut off and the recharge rate was measured using a transducer. The resulting rate of recharge was then used to calculate the hydraulic conductivity of the formation.

The following table serves to indicate the results of these recent tests within the shallow (A horizon) aquifer zone:

Table 1: ERFI Shallow Aquifer Conductivity Results

Well	SWL Depth (ft.)	Well Depth (ft.)	Hydraulic Conductivity (ft/day)
Process Area			
GW-3A (PS)	30.40	40	0.214
GW-4A (PS)	27.30	40	0.089
PDA Area			
GW-9A (D/PS)	23.23	37	1.357
GW-11A (D/PS)	29.65	39	1.163
WWTU Area			
GW-13A (D)	26.54	35	0.626
GW-17A (D/PS)	19.82	38	1.0

The RFI hydraulic conductivity data collected during the 1995 study by Roux correlated relatively well with the aforementioned data.

Table 2: 1995 RFI Shallow Aquifer Conductivity Results

Well	SWL Depth (ft.)	Well Depth (ft.)	Hydraulic Conductivity (ft/day)
Process Area			
MW-3A	29.25	35	0.39
MW-4A	27.96	37.5	0.23
MW-5A	26.29	33	0.80
MW-6A	23.17	30	0.11
MW-10	17.65	29.5	24
MW-21A	26.23	41.5	0.21
MW-22R	29.27	40	0.47
			Geo. Mean 0.57
WWTU Area			
WT-5A	23.57	43	14
WT-7A	22.71	33.8	4.5
WT-13A	24.43	34	0.11
TW-1	29.14	45	0.01
TW-2	23.25	42	0.11
TW-5	22.85	30.4	0.99
			Geo. Mean 0.44

This approach was also attempted in the deep aquifer zones (B horizon) however given the higher deliverability of these wells due in part to the much higher permeabilities, sufficient drawdown could not be established in these zones. The minimal drawdown established with the limited pumping rates offered by the small pumps was immediately recharged after the pumps were shut off. The historic RFI data was utilized to determine to estimate the hydraulic conductivities of the deeper aquifer zones.

Table 3: 1995 RFI Deep Aquifer Conductivity Results

Well	SWL Depth (ft.)	Well Depth (ft.)	Hydraulic Conductivity (ft/day)
<u>*Process Area*</u>			
MW-3B	29.02	61.5	8.5
MW-4B	27.91	37.5	2.8
MW-5B	26.73	60	6.1
MW-6B	25.25	58	4.9
MW-21B	25.74	58	13
			Geo. Mean 6.21
<u>WWTU Area</u>			
WT-3	19.33	55	7.2
WT-5B	23.18	60	12
WT-7B	22.47	33.5	5.1
			Geo. Mean 7.61

In the case of both the shallow and deep well horizons, the hydraulic conductivity results were utilized to estimate the potential discharge volume or flux to the adjacent Kanawha River. This was completed using Darcies equation (Q=kiA) where Q=discharge, k=formation hydraulic conductivity, i=hydraulic gradient, and A=cross sectional flow area of the aquifer along the river boundary. Flow estimates were provided for three distinct areas of the facility, these included the river boundary along the Process Area, Past Disposal Area, and the WWTU. The following data was utilized for this calculation in each of the study areas considered:

Process Area (Well GW-4A)

- Length of Riverbank Boundary — 787.5 feet*
- Hydraulic Gradient — 0.00615 ft/ft
- Saturated Thickness of Shallow Aquifer — 11.15 feet
- Hydraulic Conductivity — 0.089 ft./day

* *Apply half of riverbank length to each well location (total length of riverbank in Process Area is 1575 ft.*

Past Disposal Area (Well GW-9A)

- Length of Riverbank Boundary — 300 feet**
- Hydraulic Gradient — 0.00615 ft/ft
- Saturated Thickness of Shallow Aquifer — 11.56 feet
- Hydraulic Conductivity — 1.357 ft/day

Past Disposal Area (Well GW-11A)

- Length of Riverbank Boundary — 300 feet**
- Hydraulic Gradient — 0.00615 ft/ft

- Saturated Thickness of Shallow Aquifer 11.56 feet
- Hydraulic Conductivity 1.163 ft/day

** *Apply one third of riverbank length to each well location (total length of riverbank in Past Disposal Area is 900 ft.*

WWTU Area (Well GW-13A)

- Length of Riverbank Boundary 1050 feet***
- Hydraulic Gradient 0.005 ft/ft
- Saturated Thickness of Shallow Aquifer 13.32 feet
- Hydraulic Conductivity 0.626 ft/day

*** *Apply half of riverbank length to each well location (total length of riverbank in WWTU Area is 2100 ft.*

Using the aforementioned data, the resulting flux to the river from the shallow zone was estimated to be as follows:

Process Area Total Flux (GW-4A)	35.95 gal/day
Past Disposal Area (GW-9A)	216.5 gal/day
Past Disposal Area (GW-10A)	216.5 gal/day
Past Disposal Area (GW-11A)	185.6 gal/day
WWTU Area (GW-14A)	327.5 gal/day

The 1995 hydraulic conductivity data was utilized to estimate the flux to the river from the deep aquifer zones. The aquifer data utilized for these calculations is as follows:

Process Area (Well GW-4B)

- Length of Riverbank Boundary 787.5 feet*
- Hydraulic Gradient 0.00615 ft/ft
- Saturated Thickness of Deep Aquifer 31.19 feet
- Hydraulic Conductivity 6.21 ft./day

* *Apply half of riverbank length to each well location (total length of riverbank in Process Area is 1575 ft.*

Past Disposal Area (Well GW-9B)

- Length of Riverbank Boundary 300 feet**
- Hydraulic Gradient 0.00615 ft/ft
- Saturated Thickness of Deep Aquifer 28.56 feet
- Hydraulic Conductivity 6.21 ft/day

** *Apply one third of riverbank length to each well location (total length of riverbank in Past Disposal Area is 900 ft.*

WWTU Area (Well GW-14B)

- Length of Riverbank Boundary 1050 feet***
- Hydraulic Gradient 0.005 ft/ft

- Saturated Thickness of Deep Aquifer 30.28 feet
- Hydraulic Conductivity 7.61 ft/day

*** *Apply half of riverbank length to each well location (total length of riverbank in WWTU Area is 2100 ft.*

Using the aforementioned data, the resulting flux to the river from the deep zone was estimated to be as follows:

Process Area Total Flux (GW-4A)	7,017 gal/day
Past Disposal Area (GW-9A)	2,447 gal/day
WWTU Area (GW-14A)	9,049 gal/day

ATTACHMENT M.2

SOLUTIA GROUNDWATER LOADING CALCULATON

TCDD TEQ Flux (average soluble) to Kanawha River via the Groundwater Pathway in 2Q08 and 3Q08

Basis - 2008 Supplemental Data Collection- Two rounds of high volume TEQ sampling during 2Q08 and 3Q08

Groundwater Zone / Site Area	GW Flow		AVG TEQ Conc	AVG TEQ Flux		COMMENTS
	gpd	l/day	pg/l	pg/day	ug/day	
A-Shallow Zone Flux						
PA Flux	35.95	136.09	0.067	9.16E+00	0.0000	
PDA Flux(avg)	206.2	780.55	0.153	1.20E+02	0.0001	
WWTU	327.5	1239.72	0.654	8.11E+02	0.0008	
B-Deep Zone Flux						
PA Flux	7017	26562.23	0.008	3.42E+02	0.0003	
PDA Flux	2447	9262.90	0.037	3.42E+02	0.0003	
WWTU	9049	34254.19	0.195	6.68E+03	0.0067	
Total	19,083	72,236			**0.0083**	AVG TCDD TEQ Flux to river in groundwater
					16.5	TMDL TCDD allocated load (ug/day) to contaminated GW @ 7Q10 Flow- June'98 TMDL, Pg 42
					0.05%	AVG TEQ flux as % of allocated TCDD load

TCDD Flux Total - Groundwater plus surface water

	2.4454	ug/d-tcdd (TCDD flux to from Surface Water)
	0.0083	ug/d-tcdd (AverageTCDD flux - as TEQ- from GW)
TOTAL	**2.4537**	ug/day tcdd
	14.9%	Current total TCDD flux to river as % TCDD load allocation (ug/day) ("safe load level) @ 7Q10 Flow- June'98 TMDL, Pg 42 - 16.5 ug/day
	0.07%	Current load from GW plus SW as % of hypothesized TCDD load of 3324 ug/day at 7Q10 flow per TMDL Report

Conversions

3.7854118	Liters per gallon
7.4805	gal per CF
24	hrs/day
60	min/hr
60	sec/min
8.64E+04	sec/day
1.00E-06	ug/pg
2.45	Conversion factor X Conc (pg/l) X Flow Rate (cfs) = ug/day

Basis - 2008 Supplemental Data Collection- Two rounds of high volume TEQ sampling during 2Q08 and 3Q08

<table>
<tr><th colspan="2" rowspan="2">Wells</th><th colspan="3">A Aquifer TEQ Conc (pg/L)</th><th colspan="3">B Aquifer TEQ Conc (pg/L)</th></tr>
<tr><th>2Q08</th><th>3Q08</th><th>Average</th><th>2Q08</th><th>3Q08</th><th>Average</th></tr>
<tr><td rowspan="2">PA</td><td>GW-3</td><td>0.0028</td><td>0.0092</td><td rowspan="2">0.067</td><td>0.0039</td><td>0.0046</td><td rowspan="2">0.008</td></tr>
<tr><td>GW-4</td><td></td><td>0.19</td><td>0.021</td><td>0.0032</td></tr>
<tr><td rowspan="3">PDA</td><td>GW-9</td><td>0.13</td><td>0.16</td><td rowspan="3">0.153</td><td>0.088</td><td>0.083</td><td rowspan="3">0.037</td></tr>
<tr><td>GW-10</td><td>0.22</td><td>0.26</td><td>0.0097</td><td>0.022</td></tr>
<tr><td>GW-11</td><td>0.075</td><td>0.074</td><td>0.016</td><td>0.0029</td></tr>
<tr><td rowspan="6">WTA</td><td>GW-12</td><td>0.062</td><td>0.79</td><td rowspan="6">0.654</td><td>0.88</td><td>0.063</td><td rowspan="6">0.195</td></tr>
<tr><td>GW-13</td><td>0.023</td><td>0.018</td><td>1</td><td>0.039</td></tr>
<tr><td>GW-14</td><td></td><td>5.6</td><td>0.18</td><td>0.071</td></tr>
<tr><td>GW-19</td><td>0.27</td><td>0.28</td><td>0.025</td><td>0.016</td></tr>
<tr><td>GW-18</td><td>0.064</td><td>0.089</td><td>0.0021</td><td>0.0039</td></tr>
<tr><td>GW-17</td><td>0.0013</td><td>0.0012</td><td>0.026</td><td>0.034</td></tr>
</table>

ATTACHMENT M.3

SOLUTIA POINT SOURCE DISCHARGE LOADING CALCULATION

2,3,7,8-TCDD Loading Rate Calculations - via Site Surface Water

	Basis	Assume MDL/2 or Actual Avg TCDD concentration in SW		
Outlet 001				
Avg. Daily Flow	137,000	gpd	518,601	Lpd
	TCDD Conc.	**2.3**	**pg/l**	2006 avg
	Loading Rate	1.19E+00	ug/d	
Oulet 002				
Avg. Daily Flow	3,000	gpd	11,356	Lpd
	TCDD Conc.	**18.5**	**pg/l-tcdd**	Avg results - Dec-06 thru Apr-07
	Loading Rate	2.10E-01	ug/d-tcdd	
Outlet 003				
Avg. Daily Flow	15,000	gpd	56,781	Lpd
	TCDD Conc.	**2.3**	**pg/l-tcdd**	1/2 MDL for 2006
	Loading Rate	1.31E-01	ug/d-tcdd	
Sheet Flow - WTA				
Avg. Daily Flow	13,000	gpd	49,210	Lpd
	TCDD Conc.	**18.5**	**pg/l-tcdd**	1/2 MDL for 2006
	Loading Rate	9.12E-01	ug/d-tcdd	
TCDD Loading TOTALS		**2.445**	**ug/d-tcdd**	**(Maximum flow to river from Surface Water)**

Conversions

3.7854118	Liters per gallon
7.4805	gal per CF
24	hrs/day
60	min/hr
60	sec/min
8.64E+04	sec/day
2.45	Conversion factor X Conc (pg/l) X Flow Rate (cfs) = ug/day

APPENDIX N

SUMMARY OF RISK ESTIMATES BASED ON
WEST VIRGINIA FISH ADVISORY CONSUMPTION GUIDE

APPENDIX N

SUMMARY OF RISK ESTIMATES BASED ON WEST VIRGINIA FISH ADVISORY CONSUMPTION GUIDE

KANAWHA RIVER
NITRO, WEST VIRGINIA

FEBRUARY 2015
REF. NO. 031884 (51) – APPENDIX N
This report is printed on recycled paper.

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LIST OF TABLES
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LIST OF ACRONYMS AND TERMS

2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
AT	averaging time
ATSDR	Agency for Toxic Substances and Disease Registry
BW	body weight
CDI	chronic daily intake
CF	conversion factor
C_{fish}	chemical concentration in fish
COPC	chemical of potential concern
CSF	Cancer Slope Factor
EE/CA	Engineering Evaluation/ Cost Analysis
EPCs	exposure point concentrations
FM	number of fish meals per year
g	gram
HHRA	Human Health Risk Assessment
HQ	hazard quotient
LADD	Lifetime Average Daily Dose
mg/kg	milligrams per kilogram
MS	meal size
ND	non-detect
ng/kg	nanograms per kilogram
oz	ounce
PDRF	preparation dose reduction factor
RfD	reference dose
U.S. EPA	United States Environmental Protection Agency
WV DHHR	West Virginia Department of Health and Human Resources

1.0 INTRODUCTION

A Human Health Risk Assessment (HHRA) has been requested based on fish consumption parameters included in the West Virginia Sport Fish Consumption Advisory Guide (WV DHHR, 2007). Fish advisory methodology including that used by West Virginia Department of Health and Human Resources (WV DHHR) was developed to provide simplified and uniform advice to local populations regarding recommended rates of consumption of locally caught fish. The methodology is based on a standardized meal size of approximately 8 ounces (oz) or 227 grams (g). Consumption rates are included in WV DHHR (2007) for five groups based on a different number of meals/year. **Table N.1** presents the exposure factors included in WV DHHR (2007). Besides fish consumption rates, **Table N.1** also includes other exposure factors needed to calculate potential risk estimates. In particular, WV DHHR (2007) includes preparation dose reduction factors (PDRF) to account for the loss of lipophilic substances from prepared fish meals due to skin removal and cooking loss. These are selected based on the analytical methodology used to collect fish tissue sample data. For example, if the samples were analyzed with the skin on, a PDRF of 0.5 is used to account for chemical of potential concern (COPC) loss with skin removal and cooking. If the samples were analyzed with skin off, a PDRF of 0.7 is used to account for COPC loss due to cooking.

In addition, fish advisories are issued to provide guidance on consumption of specific fish species. For the Engineering Evaluation/Cost Analysis (EE/CA), fish tissue samples were collected for bass, catfish and sauger. To be consistent with WV DHHR (2007), risk estimates were developed for each species. Exposure point concentrations (EPCs) for bass, catfish, and sauger are presented in **Tables N.2, N.3, and N.4**, respectively. Since there were only three sauger composites and two of the analyses were non-detect (ND), the maximum detection limit of 1.15 nanograms per kilogram (ng/kg) was used because this value was higher than the single detection of 0.975 ng/kg.

2.0 EXPOSURE ASSESSMENT

As noted, five groups are included in the WV DHHR (2007) that reflect different intake rates. Intakes were calculated according to the following equation:

$$CDI = \frac{Cfish \times MS \times FM \times CF \times PDRF}{BW \times AT}$$

Where:

CDI	=	chronic daily intake (milligrams per kilogram (mg/kg) body weight-day)
Cfish	=	chemical concentration in fish (mg/kg)
MS	=	meal size - (g/meal)
FM	=	number of fish meals/year (meals/yr)
CF	=	conversion factor (kg/g)
BW	=	body weight (kg)
AT	=	averaging time (days)
PDRF	=	preparation dose reduction factor (unitless)

As noted previously, **Table N.1** presents the exposure factors included in WV DHHR (2007). Tissue samples of bass and sauger were analyzed with the skin on. Therefore, the PDRF for these samples used in the fish advisory HHRA was 0.5. Catfish tissue samples were analyzed with the skin off, and therefore, the PDRF used to develop risk estimates with respect to consumption of catfish was 0.7.

The following table summarizes intake rates for the five consumption groups presented in **Table N.1**. These intakes were obtained from WV DHHR (2007), and form the basis for evaluations presented in this appendix.

Group	*Meals per Year*
1	225
2	52
3	24
4	12
5	6

3.0 TOXICITY ASSESSMENT

As with the assessment included using United States Environmental Protection Agency (U.S. EPA) exposure factors, toxicity values for 2,3,7,8-Tetrachlorodibeno-p-dioxin (2,3,7,8-TCDD) were obtained from the Agency for Toxic Substances and Disease Registry (ATSDR) (ATSDR, 1998) and Cal EPA Toxicity Criteria Database (CalEPA, 2008), consistent with U.S. EPA (2009).

4.0 RISK CHARACTERIZATION

The objective of this risk characterization is to integrate information developed in the exposure and toxicity assessments. As noted previously, the potential for non-cancer health effects from exposure to a COPC is evaluated by comparing a calculated intake over a specified time period to a reference dose (RfD) for a similar time period. This ratio, termed a hazard quotient (HQ), is calculated according to the following general equation:

$$HQ = \frac{CDI}{RfD}$$

where:

HQ = The Hazard Quotient (unitless) is the ratio of the chronic daily intake of a chemical to a reference dose. A hazard quotient equal to or below 1.0 is considered protective of human health.

CDI = The Chronic Daily Intake is the chemical dose or concentration calculated by applying the exposure scenario factors and expressed as mg/(kg-day). The intake represents the average daily chemical dose or concentration over the expected period of exposure.

RfD = The Reference Dose is a daily dose believed not to cause an adverse effect from even a lifetime exposure [mg/(kg-day)].

Cancer risks are calculated utilizing the following general equation:

$$\textbf{\textit{Cancer Risk}} = LADD \times CSF$$

where:

Cancer Risk = Estimated upper bound on additional risk of cancer over a lifetime in an individual exposed to the carcinogen for a specified exposure period (unitless).

LADD = The Lifetime Average Daily Dose of the chemical calculated using exposure scenario factors and expressed in mg/(kg-day) for oral and dermal exposure. The intake represents the total lifetime chemical dose or concentration averaged over an individual's expected lifetime of 70 years.

CSF = The Cancer Slope Factor models the potential carcinogenic response and is expressed as $[mg/(kg\text{-}day)]^{-1}$.

Cancer and noncancer risk estimates for bass are presented in **Table N.5** and summarized below.

Receptor	*Medium*	*Route*	*Group*	*Carcinogenic Risk*	*Risk >10^{-4}*	*Non-Carcinogenic Hazard Quotient*	*HQ >1.0*	*Table Reference*
Recreational Angler	Bass	Ingestion	1	4.3E-04	Yes	3.3E+00	Yes	Table N.5
			2	9.9E-05	No	7.6E-01	No	Table N.5
			3	4.6E-05	No	3.5E-01	No	Table N.5
			4	2.3E-05	No	1.8E-01	No	Table N.5
			5	1.1E-05	No	8.7E-02	No	Table N.5

Cancer and noncancer risk estimates for catfish are presented in **Table N.6** and summarized below.

Receptor	*Medium*	*Route*	*Group*	*Carcinogenic Risk*	*Risk >10^{-4}*	*Non-Carcinogenic Hazard Quotient*	*HQ >1.0*	*Table Reference*
Recreational Angler	Catfish	Ingestion	1	1.5E-03	Yes	1.2E+01	Yes	Table N.6
			2	3.5E-04	Yes	2.7E+00	Yes	Table N.6
			3	1.6E-04	Yes	1.2E+00	Yes	Table N.6
			4	8.1E-05	No	6.2E-01	No	Table N.6
			5	4.0E-05	No	3.1E-01	No	Table N.6

Cancer and noncancer risk estimates for sauger are presented in **Table N.7** and summarized below.

Receptor	*Medium*	*Route*	*Group*	*Carcinogenic Risk*	*Risk >10^{-4}*	*Non-Carcinogenic Hazard Quotient*	*HQ >1.0*	*Table Reference*
Recreational Angler	Sauger	Ingestion	1	1.5E-04	Yes	1.2E+00	Yes	Table N.7
			2	3.5E-05	No	2.7E-01	No	Table N.7
			3	1.6E-05	No	1.2E-01	No	Table N.7
			4	8.0E-06	No	6.1E-02	No	Table N.7
			5	4.0E-06	No	3.1E-02	No	Table N.7

5.0 RISK QUANTIFICATION SUMMARY

Group 1 (no restrictions) cancer risk levels and HQs for bass, catfish, and sauger exceeded WV DHHR (2007) risk targets for 1.0 x 10^{-4} for cancer risk and 1.0 for HQ. The fish advisory intake rate for Group 1 is 225 meals/year each of 227 g for an average daily intake of 140 g/day.

Estimates for all other groups, i.e., Groups 2 through 5 were below WV DHHR risk targets for both bass and sauger. The fish advisory intake rate for Group 2 is one meal/week or 52 meals/year each of 227 g for an average daily intake of 32 g/day.

For catfish, estimates for Groups 4 and 5 were below WV DHHR targets. The fish advisory intake rate for Group 4 is one meal/month or 12 meals/year each of 227 g for an average daily intake of 7.5 g/day.

6.0 SUMMARY AND CONCLUSIONS

The HHRA indicates that consumption of 1 meal/week of bass or sauger and 1 meal/month of catfish are below risk targets presented in WV DHHR (2007).

7.0 REFERENCES

ATSDR, 1998. Toxicological Profile for Chlorinated Dibenzo-p-dioxins (CDDs), Agency for Toxic Substances and Disease Registry, February.

CalEPA, 2008. Cal EPA Toxicity Criteria Database, Office of Environmental Health Hazard Assessment. December 17, 2008. http://oehha.ca.gov/risk/chemicaldb/index.asp

U.S. EPA, 2009. U.S. EPA Region III: Risk-Based Concentration Table, April 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm.

WV DHHR, 2007, West Virginia Sportfish Consumption Advisory Guide (2nd Edition). West Virginia Department of Health and Human Resources. Revised December 2007. Available at:

http://www.wvdhhr.org/fish/FishAdvisorySketch/guide-intro.asp.

TABLE N.1

EXPOSURE FACTORS FROM WEST VIRGINIA SPORT FISH CONSUMPTION ADVISORY GUIDE
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

Scenario Timeframe: Current/Future
Medium: Fish
Exposure Medium: Bass; Catfish, Sauger
Receptor Population: Recreational Anglers
Receptor Age: Adult

Exposure Route	*Parameter Code*	*Parameter Definition*	*Units*	*RME Value*	*RME Rationale/ Reference*	*CT Value*	*CT Rationale/ Reference*	*Intake Equation/ Model Name*
Ingestion	Cfish	Chemical Concentration in Fish	mg/kg	(1)	(1)	--	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	MS	Meal Size	g/meal	227	WVDHHR, 2007	--	--	Cfish x MS x FM x PDRF x CF x 1/BW x 1/AT
	FM	Number of Fish Meals - Group 1	meals/yr	225	WVDHHR, 2007	--	--	
	FM	Number of Fish Meals - Group 2	meals/yr	52	WVDHHR, 2007	--	--	
	FM	Number of Fish Meals - Group 3	meals/yr	24	WVDHHR, 2007	--	--	
	FM	Number of Fish Meals - Group 4	meals/yr	12	WVDHHR, 2007	--	--	
	FM	Number of Fish Meals - Group 5	meals/yr	6	WVDHHR, 2007	--	--	
	CF	Conversion Factor	kg/g	0.001	--	--	--	
	BW	Body Weight	kg	70	WVDHHR, 2007	--	--	
	AT	Averaging Time	days	365	WVDHHR, 2007	--	--	
	PDRF-off	Preparation Dose Reduction Factor - Bottom Dwellers (Skin Off)	unitless	0.7	WVDHHR, 2007 (2)	--	--	
	PDRF-on	Preparation Dose Reduction Factor - Non-Bottom Dwellers (Skin On)	unitless	0.5	WVDHHR, 2007 (3)	--	--	

Notes:
(1) For concentration in Bass, refer to Table N.2. For concentration in Catfish, refer to Table N.3. For concentration in Sauger refer to Table N.4.
(2) PDRF for Catfish.
(3) PDRF for Bass and Sauger.

Sources:
WVDEP, 1997: West Virginia Voluntary Remediation and Redevelopment Act Guidance Manual Version 2.1. 1997.
WVDHHR, 2007: West Virginia Sport Fish Consumption Advisory Guide 2nd Edition. Revised: December 12, 2007.

TABLE N.2

EXPOSURE POINT CONCENTRATION (EPC) SUMMARY FOR CHEMICALS OF POTENTIAL CONCERN IN FISH - BASS

EE/CA REPORT

KANAWHA RIVER, WEST VIRGINIA

Scenario Timeframe: Current/Future
Medium: Fish
Exposure Medium: Bass

Chemical of Potential Concern	*Units*	*Arithmetic Mean*	*Statistic Rationale*	*Maximum Detected Concentration*	*Maximum Qualifier*	*EPC Units*	*Reasonable Maximum Exposure*			*Central Tendency*		
							Medium EPC Value	*Medium EPC Statistic*	*Medium EPC Rationale*	*Medium EPC Value*	*Medium EPC Statistic*	*Medium EPC Rationale*
<u>*Dioxins*</u>												
2,3,7,8-TCDD	ng/kg	2.41E+00	(1)	1.26E+01		ng/kg	3.29E+00	95% UCL-NP	(1), (2)	2.40E+00	Average	(1), (2)

<u>Notes:</u>

Data set evaluated using USEPA's ProUCL 4.00.04

US EPA ProUCL: User Guide EPA/600/R-07/038 February 2009; Software http://www.epa.gov/esd/tsc/TSC_form.htm

For data sets with multiple detection limits, ProUCL recommends use of the Kaplan-Meier method.

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-L);

95% UCL of Gamma distributed data (95% UCL-G); Non-parametric method used to Determine 95% UCL (95% UCL-NP).

(1) ProUCL calculated or recommended value.

(2) Statistic included in Exposure Factors submitted for regulatory review.

TABLE N.3

EXPOSURE POINT CONCENTRATION (EPC) SUMMARY FOR CHEMICALS OF POTENTIAL CONCERN IN FISH - CATFISH

EE/CA REPORT

KANAWHA RIVER, WEST VIRGINIA

Scenario Timeframe: Current/Future
Medium: Fish
Exposure Medium: Catfish

Chemical of Potential Concern	*Units*	*Arithmetic Mean*	*Statistic Rationale*	*Maximum Detected Concentration*	*Maximum Qualifier*	*EPC Units*	*Reasonable Maximum Exposure*			*Central Tendency*		
							Medium EPC Value	*Medium EPC Statistic*	*Medium EPC Rationale*	*Medium EPC Value*	*Medium EPC Statistic*	*Medium EPC Rationale*
<u>*Dioxins*</u>												
2,3,7,8-TCDD	ng/kg	3.94E+00	(1)	1.95E+01		ng/kg	8.32E+00	95% UCL-G	(1), (2)	3.94E+00	Average	(1), (2)

<u>Notes:</u>

Data set evaluated using US EPA's ProUCL 4.00.04

US EPA ProUCL: User Guide EPA/600/R-07/038 February 2009; Software http://www.epa.gov/esd/tsc/TSC_form.htm

For data sets with multiple detection limits, ProUCL recommends use of the Kaplan-Meier method.

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-L);

95% UCL of Gamma distributed data (95% UCL-G); Non-parametric method used to Determine 95% UCL (95% UCL-NP).

(1) ProUCL calculated or recommended value.

(2) Statistic included in Exposure Factors submitted for regulatory review.

TABLE N.4

EXPOSURE POINT CONCENTRATION (EPC) SUMMARY FOR CHEMICALS OF POTENTIAL CONCERN IN FISH - SAUGER
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

Scenario Timeframe: Current/Future
Medium: Fish
Exposure Medium: Sauger

Chemical of Potential Concern	*Units*	*Arithmetic Mean*	*Statistic Rationale*	*Maximum Detected Concentration*	*Maximum Qualifier*	*EPC Units*	*Reasonable Maximum Exposure*			*Central Tendency*		
							Medium EPC Value	*Medium EPC Statistic*	*Medium EPC Rationale*	*Medium EPC Value*	*Medium EPC Statistic*	*Medium EPC Rationale*
Dioxins												
2,3,7,8-TCDD	ng/kg	1.15E+00	(1)	9.75E-01		ng/kg	1.15E+00	(2)	(1), (3)	1.15E+00	Average	(1), (3)

Notes:
Data set evaluated using US EPA's ProUCL 4.00.04
US EPA ProUCL: User Guide EPA/600/R-07/038 February 2009; Software http://www.epa.gov/esd/tsc/TSC_form.htm
For data sets with multiple detection limits, ProUCL recommends use of the Kaplan-Meier method.
Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-L);
95% UCL of Gamma distributed data (95% UCL-G); Non-parametric method used to Determine 95% UCL (95% UCL-NP).
(1) There were only three samples, which is too few for development of EPCs by ProUCL. EPC repesents highest detection limit, which exceeded the single dection of 0.975 ng/kg.
(2) EPC repesents highest detection limit.
(3) Statistic included in Exposure Factors submitted for regulatory review.

TABLE N.5

CALCULATION OF CHEMICAL CANCER RISK AND NON-CANCER HAZARD QUOTIENT BASED ON SPORT FISH CONSUMPTION ADVISORY GUIDE FOR CURRENT/FUTURE RECREATIONAL ANGLER - BASS
REASONABLE MAXIMUM EXPOSURE
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

Scenario Timeframe: Current/Future
Receptor Population: Recreational Angler
Receptor Age: Adult

Medium	*Exposure Medium*	*Exposure Point*	*Exposure Route*	*Chemical of Potential Concern*	*EPC*		*Group*	*Cancer Risk Calculations*					*Non-Cancer Hazard Calculations*				
					Value	*Units*		*Intake/Exposure Concentration*		*CSF/Unit Risk*		*Cancer Risk*	*Intake/Exposure Concentration*		*RfD/RfC*		*Hazard Quotient*
								Value	*Units*	*Value*	*Units*		*Value*	*Units*	*Value*	*Units*	
Fish	Bass	Kanawha River	Ingestion	2,3,7,8-TCDD	3.29E+00	ng/kg	1	3.29E-09	mg/kg-d	1.30E+05	$(mg/kg\text{-}d)^{-1}$	4.27E-04	3.29E-09	mg/kg-d	1.00E-09	mg/kg-d	3.29E+00
							2	7.60E-10	mg/kg-d	1.30E+05	$(mg/kg\text{-}d)^{-1}$	9.88E-05	7.60E-10	mg/kg-d	1.00E-09	mg/kg-d	7.60E-01
							3	3.51E-10	mg/kg-d	1.30E+05	$(mg/kg\text{-}d)^{-1}$	4.56E-05	3.51E-10	mg/kg-d	1.00E-09	mg/kg-d	3.51E-01
							4	1.75E-10	mg/kg-d	1.30E+05	$(mg/kg\text{-}d)^{-1}$	2.28E-05	1.75E-10	mg/kg-d	1.00E-09	mg/kg-d	1.75E-01
							5	8.77E-11	mg/kg-d	1.30E+05	$(mg/kg\text{-}d)^{-1}$	1.14E-05	8.77E-11	mg/kg-d	1.00E-09	mg/kg-d	8.77E-02

TABLE N.6

CALCULATION OF CHEMICAL CANCER RISK AND NON-CANCER HAZARD QUOTIENT BASED ON SPORT FISH CONSUMPTION ADVISORY GUIDE FOR CURRENT/FUTURE RECREATIONAL ANGLER - CATFISH
REASONABLE MAXIMUM EXPOSURE
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

Scenario Timeframe: Current/Future
Receptor Population: Recreational Angler
Receptor Age: Adult

Medium	*Exposure Medium*	*Exposure Point*	*Exposure Route*	*Chemical of Potential Concern*	*EPC*		*Group*	*Cancer Risk Calculations*					*Non-Cancer Hazard Calculations*				
								Intake/Exposure Concentration		*CSF/Unit Risk*		*Cancer Risk*	*Intake/Exposure Concentration*		*RfD/RfC*		*Hazard Quotient*
					Value	*Units*		*Value*	*Units*	*Value*	*Units*		*Value*	*Units*	*Value*	*Units*	
Fish	Catfish	Kanawha River	Ingestion	2,3,7,8-TCDD	8.32E+00	ng/kg	1	1.16E-08	mg/kg-d	1.30E+05	$(mg/kg\text{-}d)^{-1}$	1.51E-03	1.16E-08	mg/kg-d	1.00E-09	mg/kg-d	1.16E+01
							2	2.69E-09	mg/kg-d	1.30E+05	$(mg/kg\text{-}d)^{-1}$	3.50E-04	2.69E-09	mg/kg-d	1.00E-09	mg/kg-d	2.69E+00
							3	1.24E-09	mg/kg-d	1.30E+05	$(mg/kg\text{-}d)^{-1}$	1.61E-04	1.24E-09	mg/kg-d	1.00E-09	mg/kg-d	1.24E+00
							4	6.21E-10	mg/kg-d	1.30E+05	$(mg/kg\text{-}d)^{-1}$	8.07E-05	6.21E-10	mg/kg-d	1.00E-09	mg/kg-d	6.21E-01
							5	3.10E-10	mg/kg-d	1.30E+05	$(mg/kg\text{-}d)^{-1}$	4.04E-05	3.10E-10	mg/kg-d	1.00E-09	mg/kg-d	3.10E-01

TABLE N.7

CALCULATION OF CHEMICAL CANCER RISK AND NON-CANCER HAZARD QUOTIENT BASED ON SPORT FISH CONSUMPTION ADVISORY GUIDE FOR CURRENT/FUTURE RECREATIONAL ANGLER - SAUGER

REASONABLE MAXIMUM EXPOSURE

EE/CA REPORT

KANAWHA RIVER, WEST VIRGINIA

Scenario Timeframe: Current/Future
Receptor Population: Recreational Angler
Receptor Age: Adult

Medium	*Exposure Medium*	*Exposure Point*	*Exposure Route*	*Chemical of Potential Concern*	*EPC*		*Group*	*Cancer Risk Calculations*					*Non-Cancer Hazard Calculations*				
					Value	*Units*		*Intake/Exposure Concentration*		*CSF/Unit Risk*		*Cancer Risk*	*Intake/Exposure Concentration*		*RfD/RfC*		*Hazard Quotient*
								Value	*Units*	*Value*	*Units*		*Value*	*Units*	*Value*	*Units*	
Fish	Sauger	Kanawha River	Ingestion	2,3,7,8-TCDD	1.15E+00	ng/kg	1	1.15E-09	mg/kg-d	1.30E+05	$(mg/kg\text{-}d)^{-1}$	1.49E-04	1.15E-09	mg/kg-d	1.00E-09	mg/kg-d	1.15E+00
							2	2.66E-10	mg/kg-d	1.30E+05	$(mg/kg\text{-}d)^{-1}$	3.45E-05	2.66E-10	mg/kg-d	1.00E-09	mg/kg-d	2.66E-01
							3	1.23E-10	mg/kg-d	1.30E+05	$(mg/kg\text{-}d)^{-1}$	1.59E-05	1.23E-10	mg/kg-d	1.00E-09	mg/kg-d	1.23E-01
							4	6.13E-11	mg/kg-d	1.30E+05	$(mg/kg\text{-}d)^{-1}$	7.97E-06	6.13E-11	mg/kg-d	1.00E-09	mg/kg-d	6.13E-02
							5	3.07E-11	mg/kg-d	1.30E+05	$(mg/kg\text{-}d)^{-1}$	3.98E-06	3.07E-11	mg/kg-d	1.00E-09	mg/kg-d	3.07E-02

APPENDIX O

REVIEW OF RARE, THREATENED, AND ENDANGERED SPECIES

DIVISION OF NATURAL RESOURCES
Wildlife Resources Section
Operations Center
P.O. Box 67
Elkins, West Virginia 26241-3235
Telephone (304) 637-0245
Fax (304) 637-0250

Joe Manchin III
Governor

Frank Jezioro
Director

January 23, 2009

Ms. Amy MacCausland
Conestoga-Rovers & Associates
410 Eagleview Boulevard, Suite 110
Exton, PA 19341

Dear Ms. MacCausland:

We have reviewed our files for information on rare, threatened and endangered (RTE) species and sensitive habitats for the area of Monsanto Company's Kanawha River site in Kanawha and Putnam counties, WV.

We have several records for rare species along the Kanawha River in this area, which includes an area known as Winfield Swamp. In addition to the rare species, the backwater areas associated with tributaries of the Kanawha River are important breeding and feeding areas for a variety of wildlife. The following plant communities and rare species occur along the Kanawha River from the Coal River to the Winfield Locks and Dam:

Decodon verticillatus semi-permanently flooded shrubland – Water willow shrub swamp
Quercus palustris-Quercus bicolor-(Liquidambar styraciflua) mixed hardwood forest – Pin oak mixed hardwood forest

Carex typhina – Cat-tail sedge
Phoxinus erythrogaster – Southern redbelly dace
Potamogeton pulchra – spotted pondweed
Pycnanthemum muticum – Blunt mountain-mint
Sida hermaphrodita – Virginia mallow
Triadenum tubulosum – Large marsh St. John's-wort
Wolffia columbiana – Columbia water-meal
Zapus hudsonius – Meadow jumping mouse

This response is based on information currently available and should not be considered a comprehensive survey of the area under review.

The information provided above is the product of a database search and retrieval. This information does not satisfy other consultation or permitting requirements for disturbances to the natural resources of the state. If your project will directly impact the waters of the state or cause a a "take" of fish and/or wildlife, consultation may be required. Requests for WV wildlife agency consultation should be directed to Mr. Roger Anderson at the address given in the letterhead or by email at rogeranderson@wvdnr.gov. Database requests for information on RTE species and sensitive habitats should still be directed to me.

Thank you for your inquiry, and should you have any questions please feel free to contact me at the above number, extension 2048. Enclosed please find an invoice.

Sincerely,

Barbara Sargent
Environmental Resources Specialist
Wildlife Diversity Program

enclosure

S:\Monthly\Barb\Invoices\CRA.doc

Polan, Heather

From: Sargent, Barbara D [Barbara.D.Sargent@wv.gov]
Sent: Thursday, November 29, 2012 11:34 AM
To: Polan, Heather
Subject: RE: Information Request (31884)

Heather—

I reviewed the current map for the Monsanto Company's EE/CA study area on a 14-mile portion of the Kanawha River in the Nitro area. This project was previously reviewed in January 2009. There is no new information on rare, threatened and endangered species for this area, and my 2009 letter remains accurate.

Please let me know if you require more information.

Barbara

Barbara Sargent
WVDNR – Wildlife Resources Section
Wildlife Diversity Unit
PO Box 67 – Ward Road
Elkins, WV 26241
304/637-0245 (voice)
304/637-0250 (fax)
www.wvdnr.gov

"There are some who can live without wild things and some who cannot."
--Aldo Leopold

From: Polan, Heather [mailto:hpolan@craworld.com]
Sent: Thursday, November 29, 2012 9:04 AM
To: Sargent, Barbara D
Cc: Project Email Hold; Lawlor, Laura
Subject: Information Request (31884)

Hi Barbara,

As per our recent conversation, please find the attached information request for rare, threatened and endangered species. If you have any questions feel free to contact me. Thank you,

Heather

Heather Polan, BES.
Conestoga-Rovers & Associates (CRA)
651 Colby Drive
Waterloo, Ontario N2V 1C2

Phone: 519.884.0510
Fax: 519.884.5256

Cell: 519.571.7699
Email: hpolan@craworld.com
www.CRAworld.com

APPENDIX P

SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT
ANALYTICAL DATA TABLES

TABLE P.1

ANALYTICAL DATA SUMMARY- SURFACE WATER
KANAWHA RIVER, WEST VIRGINIA

RM	*Sample ID*	***Sample Date***	***2,3,7,8 TCDD Results (pg/sample)***	***Sample Volume Filtered***	***2,3,7,8-TCDD Results (pg/L)***	***Notes***
RM 31	***SW-31884-DL-10/19/04-003A***	***10/19/2004***	5.96 J	1000	0.00596	Dissolved
RM 31	***SW-31884-DL-4/14/05-004A***	***4/14/2005***	14	1000	0.01400	Dissolved
RM 31	***SW-31884-DL-4/14/05-004B***	***4/14/2005***	48.9	1000	0.04890	Particulate
RM 31	***SW-31884-DL-10/19/04-003B***	***10/19/2004***	46.3	1000	0.04630	Particulate
RM 33	***SW-31884-DL-10/14/04-004A***	***10/14/2004***	10.9	1000	0.01090	Dissolved
RM 33	***SW-31884-DL-4/15/05-004A***	***4/15/2005***	10.3	997	0.01033	Dissolved
RM 33	***SW-31884-DL-4/15/05-004B***	***4/15/2005***	33.5	997	0.03360	Particulate
RM 33	***SW-31884-DL-10/14/04-004B***	***10/14/2004***	15.6	1000	0.01560	Particulate
RM 42	***SW-31884-DL-10/13/04-004A***	***10/13/2004***	5.33 J	756	0.00705	Dissolved
RM 42	***SW-31884-DL-10/13/04-004B***	***10/13/2004***	3.78 J	756	0.00500	Particulate
RM 42	***SW-31884-DL-10/13/04-005A***	***10/13/2004***	5.36 J	756	0.00709	Dissolved, Duplicate
RM 42	***SW-31884-DL-4/16/05-005A***	***4/16/2005***	9.67 J	1003	0.00964	Dissolved
RM 42	***SW-31884-DL-4/16/05-005B***	***4/16/2005***	7.98 J	1003	0.00796	Particulate
RM 42	***SW-31884-DL-4/16/05-006A***	***4/16/2005***	9.69 J	1003	0.00966	Dissolved, Duplicate
RM 42	***SW-31884-DL-4/16/05-006B***	***4/16/2005***	119	1003	0.11864	Particulate, Duplicate
RM 46	***SW-31884-DL-10/12/04-001A***	***10/12/2004***	0.874 J	1000	0.00087	Dissolved
RM 46	***SW-31884-DL-4/13/05-004A***	***4/13/2005***	ND (2.20)	994	0.00111	Dissolved
RM 46	***SW-31884-DL-4/13/05-004B***	***4/13/2005***	8.48 J	994	0.00853	Particulate
RM 46	***SW-31884-DL-10/12/04-001B***	***10/12/2004***	ND (1.27) U	1000	0.00064	Particulate
RM 68	***SW-31884-DL-10/18/04-004A***	***10/18/2004***	1.12 J	1000	0.00112	Dissolved
RM 68	***SW-31884-DL-4/12/05-004A***	***4/12/2005***	ND (1.90)	1008	0.00094	Dissolved
RM 68	***SW-31884-DL-4/12/05-004B***	***4/12/2005***	6.40 J	1008	0.00635	Particulate
RM 68	***SW-31884-DL-10/18/04-004B***	***10/18/2004***	ND (0.753) U	1000	0.00038	Particulate

Notes:
pg/L - picograms per liter
ND - Not detected at or above the associated value
J - Estimated concentration

TABLE P.2

ANALYTICAL DATA SUMMARY- SURFACE SEDIMENT
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

Location	Sample ID	*Sample Date*	*Study Area*	*Sample Depth (inches)*	*2,3,7,8 TCDD Results (pg/g)*	*Total Organic Carbon (mg/kg)*	*Percent Solids (%)*	*Notes*
COR-43	SE-031884-112807-DD-006	11/28/2007	Study Area 1	0 - 3	ND (0.82)	9100	69.7	
SSD-26	SE-031884-112807-DD-004	11/28/2007	Study Area 1	0 - 3.5	2.9	25600	58.8	
SSD-26	SE-031884-112807-DD-005	11/28/2007	Study Area 1	0 - 3.5	1.4	21800	60.7	Duplicate
SSD-27	SE-031884-112807-DD-003	11/28/2007	Study Area 1	0 - 2	ND (0.87)	24700	54.1	
SSD-28	SE-031884-112807-DD-002	11/28/2007	Study Area 1	0 - 2	ND (0.79)	29500	55.4	
SSD-29	SE-031884-112807-DD-001	11/28/2007	Study Area 1	0 - 2	ND (0.62)	21000	72.2	
RM 68	SD-31884-10302004-KD-204	10/30/2004	Study Area 1	surface grab	ND (0.36)	---	---	Composite Sample (KD-021 to KD025)
RM 68	SD-31884-10302004-KD-205	10/30/2004	Study Area 1	surface grab	ND (0.31)	---	---	Composite Sample (KD-026 to KD030)
COR-33	SE-031884-112907-DD-019	11/29/2007	Study Area 2	0 - 3	15	24200	47.4	
COR-34	SE-031884-112907-DD-018	11/29/2007	Study Area 2	0 - 4	21	10800	33.1	
COR-35	SE-031884-112907-DD-017	11/29/2007	Study Area 2	0 - 1	55	27300	58.9	
COR-36	SE-031884-112907-DD-016	11/29/2007	Study Area 2	0 - 4	5.6	31900	60.5	
COR-37	SE-031884-112807-DD-015	11/28/2007	Study Area 2	0 - 3	3.1	101000	73.1	
COR-38	SE-031884-112807-DD-012	11/28/2007	Study Area 2	0 - 3	250	14200	60.4	
COR-39	SE-031884-112807-DD-011	11/28/2007	Study Area 2	0 - 3	3400 J	16000	65.5	
COR-40	SE-031884-112807-DD-010	11/28/2007	Study Area 2	surface grab	59	27000	59	
COR-41	SE-031884-112807-DD-009	11/28/2007	Study Area 2	0 - 2.5	ND (0.6)	2400	78.4	
COR-42	SE-031884-112807-DD-007	11/28/2007	Study Area 2	0 - 3.5	ND (1.7)U	28000	58.4	MS/MSD
SSD-23	SE-031884-112807-DD-014	11/28/2007	Study Area 2	0 - 1	74	31500	43.4	
SSD-24	SE-031884-112807-DD-013	11/28/2007	Study Area 2	0 - 2	ND (1.7)U	3100	69	
SSD-25	SE-031884-112807-DD-008	11/28/2007	Study Area 2	0 - 4	ND (0.98)	27500	46.8	
RM 42	SD-31884-10282004-KD-202	10/28/2004	Study Area 2	surface grab	71	---	---	Composite Sample (KD-011 to KD015)
RM 42	SD-31884-10292004-KD-203	10/29/2004	Study Area 2	surface grab	24	---	---	Composite Sample (KD-016 to KD020)
COR-24	SE-031884-113007-DD-037	11/30/2007	Study Area 3	0 - 4	4.3	3300	71	
COR-25	SE-031884-112907-DD-031	11/29/2007	Study Area 3	0 - 3	1.1	10800	63.2	
COR-25	SE-031884-112907-DD-032	11/29/2007	Study Area 3	0 - 3	2	9900	60.6	Duplicate
COR-26	SE-031884-112907-DD-030	11/29/2007	Study Area 3	0 - 3.5	2.6	2100	74.2	
COR-27	SE-031884-112907-DD-028	11/29/2007	Study Area 3	0 - 3	13	3800	72.8	
COR-28	SE-031884-112907-DD-027	11/29/2007	Study Area 3	0 - 1	8.8	14400	66.3	
COR-29	SE-031884-112907-DD-025	11/29/2007	Study Area 3	0 - 3	1.3	9700	80.5	
COR-30	SE-031884-112907-DD-024	11/29/2007	Study Area 3	0 - 1.5	13	13900	64.8	
COR-31	SE-031884-112907-DD-023	11/29/2007	Study Area 3	0 - 4	3.9	7600	69.7	
COR-32	SE-031884-112907-DD-021	11/29/2007	Study Area 3	0 - 4	12	23900	62.2	
SSD-15	SE-031884-113007-DD-036	11/30/2007	Study Area 3	0 - 2	12	16500	60.3	
SSD-16	SE-031884-113007-DD-035	11/30/2007	Study Area 3	0 - 4	5.5	31100	55.9	
SSD-17	SE-031884-113007-DD-034	11/30/2007	Study Area 3	0 - 3	35	22000	55.1	
SSD-19	SE-031884-112907-DD-029	11/29/2007	Study Area 3	0 - 1	1.8	1300	79	
SSD-21	SE-031884-112907-DD-022	11/29/2007	Study Area 3	0 - 1	10	8250	66.2	
SSD-22	SE-031884-112907-DD-020	11/29/2007	Study Area 3	0 - 4	15	12900	72.7	
COR-01	SE-031884-120207-DD-071	12/2/2007	Study Area 4	0 - 6	14	30600	42.4	
COR-02	SE-031884-120207-DD-070	12/2/2007	Study Area 4	0 - 3	48	16000	78.8	
COR-03	SE-031884-120207-DD-068	12/2/2007	Study Area 4	0 - 4	10	33400	65.6	
COR-04	SE-031884-120107-DD-067	12/1/2007	Study Area 4	0 - 4	7.3	40000	64	
COR-05	SE-031884-120107-DD-065	12/1/2007	Study Area 4	0 - 4	20	2300	75.8	
COR-05	SE-031884-120107-DD-066	12/1/2007	Study Area 4	0 - 4	5.7	2300	78	Duplicate
COR-06	SE-031884-120107-DD-062	12/1/2007	Study Area 4	0 - 2	3.1	1400	74.5	
COR-07	SE-031884-120107-DD-063	12/1/2007	Study Area 4	0 - 5	48	31800	56.1	
COR-08	SE-031884-120107-DD-061	12/1/2007	Study Area 4	0 - 5	4.1	31100	44.8	
COR-09	SE-031884-120107-DD-059	12/1/2007	Study Area 4	0 - 4	14	39100	55.4	
COR-10	SE-031884-120107-DD-058	12/1/2007	Study Area 4	0 - 4	ND (3.8) U	7000	78.8	
COR-11	SE-031884-120107-DD-057	12/1/2007	Study Area 4	0 - 5	10	32000	55	
COR-12	SE-031884-120107-DD-056	12/1/2007	Study Area 4	0 - 5	23	30400	55.1	
COR-13	SE-031884-120107-DD-055	12/1/2007	Study Area 4	0 - 4	10	12700	71.2	
COR-14	SE-031884-120107-DD-054	12/1/2007	Study Area 4	0 - 2	12	26500	48	
COR-15	SE-031884-120107-DD-053	12/1/2007	Study Area 4	0 - 6	ND (6.9) U	30300	47.1	MS/MSD
COR-16	SE-031884-120107-DD-052	12/1/2007	Study Area 4	0 - 2	ND (5.2) U	27900	62.1	
COR-17	SE-031884-120107-DD-051	12/1/2007	Study Area 4	0 - 3	ND (2.8 U)	4100	81.4	
COR-18	SE-031884-120107-DD-049	12/1/2007	Study Area 4	0 - 2	ND (7.2) U	19700	56.5	
COR-19	SE-031884-113007-DD-044	11/30/2007	Study Area 4	0 - 4	12	29900	61.2	
COR-20	SE-031884-113007-DD-042	11/30/2007	Study Area 4	0 - 4	9	33500	45.7	
COR-20	SE-031884-113007-DD-043	11/30/2007	Study Area 4	0 - 4	9.4	31400	44.5	Duplicate
COR-21	SE-031884-113007-DD-041	11/30/2007	Study Area 4	0 - 2	23	32800	48.6	
COR-22	SE-031884-113007-DD-040	11/30/2007	Study Area 4	0 - 4	56	19100	63	
COR-23	SE-031884-113007-DD-039	11/30/2007	Study Area 4	0 - 2.5	66	15900	56.1	
SSD-01	SE-031884-120207-DD-075	12/2/2007	Study Area 4	0 - 2	2.6	2100	71.6	
SSD-02	SE-031884-120207-DD-074	12/2/2007	Study Area 4	0 - 3	6.5	32100	52.7	
SSD-03	SE-031884-120207-DD-073	12/2/2007	Study Area 4	0 - 4	4.6	24700	55.4	
SSD-04	SE-031884-120207-DD-072	12/2/2007	Study Area 4	0 - 4	4.1	23700	62.6	
SSD-05	SE-031884-120207-DD-069	12/2/2007	Study Area 4	0 - 4	24	59300	51.2	MS/MSD
SSD-06	SE-031884-120107-DD-064	12/1/2007	Study Area 4	0 - 6	38	30300	40.3	
SSD-07	SE-031884-120107-DD-060	12/1/2007	Study Area 4	0 - 3	17	4600	77.2	
SSD-09	SE-031884-120107-DD-050	12/1/2007	Study Area 4	0 - 2	ND (25) U	20000	49.3	
SSD-10	SE-031884-113007-DD-048	11/30/2007	Study Area 4	0 - 4	3.8	22600	59.4	
SSD-12	SE-031884-113007-DD-046	11/30/2007	Study Area 4	0 - 3	15	27500	62.1	
SSD-13	SE-031884-113007-DD-045	11/30/2007	Study Area 4	0 - 4	38	33200	49.7	
SSD-14	SE-031884-113007-DD-038	11/30/2007	Study Area 4	0 - 3	23	10400	65.3	
RM 33	SD-31884-10282004-KD-200	10/28/2004	Study Area 4	surface grab	15	---	---	Composite Sample (KD-001 to KD005)
RM 33	SD-31884-10282004-KD-201	10/28/2004	Study Area 4	surface grab	280	---	---	Composite Sample (KD-006 to KD010)

Notes:

Results for sample locations SSD-11, SSD-18, and SSD-20 were excluded from the screening as they were not collected from the main stem of the River.

-- Parameter not analyzed

pg/g - picograms per gram

mg/kg - milligrams per kilogram

ND - Non-detect

J - Estimated concentration

U - Analyte was analyzed for but not detected above the reporting limit.

TABLE P.3

ANALYTICAL DATA SUMMARY- PCBs IN SEDIMENT
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

Location Name		*COR-08*	*COR-22*	*COR-28*	*COR-33*	*COR-36*	*COR-36*	*COR-39*	*COR-39*
Sample ID		*SE-031884-121307-DD-280*	*SE-031884-121007-DD-181*	*SE-031884-120807-DD-176*	*SE-031884-120607-DD-128*	*SE-031884-120507-DD-124*	*SE-031884-120507-DD-125*	*SE-031884-120407-DD-083*	*SE-031884-120407-DD-084*
Sample Date		*12/13/2007*	*12/10/2007*	*12/8/2007*	*12/6/2007*	*12/5/2007*	*12/5/2007*	*12/4/2007*	*12/4/2007*
Sample Depth (inches)		*24-48*	*24-49*	*0-24*	*0-21*	*24-48*	*48-72*	*0-17*	*17-33.5*
Location		*Study Area 4*	*Study Area 4*	*Study Area 3*	*Study Area 2*	*Study Area 2*	*Study Area 2*	*Study Area 2*	*Study Area 2*
	Units								
PCBs									
Aroclor-1016 (PCB-1016)	ug/kg	ND(54)	ND(56)	ND(44)	ND(48)	ND(55)	ND(56)	ND(3400)	ND(5400)
Aroclor-1221 (PCB-1221)	ug/kg	ND(54)	ND(56)	ND(44)	ND(48)	ND(55)	ND(56)	ND(3400)	ND(5400)
Aroclor-1232 (PCB-1232)	ug/kg	ND(54)	ND(56)	ND(44)	ND(48)	ND(55)	ND(56)	ND(3400)	ND(5400)
Aroclor-1242 (PCB-1242)	ug/kg	ND(54)	ND(56)	ND(44)	ND(48)	46 J	ND(56)	ND(3400)	ND(5400)
Aroclor-1248 (PCB-1248)	ug/kg	89	39 J	ND(44)	ND(48)	ND(55)	530	3000 J	75000
Aroclor-1254 (PCB-1254)	ug/kg	ND(54)	ND(56)	ND(44)	31 J	39 J	ND(56)	ND(3400)	ND(5400)
Aroclor-1260 (PCB-1260)	ug/kg	67	ND(56)	ND(44)	ND(48)	ND(55)	ND(56)	ND(3400)	14000
total (including half DL)	ug/kg	291	207	154	175	222.5	698	13200	102500
Total Organic Carbon (TOC)	%	--	--	--	--	--	--	--	--
Total Organic Carbon (TOC)	ug/kg	72200000 Q	102000000 Q	5400000	27900000	69500000 Q	80200000 Q	83900000 Q	79200000 Q
Total Solids	%	60.6 Dup 60.6	59.2 Dup 59.2	74.2 Dup 74.2	68.8 Dup 68.8	60.4 Dup 60.4	58.5 Dup 58.5	49.2 Dup 49.2	61.4 Dup 49.2

Notes:
ND - Not detected at or above the associated value
J - Estimated concentration
ug/kg - micrograms per kilogram
Q - Elevated reporting limit. The reporting limit is elevated due to high analyte levels.

TABLE P.4

ANALYTICAL DATA SUMMARY- SUBSURFACE SEDIMENT
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

Station ID	Sample ID	Sample Date	Study Area	Sample Interval (ft)	2,3,7,8 TCDD (pg/g)	Total Organic Carbon (mg/kg)	Percent Solids (%)	Notes
COR-41	SE-031884-120407-DD-081	12/4/2007	Study Area 2	0-1	ND (1.6) U	17900	74.6	
COR-25	SE-031884-120807-DD-178	12/8/2007	Study Area 3	0-1.17	ND (0.45)	14400	68.9	
COR-16	SE-031884-022308-DD-407A/B/C	2/23/2008	Study Area 4	0-1.33	0.76J, 0.76J, 0.77J	20,800, 23,100, 49,500 Q	99.8, 100, 100	
COR-42	SE-031884-120908-SG-001	12/3/2007	Study Area 2	0-1.38	ND(1.1)U	14000	68.4	
COR-39	SE-031884-120407-DD-083	12/4/2007	Study Area 2	0-1.42	22000 J	83900 Q	49.2	
COR-42	SE-031884-120908-SG-002	12/9/2007	Study Area 2	0-1.438	1.8	16000	68.6	Duplicate
COR-15	SE-031884-022308-DD-406A/B/C	2/23/2008	Study Area 4	0-1.58	13, 4.2, 4.9	33,600 Q, 10,600, 14,600	99.2, 99.6, 99.7	
COR-33	SE-031884-120607-DD-128	12/6/2007	Study Area 2	0-1.75	190	27900	68.8	
COR-12	SE-031884-121507-DD-334	12/15/2007	Study Area 4	0-1.83	2	10800	69.2	
COR-43	SE-031884-120307-DD-077	12/3/2007	Study Area 2	0-2	ND (0.22)	4480	76.8	
COR-38	SE-031884-120407-DD-085	12/4/2007	Study Area 2	0-2	8.7	8100	73.5	
COR-40	SE-031884-120407-DD-079	12/4/2007	Study Area 2	0-2	10	68700 Q	62.4	
COR-40	SE-031884-120908-SG-003	12/9/2007	Study Area 2	0-2	49	42000	67.0	
COR-35	SE-031884-120507-DD-086	12/5/2007	Study Area 2	0-2	3.6	31400	67.2	
COR-35	SE-031884-120507-DD-087	12/5/2007	Study Area 2	0-2	3	30900	66.5	Duplicate
COR-36	SE-031884-120507-DD-123	12/5/2007	Study Area 2	0-2	27	42700	65.3	
COR-36	SE-031884-121008-SG-007	12/10/2007	Study Area 2	0-2	150	43000	64.5	
COR-30	SE-031884-120707-DD-175	12/7/2007	Study Area 3	0-2	ND (0.36)	1800	78.1	
COR-28	SE-031884-120807-DD-176	12/8/2007	Study Area 3	0-2	ND (0.4)	5400	74.2	
COR-18	SE-031884-121107-DD-221	12/11/2007	Study Area 4	0-2	ND (0.47) U	5700	76.4	
COR-20	SE-031884-121107-DD-218	12/10/2007	Study Area 4	0-2	14	30600	56.2	
COR-21	SE-031884-121007-DD-213	12/10/2007	Study Area 4	0-2	2700 J	63800 Q	58.2	
COR-21	SE-031884-121007-DD-214	12/10/2007	Study Area 4	0-2	2300 J	65000 Q	55.2	Duplicate
COR-22	SE-031884-121007-DD-180	12/10/2007	Study Area 4	0-2	3000 J	110000 Q	58.8	
COR-04	SE-031884-121207-DD-269	12/12/2007	Study Area 4	0-2	13	34700	67.4	
COR-03	SE-031884-121307-DD-274	12/13/2007	Study Area 4	0-2	8.3	27300	64.4	
COR-08	SE-031884-121307-DD-279	12/13/2007	Study Area 4	0-2	9.3	24700	65.2	
COR-07	SE-031884-121407-DD-282	12/14/2007	Study Area 4	0-2	ND (0.31)	8000	70.8	
COR-09	SE-031884-121507-DD-332	12/15/2007	Study Area 4	0-2	8.6	36700	63.9	
COR-11	SE-031884-121507-DD-331	12/15/2007	Study Area 4	0-2	150	31700	59.6	
COR-23	SE-031884-120807-DD-179	12/8/2007	Study Area 4	0-2.25	ND (0.52)	28600	64.9	
COR-42	SE-031884-120307-DD-078	12/3/2007	Study Area 2	0-2.42	ND (0.26)	17500	69.4	
COR-39	SE-031884-120407-DD-084	12/4/2007	Study Area 2	1.4-2.79	33000 J	79200 Q	49.2	
COR-41	SE-031884-120407-DD-082	12/4/2007	Study Area 2	1-2.08	ND (0.49)	9400	75.2	
COR-30	SE-031884-120707-DD-174	12/7/2007	Study Area 3	2-2.5	2.1	4900	80.3	
COR-20	SE-031884-121107-DD-219	12/11/2007	Study Area 4	2-2.63	52	32900	60.9	
COR-09	SE-031884-121507-DD-333	12/15/2007	Study Area 4	2-2.83	ND (0.55)	42900	65.9	
COR-07	SE-031884-121407-DD-283	12/14/2007	Study Area 4	2-3	ND (0.27)	7400	73.6	
COR-40	SE-031884-120407-DD-080	12/4/2007	Study Area 2	2-3.3	8.1	84300 Q	67.1	
COR-22	SE-031884-121007-DD-181	12/10/2007	Study Area 4	2-4.1	1100 J	102000 Q	59.2	
COR-40	SE-031884-120908-SG-004	12/9/2007	Study Area 2	2-4	ND(0.74)U	38000	67.3	
COR-35	SE-031884-120507-DD-088	12/5/2007	Study Area 2	2-4	ND (0.34)	12600	70.1	
COR-36	SE-031884-120507-DD-124	12/5/2007	Study Area 2	2-4	3300 J	69500 Q	60.4	
COR-36	SE-031884-121008-SG-008	12/10/2007	Study Area 2	2-4	2300 J	78000	63.9	
COR-36	SE-031884-121008-SG-009	12/10/2007	Study Area 2	2-4	1600 J	70000	63.4	Duplicate
COR-21	SE-031884-121007-DD-215	12/10/2007	Study Area 4	2-4	88	55600 Q	64.6	
COR-04	SE-031884-121207-DD-270	12/12/2007	Study Area 4	2-4	9.8	43100	58.8	
COR-03	SE-031884-121307-DD-275	12/13/2007	Study Area 4	2-4	11	40500	57	
COR-08	SE-031884-121307-DD-280	12/13/2007	Study Area 4	2-4	1400 J	72200 Q	60.6	
COR-35	SE-031884-120507-DD-089	12/5/2007	Study Area 2	4-4.5	ND (0.38)	20800	69.3	
COR-40	SE-031884-120908-SG-005	12/9/2007	Study Area 2	4-5.5	ND(0.30)	26000	73.1	
COR-36	SE-031884-120507-DD-125	12/5/2007	Study Area 2	4-6	18000 J	80200 Q	58.5	
COR-36	SE-031884-121008-SG-010	12/10/2007	Study Area 2	4-6	25000 J	82000	61.0	
COR-21	SE-031884-121007-DD-216	12/10/2007	Study Area 4	4-6.5	1.8	40900	64.3	
COR-04	SE-031884-121207-DD-271	12/12/2007	Study Area 4	4-6	8.6	50400 Q	63.1	
COR-03	SE-031884-121307-DD-276	12/13/2007	Study Area 4	4-6.8	19	45900	59.8	
COR-36	SE-031884-121008-SG-011	12/10/2007	Study Area 2	6-8	3800 J	43000	69.6	
COR-36	SE-031884-121008-SG-012	12/10/2007	Study Area 2	8-9	210	27000	73.1	

Notes:
pg/g - picograms per gram
mg/kg - milligrams per kilogram
Q - Elevated reporting limit. The reporting limit is elevated due to high analyte levels.
ND - Not detected at or above the associated value
J - Estimated concentration

TABLE P.5

ANALYTICAL DATA SUMMARY- GIZZARD SHAD
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

Sample ID	*Sample Date*	*Location*	*2,3,7,8-TCDD (ng/kg)*	*Lipids (%)*	*Lipid normalized concentration*
TISS-031884-101404-DK-013	10/14/2004	RM 33	4.50	2.39	1.88
TISS-031884-101404-DK-014	10/14/2004	RM 33	3.69	2.07	1.78
TISS-031884-101404-DK-015	10/14/2004	RM 33	7.53	2.61	2.89
TISS-031884-101404-DK-016	10/14/2004	RM 33	3.40	1.97	1.73
TISS-031884-101404-DK-017	10/14/2004	RM 33	3.35	2.63	1.27
TISS-031884-101404-DK-019	10/14/2004	RM 33	5.72	2.56	2.23
TISS-031884-101404-DK-020	10/14/2004	RM 33	5.99	2.54	2.36
TISS031884-121708-DFK-016	12/17/2008	RM 33	15.8	7.39	2.14
TISS031884-121708-DFK-017	12/17/2008	RM 33	7.07	6.9	1.02
TISS031884-121708-DFK-018	12/17/2008	RM 33	13.7	8.15	1.68
TISS031884-121708-DFK-019	12/17/2008	RM 33	16.1	6.35	2.54
TISS031884-121708-DFK-020	12/17/2008	RM 33	16.1	6.76	2.38
TISS-031884-101304-DK-003	10/13/2004	RM 42	1.50	1.8	0.83
TISS-031884-101304-DK-004	10/13/2004	RM 42	6.70	2.15	3.12
TISS-031884-101304-DK-005	10/13/2004	RM 42	0.877 J	2.14	0.41
TISS-031884-101304-DK-006	10/13/2004	RM 42	1.59	1.94	0.82
TISS-031884-101304-DK-007	10/13/2004	RM 42	5.98	2.49	2.40
TISS031884-121608-DFK-003	12/16/2008	RM 42	9.05	6.31	1.43
TISS031884-121608-DFK-004	12/16/2008	RM 42	7.1	6.13	1.16
TISS031884-121608-DFK-005	12/16/2008	RM 42	4.22	6.05	0.70
TISS031884-121608-DFK-006	12/16/2008	RM 42	5.2	6.45	0.81
TISS031884-121608-DFK-007	12/16/2008	RM 42	7.93	5.32	1.49
TISS-031884-101604-DK-036	10/16/2004	RM 68	1.44	3.73	0.39
TISS-031884-101804-DK-037	10/18/2004	RM 68	2.10	3.19	0.66
TISS-031884-102104-DK-038	10/21/2004	RM 68	0.511 J	3.13	0.16
TISS-031884-102104-DK-039	10/21/2004	RM 68	0.222 J	4.56	0.05
TISS-031884-111704-DFK-051	11/17/2004	RM 68	0.936 J	4.6	0.20
TISS-031884-111704-DFK-052	11/17/2004	RM 68	0.307 J	5.02	0.06
TISS031884-121808-DFK-031	12/18/2008	RM 68	ND (1.22) U	10.9	0.06
TISS031884-121808-DFK-032	12/18/2008	RM 68	0.191 J	9.65	0.02
TISS031884-122208-DFK-033	12/22/2008	RM 68	0.185 J	9.48	0.02
TISS031884-122208-DFK-034	12/22/2008	RM 68	0.387 J	7.22	0.05
TISS031884-122208-DFK-035	12/22/2008	RM 68	0.195 J	10.5	0.02

Notes:
J - Concentration less than LMCL
ND - Not detected at or above the associated value

TABLE P.6

ANALYTICAL DATA SUMMARY- BASS
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

Sample ID	*Sample Date*	*Location*	*2,3,7,8-TCDD (ng/kg)*	*Lipids (%)*	*Lipid normalized concentration*
TISS-031884-101404-DK-023	10/14/2004	RM 33	4.46	0.52	8.58
TISS-031884-101404-DK-024	10/14/2004	RM 33	2.83	0.51	5.55
TISS-031884-101404-DK-025	10/14/2004	RM 33	2.72	0.5	5.44
TISS-031884-101504-DK-026	10/15/2004	RM 33	1.37	0.76	1.80
TISS-031884-101504-DK-027	10/15/2004	RM 33	1.74	0.45	3.87
TISS031884-121708-DFK-021	12/17/2008	RM 33	1.44	0.34	4.24
TISS031884-121708-DFK-022	12/17/2008	RM 33	2.14	0.31	6.90
TISS031884-121708-DFK-023	12/17/2008	RM 33	1.7	0.29	5.86
TISS031884-121708-DFK-024	12/17/2008	RM 33	1.22	0.26	4.69
TISS031884-121708-DFK-025	12/17/2008	RM 33	1.28	0.3	4.27
TISS-031884-101204-DK 001	10/12/2004	RM 42	3.58	0.28	12.79
TISS-031884-101304-DK-011	10/13/2004	RM 42	4.02	0.39	10.31
TISS-031884-101304-DK-012	10/13/2004	RM 42	3.52	0.42	8.38
TISS-031884-101504-DK-033	10/15/2004	RM 42	1.79	0.53	3.38
TISS-031884-101504-DK-034	10/15/2004	RM 42	2.04	0.48	4.25
TISS031884-121708-DFK-001	12/17/2008	RM 42	1.71	0.4	4.28
TISS031884-121708-DFK-002	12/17/2008	RM 42	5.68	0.54	10.52
TISS031884-121708-DFK-008	12/17/2008	RM 42	4.77	0.67	7.12
TISS031884-121708-DFK-009	12/17/2008	RM 42	7.17	0.49	14.63
TISS031884-121708-DFK-010	12/17/2008	RM 42	12.6	0.78	16.15
TISS-031884-101604-DK-041	10/16/2004	RM 68	ND (0.221) U	0.38	0.29
TISS-031884-101604-DK-042	10/16/2004	RM 68	0.469 J	0.3	1.56
TISS-031884-101604-DK-043	10/16/2004	RM 68	ND (0.178) U	0.26	0.34
TISS-031884-101804-DK-044	10/18/2004	RM 68	0.365 J	0.65	0.56
TISS-031884-101804-DK-045	10/18/2004	RM 68	ND (0.077) U	0.31	0.12
TISS031884-121808-DFK-026	12/18/2008	RM 68	ND (0.989) U	0.21	2.35
TISS031884-121808-DFK-027	12/18/2008	RM 68	ND (1.13) U	0.21	2.69
TISS031884-121808-DFK-028	12/18/2008	RM 68	ND (0.97) U	0.15	3.23
TISS031884-121808-DFK-029	12/18/2008	RM 68	ND (1.13) U	0.12	4.71
TISS031884-121808-DFK-030	12/18/2008	RM 68	ND (1.14) U	0.81	0.70

Notes:
J - Concentration less than LMCL
ND - Not detected at or above the associated value

TABLE P.7

ANALYTICAL DATA SUMMARY- CATFISH AND SAUGER
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

Sample ID	*species*	*Sample Date*	*Location*	*2,3,7,8-TCDD (ng/kg)*	*Lipids (%)*	*lipid normalized concentration*
TISS-031884-101204-DK 002	***catfish***	***10/12/2004***	***RM 33-45***	19.5	3.05	6.39
TISS-031884-101304-DK-008	***catfish***	***10/13/2004***	***RM 33-45***	3.34	1.20	2.78
TISS-031884-101304-DK-009	***catfish***	***10/13/2004***	***RM 33-45***	1.33	2.26	0.59
TISS-031884-101304-DK-010	***catfish***	***10/13/2004***	***RM 33-45***	6.07	2.51	2.42
TISS-031884-101504-DK-035	***catfish***	***10/15/2004***	***RM 33-45***	4.02	0.77	5.22
TISS031884-121708-DFK-011	***catfish***	***12/17/2008***	***RM 33-45***	8.58	1.08	7.94
TISS031884-121708-DFK-012	***catfish***	***12/17/2008***	***RM 33-45***	2.09	0.94	2.22
TISS031884-121708-DFK-013	***catfish and sauger***	***12/17/2008***	***RM 33-45***	36.2	1.18	30.68
TISS031884-121708-DFK-014	***catfish and sauger***	***12/17/2008***	***RM 33-45***	2.53	1.07	2.36
TISS031884-121708-DFK-015	***sauger***	***12/17/2008***	***RM 33-45***	0.975	1.31	0.74
TISS-031884-102104-DK-046	***catfish***	***10/21/2004***	***RM 75-95***	0.635	2.13	0.30
TISS-031884-102104-DK-047	***catfish***	***10/21/2004***	***RM 75-95***	0.251 J	4.85	0.05
TISS-031884-111704-DFK-050	***catfish***	***11/17/2004***	***RM 75-95***	0.300 J	2.91	0.10
TISS031884-121808-DFK-036	***sauger***	***12/18/2008***	***RM 75-95***	ND (1.15) U	0.49	1.17
TISS031884-121808-DFK-037	***sauger***	***12/18/2008***	***RM 75-95***	ND (1.11) U	0.39	1.42
TISS-031884-102204-DK-048	***catfish***	***10/22/2004***	***RM 95***	0.736 J	2.24	0.33
TISS-031884-102204-DK-049	***catfish***	***10/22/2004***	***RM 95***	0.462 J	2.20	0.21

Notes:
ND - Not detected at or above the associated value

APPENDIX Q

SURFACE WEIGHTED AVERAGE CONCENTRATION CALCULATION METHODOLOGY

APPENDIX Q

SURFACE WEIGHTED AVERAGE CONCENTRATION CALCULATION METHODOLOGY

KANAWHA RIVER
NITRO, WEST VIRGINIA

FEBRUARY 2015
REF. NO. 031884 (51) – APPENDIX Q
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LIST OF ACRONYMS

2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
CA	Corrective Action
EOC	Extent of Contamination
EVS	Environmental Visualization System
River	Kanawha River
RCRA	Resource Conservation and Recovery Act
Site	Kanawha River Site
SWAC	Surface Weighed Average Concentration
U.S. EPA	United States Environmental Protection Agency

1.0 GENERAL APPROACH

Surface-weighted Average Concentrations (SWACs) were determined for a number of different boundary conditions corresponding to fish migration boundaries and exposure scenarios. The boundary conditions are consistent with home ranges of target fish species (bottom feeders and sport fish). The home range for bottom feeders includes the entire length of the Study Area. The home range for sport fish is shorter than the length of the Study Area. Therefore, SWACs for sport fish were calculated based on the length of their home ranges. A 3-mile home range was selected to represent a conservative home range for the target fish species. A rolling 3-mile SWAC in half mile increments was calculated for the Site based on surficial sediment 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) concentrations. The 1/2-mile increments for which SWACs were calculated are identified on Figure Q.1.

Within each 3-mile reach, SWAC calculations focused on areas in which receptor species would be exposed to sediment deposits, to ensure concentrations are not impacted by areas which are not subject to exposure. Specifically, the center channel area of the river which is primarily bare rock or coarse-grained sediment deposits was not included in the SWAC calculations, as inclusion of these areas would inappropriately bias the results low. SWACs were calculated for backwater areas from tributaries discharging into the river. SWACs for the 1/2-mile increment into which they discharged are presented both including and excluding the backwater areas.

2.0 SWAC CALCULATION METHOD

Prior to calculating the SWACs, the database of surficial samples was reviewed to address non-detect and duplicate results. Non-detect values were replaced with concentrations at one-half of the detection limit. In any cases where split samples or field duplicate sample results are available, these values were averaged prior to any statistical or geostatistical computations.

Boundary conditions were established laterally at riverbanks, home range boundaries and the mouths of tributaries, and at sediment deposit limits. Boundaries for backwater areas were established laterally at the tributary banks and extended upstream from the Kanawha River to either the limit of the backwater area or the limit of the backwater area where data existed to calculate the SWAC, whichever was encountered first.

Six adjacent 1/2-mile increments were combined to form a 3-mile reach. The distribution of 2,3,7,8-TCDD in each 3- mile reach is described by producing a three-dimensional contour map using commercial software, Environmental Visualization System (EVS). Contouring was performed by kriging routines using a method appropriate for the observed data distribution

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(e.g., normal, lognormal, gamma-distributed, etc.). The distribution was confirmed prior to the kriging to confirm an appropriate approach. The kriging performs surface weighting, as each grid node on the map was based on a weighed average, median or other statistic based on the kriging model used. Statistical outliers were identified and screened and boundary conditions finalized prior to this process.

The kriged data was used to estimate a baseline SWAC and upper confidence level bound on this value for each area from the contoured model. The remedial action alternatives were developed and tested to assess effectiveness in reducing the SWAC of each area.

If a remedial scenario includes capping of portions of the remaining in-place sediments, then the capping material was assumed to have a concentration of 2,3,7,8-TCDD consistent with the upstream background concentration.

3.0 INPUT DATA

Tables Q.1 through Q.29.present the data utilized for SWAC calculation for each of the rolling 1/2-mile reaches, moving from upstream to downstream from Half-Mile 2 through Half-Mile 30. There was no surficial sediment data within Half-Mile 1. Post implementation SWACs associated with the capping alternative evaluated for the Site removed data points within the capped area, replacing those data points with upstream background concentrations.

Surficial sediment data was included in this data set from four sources:

- Phase I and II Extent of Contamination (EOC) Study data collected as part of this Project
- Historic data obtained as part of the file search completed to support EE/CA Work Plan development
- United States Environmental Protection Agency (U.S. EPA) data collected in 2000
- Data collected by Solutia as part of the Resource Conservation and Recovery Act (RCRA) Corrective Action (CA) Program investigation of the Former Flexsys Facility colleted in 2001

4.0 SWAC CALCULATION RESULTS

Output data from the SWAC determination for the rolling 3-mile reaches is presented on Figures Q.2 and Q.3 for the existing condition and the capping scenario, respectively. Scenarios both including and excluding backwater areas are included. The results are summarized below.

The SWAC for the 3-mile reach from River Mile (RM) 39 to RM 42 exhibited the highest existing condition SWAC (0.022 µg/kg). Four areas were identified for active remediation. Following remediation the highest calculated SWAC concentration is estimated to be 0.009 µg/kg in the 3-mile reach from RM 34.5 to RM 37.5.

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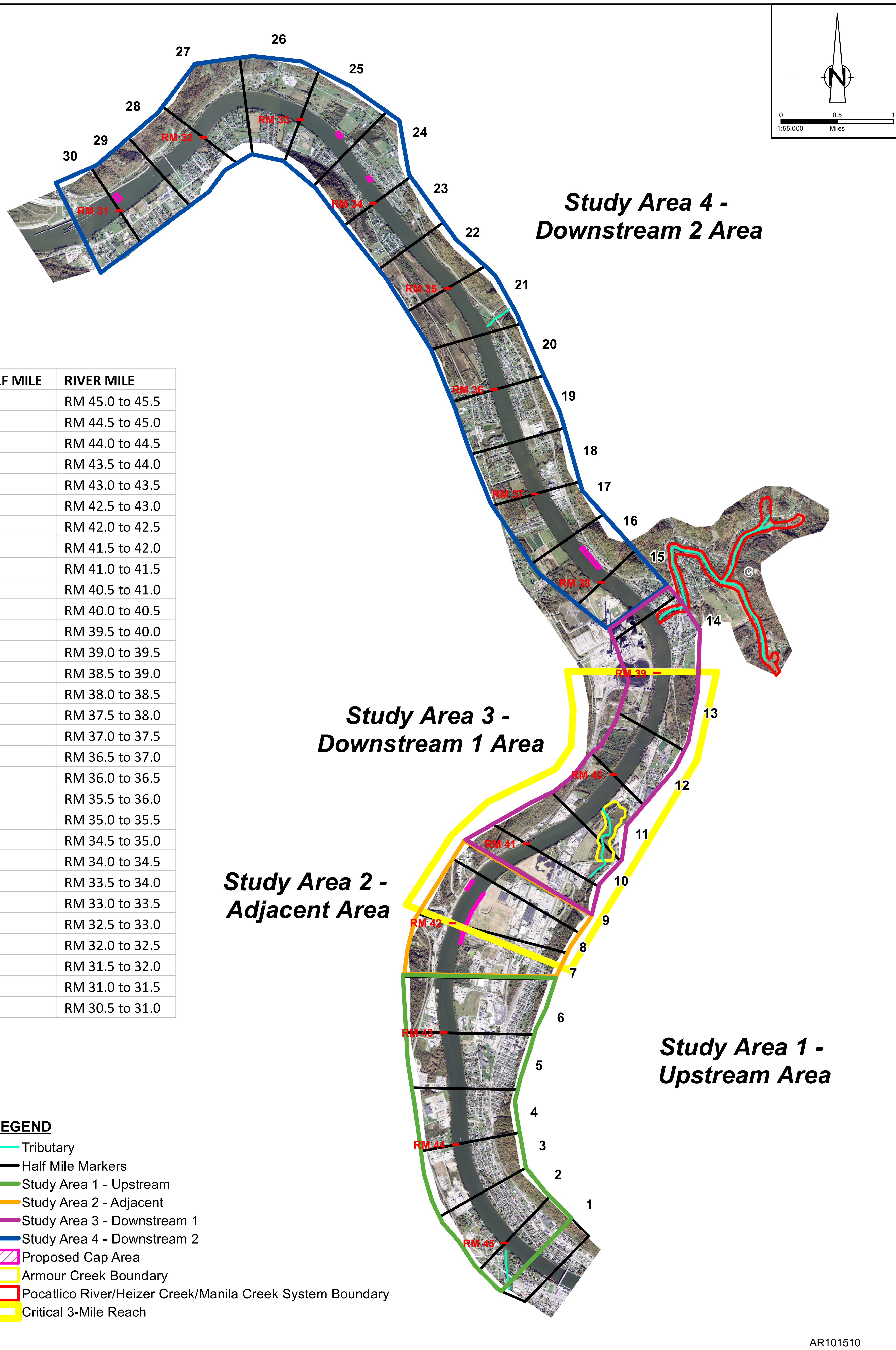


HALF MILE	RIVER MILE
1	RM 45.0 to 45.5
2	RM 44.5 to 45.0
3	RM 44.0 to 44.5
4	RM 43.5 to 44.0
5	RM 43.0 to 43.5
6	RM 42.5 to 43.0
7	RM 42.0 to 42.5
8	RM 41.5 to 42.0
9	RM 41.0 to 41.5
10	RM 40.5 to 41.0
11	RM 40.0 to 40.5
12	RM 39.5 to 40.0
13	RM 39.0 to 39.5
14	RM 38.5 to 39.0
15	RM 38.0 to 38.5
16	RM 37.5 to 38.0
17	RM 37.0 to 37.5
18	RM 36.5 to 37.0
19	RM 36.0 to 36.5
20	RM 35.5 to 36.0
21	RM 35.0 to 35.5
22	RM 34.5 to 35.0
23	RM 34.0 to 34.5
24	RM 33.5 to 34.0
25	RM 33.0 to 33.5
26	RM 32.5 to 33.0
27	RM 32.0 to 32.5
28	RM 31.5 to 32.0
29	RM 31.0 to 31.5
30	RM 30.5 to 31.0

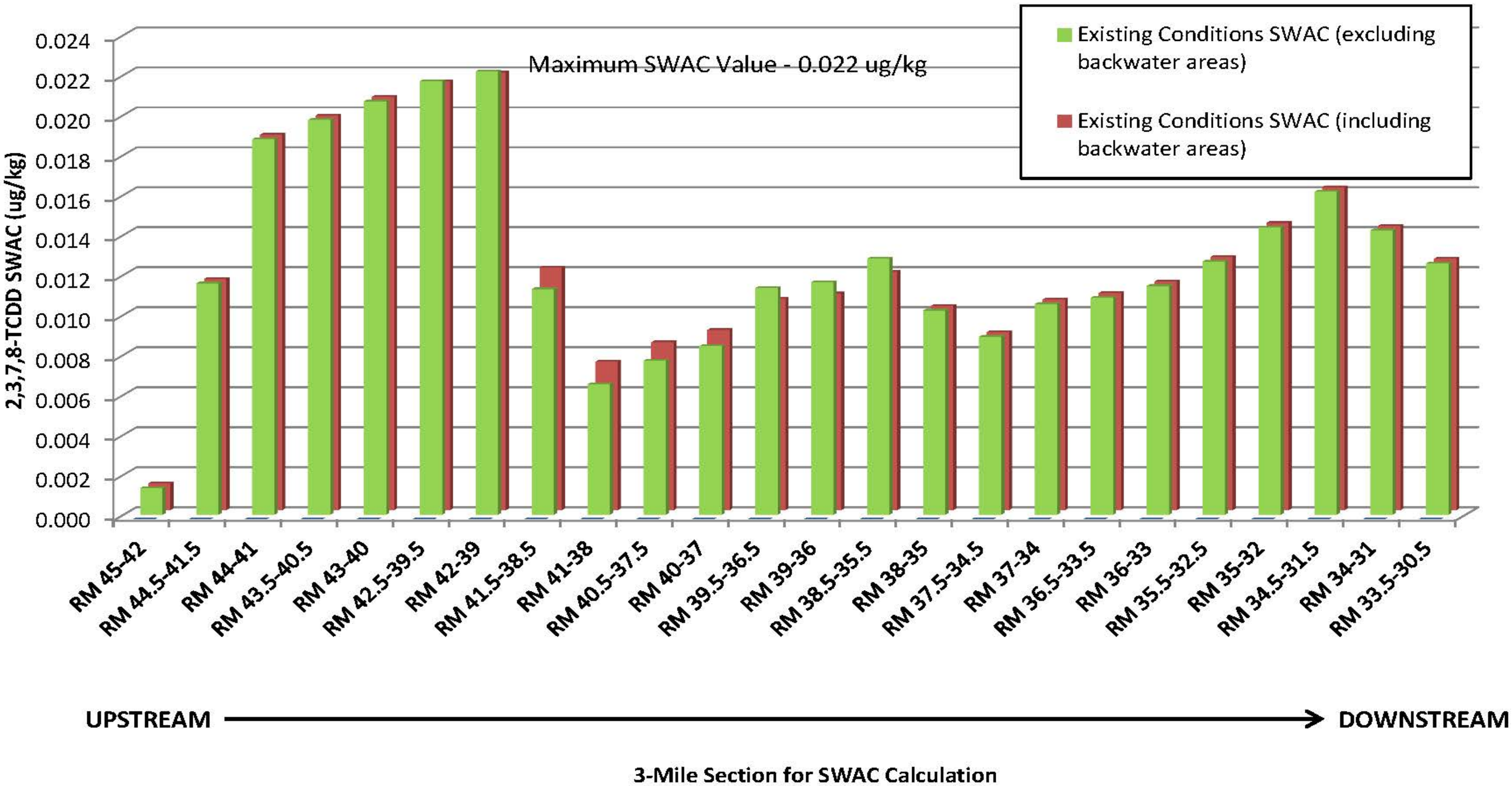
Aerial: National Agriculture Imagery Program Dated 2014 (West Virginia South SPC, NAD83); Coordinate System: NAD 1983 StatePlane West Virginia South FIPS 4702 Feet

NOTE:
(1) Property boundaries shown are approximate.
(2) The lateral extent of the Site and Study Area boundaries are limited to the River within the water surface defined by the normal pool elevation. Adjacent areas are included for reference only, and do not form part of the Site.
(3) Proposed cap areas to be defined during the design process.

figure Q.1

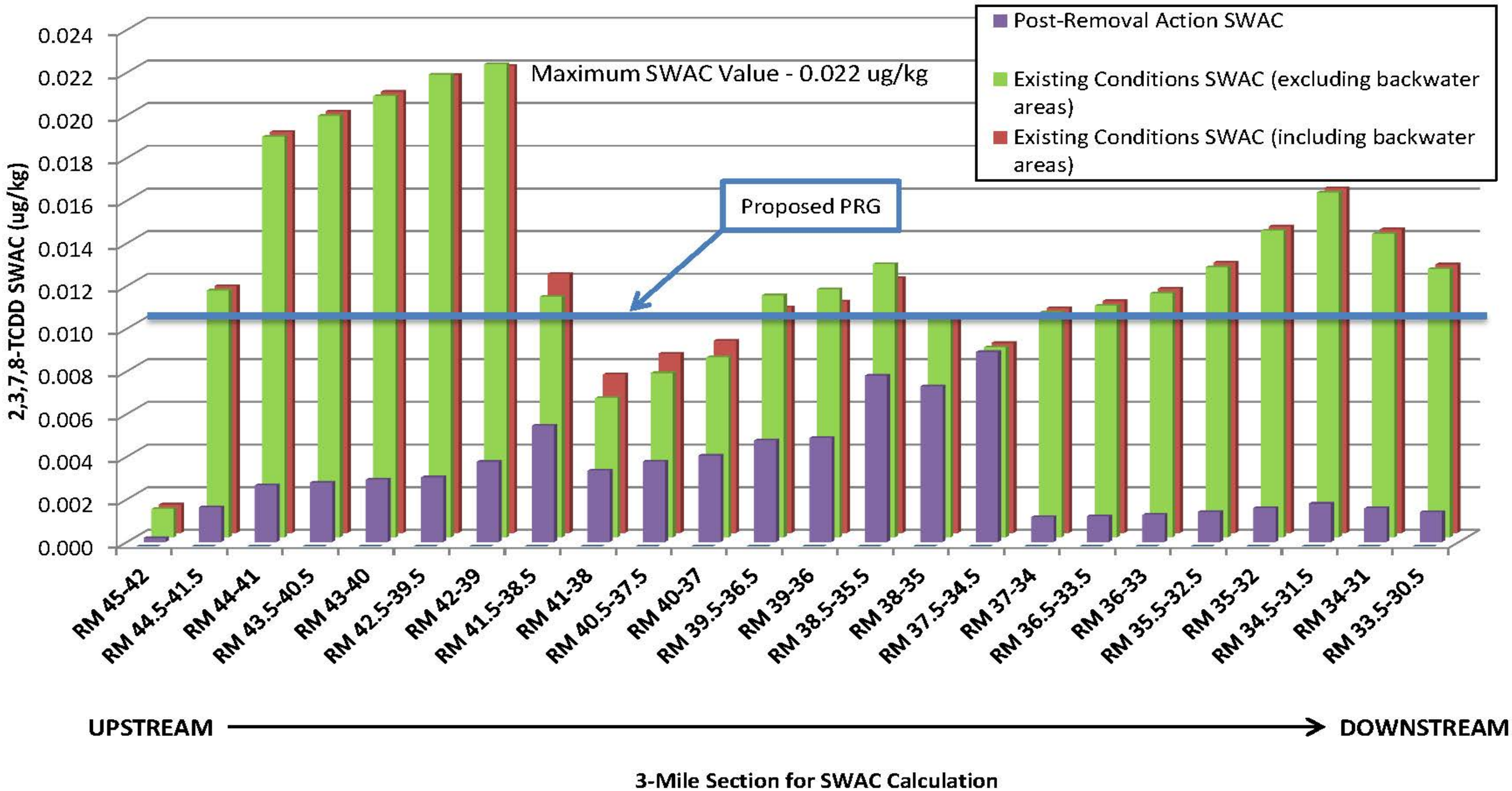
SWAC CALCULATION - HALF-MILE BOUNDARY LOCATIONS
EE/CA REPORT
KANAWHA RIVER, WEST VIRGINIA

031884-00(REP051)GIS-WA116 February 27, 2015



Note: Study Area 1 corresponds to approximately RM 45.5 to 42.5, Study Area 2 - RM 42.5 to 41.5, Study Area 3 - RM 41.5 to 38.5, and Study Area 4 - RM 38.5 to 30.5.

figure Q.2
EXISTING CONDITION SWAC FOR ROLLING 3-MILE RANGE
EE/CA REPORT
Kanawha River, West Virginia



Note: Study Area 1 corresponds to approximately RM 45.5 to 42.5, Study Area 2 - RM 42.5 to 41.5, Study Area 3 - RM 41.5 to 38.5, and Study Area 4 - RM 38.5 to 30.5.

figure Q.3
POST-REMOVAL ACTION SWAC FOR ROLLING 3-MILE RANGE
EE/CA REPORT
Kanawha River, West Virginia

CRA

TABLE Q.1

SWAC CALCULATION
STUDY AREA 01 - HALF MILE 02
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 1 Half Mile 2*	*Original Result*	*Chemical Name*	*Concentration Unit*
1729473.621	508685.2531	STUDY AREA 1	1	A	KRSO-3	1.7	-	-	0.00033	0.00033 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1727170.996	509428.1558	STUDY AREA 1	2	A	KRSD-28	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1727170.996	509428.1558	STUDY AREA 1	2	A	KRSD-28	0	2	1	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1727170.996	509428.1558	STUDY AREA 1	2	A	KRSD-28	2	4	3	0.00092	0.00092	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1727170.996	509428.1558	STUDY AREA 1	2	A	KRSD-28	4	6	5	0.00211	0.00211	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1727791.243	509981.5377	STUDY AREA 1	2	A	KRSD-29	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1727513.629	510338.3153	STUDY AREA 1	2	A	KRSO-5	1.7	-	-	0.0005	ND(0.001)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1726954.353	510975.15	STUDY AREA 1	2	B	SSD-29	0	0	0	0.00031	ND(0.00062)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1726079.843	512707.185	STUDY AREA 1	3	A	KRSD-27	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1726079.843	512707.185	STUDY AREA 1	3	A	KRSD-27	0	2	1	0.00069	0.00069	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg

Legend

- Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
- Core data excluded as it is co-located with surficial samples
- Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.1

SWAC CALCULATION
STUDY AREA 01 - HALF MILE 02
KANAWHA RIVER, WEST VIRGINIA

RDL Half	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
-	Traced - 20130116	Nitro Sanitary Board Outfall 006	Kanawha River	KR-KRSO-3	45.7	R3109139	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
-	-	-	Kanawha River	KR-KRSD-28	NA	R380992	5/18/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
-	-	-	Kanawha River	KR-KRSD-28	NA	R380989	5/18/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
-	-	-	Kanawha River	KR-KRSD-28	NA	R380990	5/18/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
-	-	-	Kanawha River	KR-KRSD-28	NA	R380991	5/18/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
-	-	-	Kanawha River	KR-KRSD-29	NA	R380993	5/18/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
0.0005	Traced - 20130116	Nitro Sanitary Board Outfall 005	Kanawha River	KR-KRSO-5	45.3	R3109138	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
0.00031	Surveyed	-	Kanawha River	KR-SSD-29	NA	SE-031884-112807-DD-001	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
-	-	-	Kanawha River	KR-KRSD-27	NA	R380986	5/18/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
-	-	-	Kanawha River	KR-KRSD-27	NA	R380985	5/18/2000	(0-2) ft BGS	-	Diox Fur	SE	KR

TABLE Q.2

SWAC CALCULATION
STUDY AREA 01 - HALF MILE 03
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 1 Half Mile 3*	*Original Result*
1726954.353	510975.15	STUDY AREA 1	2	B	SSD-29	0	0	0	0.00031	ND(0.00062)
1726079.843	512707.185	STUDY AREA 1	3	A	KRSD-27	0	0.5	0.25	0.0000335	ND(0.000067)
1726079.843	512707.185	STUDY AREA 1	3	A	KRSD-27	0	2	1	0.00069	0.00069
1725713.156	514160.2121	STUDY AREA 1	3	B	KRSO-48	1.7	-	1.7	0.0005	ND(0.001)
1725704.006	513996.788	STUDY AREA 1	3	B	SSD-28	0	0	0	0.000395	ND(0.00079)
1725571.579	515255.6078	STUDY AREA 1	4	A	KRSD-25	0	2	1	0.00735	0.00735
1725571.579	515255.6078	STUDY AREA 1	4	A	KRSD-25	2	4	3	0.00282	0.00282
1725571.579	515255.6078	STUDY AREA 1	4	A	KRSD-25	4	6	5	0.00042	0.00042
1724931.042	514200.5023	STUDY AREA 1	4	A	KRSD-26	0	0.5	0.25	0.00024	0.00024
1725635.096	514936.7135	STUDY AREA 1	4	A	KRSO-12	1.7	-	1.7	0.00077	0.00077 J
1725596.41	515320.4876	STUDY AREA 1	4	A	KRSO-13	1.7	-	1.7	0.00036	0.00036 J
1725596.41	515320.4876	STUDY AREA 1	4	A	KRSO-40	1.7	-	1.7	0.212	0.212

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.2

SWAC CALCULATION
STUDY AREA 01 - HALF MILE 03
KANAWHA RIVER, WEST VIRGINIA

Chemical Name	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00031	Surveyed	-	Kanawha River	KR-SSD-29	NA
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-27	NA
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-27	NA
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.0005	Traced - 20130116	Unknown Stormwater	Kanawha River	KR-KRSO-48	44.2
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.000395	Surveyed	-	Kanawha River	KR-SSD-28	NA
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-25	43.8
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-25	43.8
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-25	43.8
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-26	NA
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced - 20130116	Abandoned Pipe	Kanawha River	KR-KRSO-12	44.3
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced - 20130116	Nitro Sanitation Landfill Outfall	Kanawha River	KR-KRSO-13	44.2
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced - 20130116	Nitro Sanitary Board Outfall 001	Kanawha River	KR-KRSO-40	41.7

TABLE Q.2

SWAC CALCULATION
STUDY AREA 01 - HALF MILE 03
KANAWHA RIVER, WEST VIRGINIA

Sample Name	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
SE-031884-112807-DD-001	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
R380986	5/18/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
R380985	5/18/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
R3109137	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
SE-031884-112807-DD-002	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
R380982	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
R380983	5/18/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
R380984	5/18/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
R380994	5/19/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
R3109136	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
R3109133	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
R3109118	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR

TABLE Q.3

SWAC CALCULATION
STUDY AREA 01 - HALF MILE 04
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 1 Half Mile 4*
1725713.156	514160.2121	STUDY AREA 1	3	B	KRSO-48	1.7	-	1.7	0.0005
1725704.006	513996.788	STUDY AREA 1	3	B	SSD-28	0	0	0	0.000395
1725571.579	515255.6078	STUDY AREA 1	4	A	KRSD-25	0	2	1	0.00735
1725571.579	515255.6078	STUDY AREA 1	4	A	KRSD-25	2	4	3	0.00282
1725571.579	515255.6078	STUDY AREA 1	4	A	KRSD-25	4	6	5	0.00042
1724931.042	514200.5023	STUDY AREA 1	4	A	KRSD-26	0	0.5	0.25	0.00024
1725635.096	514936.7135	STUDY AREA 1	4	A	KRSO-12	1.7	-	1.7	0.00077
1725596.41	515320.4876	STUDY AREA 1	4	A	KRSO-13	1.7	-	1.7	0.00036
1725596.41	515320.4876	STUDY AREA 1	4	A	KRSO-40	1.7	-	1.7	0.212
1725280.597	518680.3286	STUDY AREA 1	5	B	KRSD-23	0	0.5	0.25	0.0000335
1725280.597	518680.3286	STUDY AREA 1	5	B	KRSD-23	0	2	1	0.0000335
1724502.729	518418.5816	STUDY AREA 1	5	B	KRSD-24	0	0.5	0.25	0.0000335
1724502.729	518418.5816	STUDY AREA 1	5	B	KRSD-24	0	2	1	0.0000335
1724502.729	518418.5816	STUDY AREA 1	5	B	KRSD-24	2	4	3	0.0000335

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.3

SWAC CALCULATION
STUDY AREA 01 - HALF MILE 04
KANAWHA RIVER, WEST VIRGINIA

Original Result	*Chemical Name*	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*
ND(0.001)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.0005	Traced - 20130116	Unknown Stormwater
ND(0.00079)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.000395	Surveyed	-
0.00735	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
0.00282	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
0.00042	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
0.00024	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
0.00077 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced - 20130116	Abandoned Pipe
0.00036 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced - 20130116	Nitro Sanitation Landfill Outfall
0.212	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced - 20130116	Nitro Sanitary Board Outfall 001
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-

TABLE Q.3

SWAC CALCULATION
STUDY AREA 01 - HALF MILE 04
KANAWHA RIVER, WEST VIRGINIA

Subfacility Name	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
Kanawha River	KR-KRSO-48	44.2	R3109137	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Kanawha River	KR-SSD-28	NA	SE-031884-112807-DD-002	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-25	43.8	R380982	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-25	43.8	R380983	5/18/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-25	43.8	R380984	5/18/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-26	NA	R380994	5/19/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSO-12	44.3	R3109136	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Kanawha River	KR-KRSO-13	44.2	R3109133	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Kanawha River	KR-KRSO-40	41.7	R3109118	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Kanawha River	KR-KRSD-23	43.1	R380962	5/16/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-23	43.1	R380961	5/16/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-24	43.2	R380981	5/17/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-24	43.2	R380979	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-24	43.2	R380980	5/17/2000	(2-4) ft BGS	-	Diox Fur	SE	KR

TABLE Q.4

SWAC CALCULATION
STUDY AREA 01 - HALF MILE 05
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 1 Half Mile 5*
1725571.579	515255.6078	STUDY AREA 1	4	A	KRSD-25	0	2	1	0.00735
1725571.579	515255.6078	STUDY AREA 1	4	A	KRSD-25	2	4	3	0.00282
1725571.579	515255.6078	STUDY AREA 1	4	A	KRSD-25	4	6	5	0.00042
1724931.042	514200.5023	STUDY AREA 1	4	A	KRSD-26	0	0.5	0.25	0.00024
1725635.096	514936.7135	STUDY AREA 1	4	A	KRSO-12	1.7		1.7	0.00077
1725596.41	515320.4876	STUDY AREA 1	4	A	KRSO-13	1.7		1.7	0.00036
1725596.41	515320.4876	STUDY AREA 1	4	A	KRSO-40	1.7		1.7	0.212
1725280.597	518680.3286	STUDY AREA 1	5	B	KRSD-23	0	0.5	0.25	0.0000335
1725280.597	518680.3286	STUDY AREA 1	5	B	KRSD-23	0	2	1	0.0000335
1724502.729	518418.5816	STUDY AREA 1	5	B	KRSD-24	0	0.5	0.25	0.0000335
1724502.729	518418.5816	STUDY AREA 1	5	B	KRSD-24	0	2	1	0.0000335
1724502.729	518418.5816	STUDY AREA 1	5	B	KRSD-24	2	4	3	0.0000335
1725145.572	519553.4399	STUDY AREA 1	6	A	KRSO-18	1.7		1.7	0.00055
1725053.86	520070.2611	STUDY AREA 1	6	A	KRSO-19	1.7		1.7	0.0011
1724247.697	520104.3235	STUDY AREA 1	6	A	KRSO-45	1.7		1.7	0.00043
1724951.805	520223.789	STUDY AREA 1	6	A	SSD-27	0	0	0	0.000435

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.4

SWAC CALCULATION
STUDY AREA 01 - HALF MILE 05
KANAWHA RIVER, WEST VIRGINIA

Original Result	*Chemical Name*	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*
0.00735	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
0.00282	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
0.00042	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
0.00024	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
0.00077 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced - 20130116	Abandoned Pipe
0.00036 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced - 20130116	Nitro Sanitation Landfill Outfall
0.212	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced - 20130116	Nitro Sanitary Board Outfall 001
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
0.00055 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced - 20130116	Old World War I Outfall
0.0011	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced - 20130116	Swale Area
0.00043	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced - 20130116	Tow Maintenance Cleaning Outfall 001
ND(0.00087)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.000435	Surveyed	

TABLE Q.4

SWAC CALCULATION
STUDY AREA 01 - HALF MILE 05
KANAWHA RIVER, WEST VIRGINIA

Subfacility Name	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
Kanawha River	KR-KRSD-25	43.8	R380982	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-25	43.8	R380983	5/18/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-25	43.8	R380984	5/18/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-26	NA	R380994	5/19/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSO-12	44.3	R3109136	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Kanawha River	KR-KRSO-13	44.2	R3109133	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Kanawha River	KR-KRSO-40	41.7	R3109118	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Kanawha River	KR-KRSD-23	43.1	R380962	5/16/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-23	43.1	R380961	5/16/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-24	43.2	R380981	5/17/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-24	43.2	R380979	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-24	43.2	R380980	5/17/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSO-18	43.5	R3109131	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Kanawha River	KR-KRSO-19	43.2	R3109130	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Kanawha River	KR-KRSO-45	43	R3109132	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Kanawha River	KR-SSD-27	NA	384-112807-	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR

TABLE Q.5

SWAC CALCULATION
STUDY AREA 01 - HALF MILE 06
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 1 Half Mile 6*
1725280.597	518680.3286	STUDY AREA 1	5	B	KRSD-23	0	0.5	0.25	0.0000335
1725280.597	518680.3286	STUDY AREA 1	5	B	KRSD-23	0	2	1	0.0000335
1724502.729	518418.5816	STUDY AREA 1	5	B	KRSD-24	0	0.5	0.25	0.0000335
1724502.729	518418.5816	STUDY AREA 1	5	B	KRSD-24	0	2	1	0.0000335
1724502.729	518418.5816	STUDY AREA 1	5	B	KRSD-24	2	4	3	0.0000335
1725145.572	519553.4399	STUDY AREA 1	6	A	KRSO-18	1.7	-	1.7	0.00055
1725053.86	520070.2611	STUDY AREA 1	6	A	KRSO-19	1.7	-	1.7	0.0011
1724247.697	520104.3235	STUDY AREA 1	6	A	KRSO-45	1.7	-	1.7	0.00043
1724951.805	520223.789	STUDY AREA 1	6	A	SSD-27	0	0	0	0.000435
1724850.097	521131.841	STUDY AREA 1	6	B	BC-SSD-26A	0	0.3	0.15	0.000455
1724850.097	521131.841	STUDY AREA 1	6	B	BC-SSD-26A	0	0.3	0.15	0.0000345
1724850.097	521131.841	STUDY AREA 1	6	B	BC-SSD-26A	0	0.3	0.15	0.000145
1724850.097	521131.841	STUDY AREA 1	6	B	BC-SSD-26B	0	0.2	0.1	0.0000335
1724850.097	521131.841	STUDY AREA 1	6	B	BC-SSD-26B	0	0.2	0.1	0.0000445
1724850.097	521131.841	STUDY AREA 1	6	B	BC-SSD-26B	0	0.2	0.1	0.00005
1724854.908	521944.481	STUDY AREA 1	6	B	COR-43	0	0	0	0.00041
1724854.908	521944.481	STUDY AREA 1	6	B	COR-43	0	1.8	0.9	0.00011
1724938.486	521685.2532	STUDY AREA 1	6	B	KRSO-23	1.7		1.7	0.058
1724850.097	521131.841	STUDY AREA 1	6	B	SSD-26	0	0	0	0.0029
1724850.097	521131.841	STUDY AREA 1	6	B	SSD-26	0	0	0	0.0014
1725032.224	522972.291	STUDY AREA 2	7	A	COR-41	0	0	0	0.0003
1725032.224	522972.291	STUDY AREA 2	7	A	COR-41	0	1	0.5	0.0008
1725032.224	522972.291	STUDY AREA 2	7	A	COR-41	1	2.1	1.55	0.000245
1724245.197	523004.14	STUDY AREA 2	7	A	COR-42	0	0	0	0.00085
1724245.197	523004.14	STUDY AREA 2	7	A	COR-42	0	1.4	0.7	0.0018
1724245.197	523004.14	STUDY AREA 2	7	A	COR-42	0	1.4	0.7	0.00055
1724245.197	523004.14	STUDY AREA 2	7	A	COR-42	0	2.4	1.2	0.00013
1725005.463	522522.513	STUDY AREA 2	7	A	KRSD-22	0	0.5	0.25	0.00237
1725005.463	522522.513	STUDY AREA 2	7	A	KRSD-22	0	2	1	0.0000335
1724312.831	523194.654	STUDY AREA 2	7	A	SSD-25	0	0	0	0.00049

Legend

Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
Core data excluded as it is co-located with surficial samples
Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.5

SWAC CALCULATION
STUDY AREA 01 - HALF MILE 06
KANAWHA RIVER, WEST VIRGINIA

Original Result	*Chemical Name*	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
0.00055 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced - 201301	Old World War I Outfall
0.0011	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced - 201301	Swale Area
0.00043	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced - 201301	Tow Maintenance Cleaning Outfall 001
ND(0.00087)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.000435	Surveyed	-
ND(0.00091)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.000455	-	-
ND(0.000069)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.0000345	-	-
ND(0.00029)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.000145	-	-
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.0000335	-	-
ND(0.000089)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.0000445	-	-
ND(0.0001)UJ	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00005	-	-
ND(0.00082)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00041	Surveyed	Bank - Right
ND(0.00022)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00011	Surveyed	Bank - Right
0.058	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced - 201301	Dana/Kincaid Outfall
0.0029	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-
0.0014	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00215	Surveyed	-
ND(0.0006)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.0003	Surveyed	Bank - Right
ND(0.0016)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.0008	Surveyed	Bank - Right
ND(0.00049)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.000245	Surveyed	Bank - Right
ND(0.0017)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00085	Surveyed	Bank - Left
0.0018	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left
ND(0.0011)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00055	Surveyed	Bank - Left
ND(0.00026)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00013	Surveyed	Bank - Left
0.00237	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
ND(0.00098)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00049	Surveyed	-

TABLE Q.5

SWAC CALCULATION
STUDY AREA 01 - HALF MILE 06
KANAWHA RIVER, WEST VIRGINIA

Subfacility Name	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
Kanawha River	KR-KRSD-23	43.1	R380962	5/16/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-23	43.1	R380961	5/16/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-24	43.2	R380981	5/17/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-24	43.2	R380979	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-24	43.2	R380980	5/17/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSO-18	43.5	R3109131	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Kanawha River	KR-KRSO-19	43.2	R3109130	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Kanawha River	KR-KRSO-45	43	R3109132	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Kanawha River	KR-SSD-27	NA	SE-031884-112807-DD-003	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-BC-SSD-26A	39.7	S-031884-022408-DD-461 (A)	3/31/2008	(0-3) IN	-	Diox Fur	SE	KR
Kanawha River	KR-BC-SSD-26A	39.7	S-031884-022408-DD-461 (C)	3/31/2008	(0-3) IN	-	Diox Fur	SE	KR
Kanawha River	KR-BC-SSD-26A	39.7	S-031884-022408-DD-461 (B)	3/31/2008	(0-3) IN	-	Diox Fur	SE	KR
Kanawha River	KR-BC-SSD-26B	39.7	S-031884-022408-DD-462 (C)	3/31/2008	(0-2) IN	-	Diox Fur	SE	KR
Kanawha River	KR-BC-SSD-26B	39.7	S-031884-022408-DD-462 (A)	3/31/2008	(0-2) IN	-	Diox Fur	SE	KR
Kanawha River	KR-BC-SSD-26B	39.7	S-031884-022408-DD-462 (B)	3/31/2008	(0-2) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-43	42.5	SE-031884-112807-DD-006	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-43	42.5	SE-031884-120307-DD-077	12/3/2007	(0-22) IN	-	Diox Fur	SE	KR
Kanawha River	KR-KRSO-23	43	R3109129	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Kanawha River	KR-SSD-26	NA	SE-031884-112807-DD-004	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-SSD-26	NA	SE-031884-112807-DD-005	11/28/2007	(0-0) IN	Duplicate	Diox Fur	SE	KR
Kanawha River	KR-COR-41	42.3	SE-031884-112807-DD-009	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-41	42.3	SE-031884-120407-DD-081	12/4/2007	(0-12) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-41	42.3	SE-031884-120407-DD-082	12/4/2007	(12-25) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-42	42.3	SE-031884-112807-DD-007	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-42	42.3	SE-031884-120908-SG-002	12/9/2008	(0-16.5) IN	Duplicate	Diox Fur	Sediment	KR
Kanawha River	KR-COR-42	42.3	SE-031884-120908-SG-001	12/9/2008	(0-16.5) IN	-	Diox Fur	Sediment	KR
Kanawha River	KR-COR-42	42.3	SE-031884-120307-DD-078	12/3/2007	(0-29) IN	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-22	42.4	R380988	5/18/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-22	42.4	R380987	5/18/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-SSD-25	NA	SE-031884-112807-DD-008	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR

TABLE Q.6

SWAC CALCULATION
STUDY AREA 02 - HALF MILE 07
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 2 Half Mile 7*	*Original Result*	*Chemical Name*
1724850.097	521131.841	STUDY AREA 1	6	B	BC-SSD-26A	0	0.3	0.15	0.000455	ND(0.00091)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1724850.097	521131.841	STUDY AREA 1	6	B	BC-SSD-26A	0	0.3	0.15	0.0000345	ND(0.000069)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1724850.097	521131.841	STUDY AREA 1	6	B	BC-SSD-26A	0	0.3	0.15	0.000145	ND(0.00029)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1724850.097	521131.841	STUDY AREA 1	6	B	BC-SSD-26B	0	0.2	0.1	0.00005	ND(0.0001)UJ	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1724850.097	521131.841	STUDY AREA 1	6	B	BC-SSD-26B	0	0.2	0.1	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1724850.097	521131.841	STUDY AREA 1	6	B	BC-SSD-26B	0	0.2	0.1	0.0000445	ND(0.000089)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1724854.908	521944.481	STUDY AREA 1	6	B	COR-43	0	0	0	0.00041	ND(0.00082)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1724854.908	521944.481	STUDY AREA 1	6	B	COR-43	0	1.8	0.9	0.00011	ND(0.00022)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1724938.486	521685.2532	STUDY AREA 1	6	B	KRSO-23	1.7		1.7	0.058	0.058	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1724850.097	521131.841	STUDY AREA 1	6	B	SSD-26	0	0	0	0.0029	0.0029	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1724850.097	521131.841	STUDY AREA 1	6	B	SSD-26	0	0	0	0.0014	0.0014	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725032.224	522972.291	STUDY AREA 2	7	A	COR-41	0	0	0	0.0003	ND(0.0006)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725032.224	522972.291	STUDY AREA 2	7	A	COR-41	0	1	0.5	0.0008	ND(0.0016)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725032.224	522972.291	STUDY AREA 2	7	A	COR-41	1	2.1	1.55	0.000245	ND(0.00049)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1724245.197	523004.14	STUDY AREA 2	7	A	COR-42	0	0	0	0.00085	ND(0.0017)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1724245.197	523004.14	STUDY AREA 2	7	A	COR-42	0	1.4	0.7	0.0018	0.0018	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1724245.197	523004.14	STUDY AREA 2	7	A	COR-42	0	1.4	0.7	0.00055	ND(0.0011)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1724245.197	523004.14	STUDY AREA 2	7	A	COR-42	0	2.4	1.2	0.00013	ND(0.00026)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725005.463	522522.513	STUDY AREA 2	7	A	KRSD-22	0	0.5	0.25	0.00237	0.00237	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725005.463	522522.513	STUDY AREA 2	7	A	KRSD-22	0	2	1	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1724312.831	523194.654	STUDY AREA 2	7	A	SSD-25	0	0	0	0.00049	ND(0.00098)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725397.751	524274.529	STUDY AREA 2	7	B	COR-39	0	0	0	3.4	3.4 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725397.751	524274.529	STUDY AREA 2	7	B	COR-39	0	1.4	0.7	22	22 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725397.751	524274.529	STUDY AREA 2	7	B	COR-39	1.4	2.8	2.1	33	33 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725254.851	523688.951	STUDY AREA 2	7	B	COR-40	0	0	0	0.059	0.059	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725254.851	523688.951	STUDY AREA 2	7	B	COR-40	0	2	1	0.01	0.01	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725254.851	523688.951	STUDY AREA 2	7	B	COR-40	0	2	1	0.049	0.049	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725254.851	523688.951	STUDY AREA 2	7	B	COR-40	2	3.3	2.65	0.0081	0.0081	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725254.851	523688.951	STUDY AREA 2	7	B	COR-40	2	4	3	0.00037	ND(0.00074)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725254.851	523688.951	STUDY AREA 2	7	B	COR-40	4	5.5	4.75	0.00015	ND(0.0003)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725241.351	523672.9788	STUDY AREA 2	7	B	KRSD-21	0	2	1	5.11	5.11	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725241.351	523672.9788	STUDY AREA 2	7	B	KRSD-21	0	2	1	0.479	0.479	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725241.351	523672.9788	STUDY AREA 2	7	B	KRSD-21	2	4	3	0.166	0.166	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725241.351	523672.9788	STUDY AREA 2	7	B	KRSD-21	4	6	5	0.00689	0.00689 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725290.249	523702.536	STUDY AREA 2	7	B	KRSO-25	0.6	-	0.6	0.279	0.279	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725334.599	523909.9307	STUDY AREA 2	7	B	KRSO-27	1.5	-	1.5	0.0162	0.0162	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725930.276	525251.9666	STUDY AREA 2	8	A	ASD-2	0	0.5	0.25	0.057	0.057	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725661.812	525318.21	STUDY AREA 2	8	A	BC-COR-37A	0	0.3	0.15	0.00022	ND(0.00044)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725661.812	525318.21	STUDY AREA 2	8	A	BC-COR-37A	0	0.3	0.15	0.000225	ND(0.00045)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725661.812	525318.21	STUDY AREA 2	8	A	BC-COR-37A	0	0.3	0.15	0.0013	ND(0.0026)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725661.812	525318.21	STUDY AREA 2	8	A	BC-COR-37B	0	0.2	0.1	0.0044	0.0044	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725661.812	525318.21	STUDY AREA 2	8	A	BC-COR-37B	0	0.2	0.1	0.0011	0.0011	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725661.812	525318.21	STUDY AREA 2	8	A	BC-COR-37B	0	0.2	0.1	0.0005	ND(0.001)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725661.812	525318.21	STUDY AREA 2	8	A	COR-37	0	0	0	0.0031	0.0031	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725624.228	524781.605	STUDY AREA 2	8	A	COR-38	0	0	0	0.25	0.25	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725624.228	524781.605	STUDY AREA 2	8	A	COR-38	0	2	1	0.0087	0.0087	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725521.03	524433.4759	STUDY AREA 2	8	A	DSD-1	0	0.5	0.25	190	190 D E	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725591.764	524574.9435	STUDY AREA 2	8	A	DSD-2	0	0.5	0.25	0.083	0.083	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725642.288	524736.6206	STUDY AREA 2	8	A	DSD-3	0	0.5	0.25	0.038	0.038	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725728.179	524908.4026	STUDY AREA 2	8	A	DSD-4	0	0.5	0.25	3.6	3.6 E	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)

TABLE Q.6

SWAC CALCULATION
STUDY AREA 02 - HALF MILE 07
KANAWHA RIVER, WEST VIRGINIA

Concentration Unit	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
ug/kg	0.000455	-	-	Kanawha River	KR-BC-SSD-26A	39.7	S-031884-022408-DD-461 (A)	3/31/2008	(0-3) IN	-	Diox Fur	SE	KR
ug/kg	0.0000345	-	-	Kanawha River	KR-BC-SSD-26A	39.7	S-031884-022408-DD-461 (C)	3/31/2008	(0-3) IN	-	Diox Fur	SE	KR
ug/kg	0.000145	-	-	Kanawha River	KR-BC-SSD-26A	39.7	S-031884-022408-DD-461 (B)	3/31/2008	(0-3) IN	-	Diox Fur	SE	KR
ug/kg	0.00005	-	-	Kanawha River	KR-BC-SSD-26B	39.7	S-031884-022408-DD-462 (B)	3/31/2008	(0-2) IN	-	Diox Fur	SE	KR
ug/kg	0.0000335	-	-	Kanawha River	KR-BC-SSD-26B	39.7	S-031884-022408-DD-462 (C)	3/31/2008	(0-2) IN	-	Diox Fur	SE	KR
ug/kg	0.0000445	-	-	Kanawha River	KR-BC-SSD-26B	39.7	S-031884-022408-DD-462 (A)	3/31/2008	(0-2) IN	-	Diox Fur	SE	KR
ug/kg	0.00041	Surveyed	Bank - Right	Kanawha River	KR-COR-43	42.5	SE-031884-112807-DD-006	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
ug/kg	0.00011	Surveyed	Bank - Right	Kanawha River	KR-COR-43	42.5	SE-031884-120307-DD-077	12/3/2007	(0-22) IN	-	Diox Fur	SE	KR
ug/kg	-	Traced - 20130116	Dana/Kincaid Outfall	Kanawha River	KR-KRSO-23	43	R3109129	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-26	NA	SE-031884-112807-DD-004	11/28/2007	(0-0) IN		Diox Fur	SE	KR
ug/kg	0.00215	Surveyed	-	Kanawha River	KR-SSD-26	NA	SE-031884-112807-DD-005	11/28/2007	(0-0) IN	Duplicate	Diox Fur	SE	KR
ug/kg	0.0003	Surveyed	Bank - Right	Kanawha River	KR-COR-41	42.3	SE-031884-112807-DD-009	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
ug/kg	0.0008	Surveyed	Bank - Right	Kanawha River	KR-COR-41	42.3	SE-031884-120407-DD-081	12/4/2007	(0-12) IN	-	Diox Fur	SE	KR
ug/kg	0.000245	Surveyed	Bank - Right	Kanawha River	KR-COR-41	42.3	SE-031884-120407-DD-082	12/4/2007	(12-25) IN	-	Diox Fur	SE	KR
ug/kg	0.00085	Surveyed	Bank - Left	Kanawha River	KR-COR-42	42.3	SE-031884-112807-DD-007	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-42	42.3	SE-031884-120908-SG-002	12/9/2008	(0-16.5) IN	Duplicate	Diox Fur	Sediment	KR
ug/kg	0.00055	Surveyed	Bank - Left	Kanawha River	KR-COR-42	42.3	SE-031884-120908-SG-001	12/9/2008	(0-16.5) IN	-	Diox Fur	Sediment	KR
ug/kg	0.00013	Surveyed	Bank - Left	Kanawha River	KR-COR-42	42.3	SE-031884-120307-DD-078	12/3/2007	(0-29) IN	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-22	42.4	R380988	5/18/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-22	42.4	R380987	5/18/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
ug/kg	0.00049	Surveyed	-	Kanawha River	KR-SSD-25	NA	SE-031884-112807-DD-008	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-39	42	SE-031884-112807-DD-011	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-39	42	SE-031884-120407-DD-083	12/4/2007	(0-17) IN	-	Diox Fur	SE	KR
ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-39	42	SE-031884-120407-DD-084	12/4/2007	(17-33.5) IN	-	Diox Fur	SE	KR
ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-40	42.1	SE-031884-112807-DD-010	11/28/2007	(0-0)	-	Diox Fur	SE	KR
ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-40	42.1	SE-031884-120407-DD-079	12/4/2007	(0-24) IN	-	Diox Fur	SE	KR
ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-40	42.1	SE-031884-120908-SG-003	12/9/2008	(0-24) IN	-	Diox Fur	Sediment	KR
ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-40	42.1	SE-031884-120407-DD-080	12/4/2007	(24-40) IN	-	Diox Fur	SE	KR
ug/kg	0.00037	Surveyed	Bank - Right	Kanawha River	KR-COR-40	42.1	SE-031884-120908-SG-004	12/9/2008	(24-48) IN	-	Diox Fur	Sediment	KR
ug/kg	0.00015	Surveyed	Bank - Right	Kanawha River	KR-COR-40	42.1	SE-031884-120908-SG-005	12/9/2008	(48-66) IN	-	Diox Fur	Sediment	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-21	42.1	R380975	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-21	42.1	R380978	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-21	42.1	R380976	5/17/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-21	42.1	R380977	5/17/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	Traced - 20130116	ACS Outfall 001	Kanawha River	KR-KRSO-25	42.5	R3109128	9/1/2001	(7-) IN	-	Diox Fur	Sediment	KR
ug/kg	-	Traced - 20130116	FMC Outfall 003	Kanawha River	KR-KRSO-27	42.5	R3109127	9/1/2001	(18-) IN	-	Diox Fur	Sediment	KR
ug/kg	-	-	-	Flexsys Solutia	SOL-ASD-2	NA	ASD-2-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
ug/kg	0.00022	-	-	Kanawha River	KR-BC-COR-37A	41.8	S-031884-022408-DD-459 (B)	3/28/2008	(0-3) IN	-	Diox Fur	SE	KR
ug/kg	0.000225	-	-	Kanawha River	KR-BC-COR-37A	41.8	S-031884-022408-DD-459 (C)	3/28/2008	(0-3) IN	-	Diox Fur	SE	KR
ug/kg	0.0013	-	-	Kanawha River	KR-BC-COR-37A	41.8	S-031884-022408-DD-459 (A)	3/28/2008	(0-3) IN	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-BC-COR-37B	41.8	S-031884-022408-DD-460 (A)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-BC-COR-37B	41.8	S-031884-022408-DD-460 (B)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
ug/kg	0.0005	-	-	Kanawha River	KR-BC-COR-37B	41.8	S-031884-022408-DD-460 (C)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-37	41.8	SE-031884-112807-DD-015	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-38	41.9	SE-031884-112807-DD-012	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-38	41.9	SE-031884-120407-DD-085	12/4/2007	(0-24) IN	-	Diox Fur	SE	KR
ug/kg	-	-	-	Flexsys Solutia	SOL-DSD-1	42	DSD-1-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
ug/kg	-	-	-	Flexsys Solutia	SOL-DSD-2	42	DSD-2-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
ug/kg	-	-	-	Flexsys Solutia	SOL-DSD-3	41.9	DSD-3-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
ug/kg	-	-	-	Flexsys Solutia	SOL-DSD-4	41.9	DSD-4-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL

TABLE Q.6

SWAC CALCULATION
STUDY AREA 02 - HALF MILE 07
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 2 Half Mile 7*	*Original Result*	*Chemical Name*
1725809.018	525075.1322	STUDY AREA 2	8	A	DSD-5	0	0.5	0.25	4	4 E	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725834.28	525267.1238	STUDY AREA 2	8	A	Kanawha River - MP 42.2 east-upper layer	0	0.5	0.25	0.00864	0.00864	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725894.229	525320.3805	STUDY AREA 2	8	A	KRSD-20	0	0.5	0.25	0.0723	0.0723 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725894.229	525320.3805	STUDY AREA 2	8	A	KRSD-20	0	2	1	0.116	0.116 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725894.229	525320.3805	STUDY AREA 2	8	A	KRSD-20	2	4	3	0.00075	0.00075	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725894.229	525320.3805	STUDY AREA 2	8	A	KRSD-20	4	6	5	0.00024	0.00024 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725894.229	525320.3805	STUDY AREA 2	8	A	KRSD-20	6	8	7	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725496.058	524383.5436	STUDY AREA 2	8	A	KRSO-31	1.7	-	1.7	1.02	1.02 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725820.466	525097.23	STUDY AREA 2	8	A	KRSO-32	1.7	-	1.7	0.564	0.564 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725820.466	525097.23	STUDY AREA 2	8	A	KRSO-32	1.7	-	1.7	0.278	0.278	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725911.711	525259.6332	STUDY AREA 2	8	A	KRSO-33	0.8	-	0.8	0.106	0.106	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1725288.684	525682.336	STUDY AREA 2	8	A	SSD-23	0	0	0	0.074	0.074	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1724912.695	524969.985	STUDY AREA 2	8	A	SSD-24	0	0	0	0.00085	ND(0.0017)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)

Legend

Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
Core data excluded as it is co-located with surficial samples
Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.6

SWAC CALCULATION
STUDY AREA 02 - HALF MILE 07
KANAWHA RIVER, WEST VIRGINIA

Concentration Unit	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
ug/kg	-	-	-	Flexsys Solutia	SOL-DSD-5	41.8	DSD-5-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
ug/kg	-	-	-	Kanawha River	KR-D-34	NA	D-34	5/12/1999	-	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-20	41.8	R380974	5/17/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-20	41.8	R380970	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-20	41.8	R380971	5/17/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-20	41.8	R380972	5/17/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-20	41.8	R380973	5/17/2000	(6-8) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	Traced - 20130116	Flexsys/Solutia Outfall 007	Kanawha River	KR-KRSO-31	42.4	R3109126	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
ug/kg	-	Traced - 20130116	Monsanto 002	Kanawha River	KR-KRSO-32	42.45	R3109124	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
ug/kg	0.421	Traced - 20130116	Monsanto 002	Kanawha River	KR-KRSO-32	42.45	R3109125	9/1/2001	(20-) IN	Duplicate	Diox Fur	Sediment	KR
ug/kg	-	Traced - 20130116	Flexsys/Solutia Outfall 008	Kanawha River	KR-KRSO-33	42.2	R3109123	9/1/2001	(10-) IN	-	Diox Fur	Sediment	KR
ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-23	NA	SE-031884-112807-DD-014	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
ug/kg	0.00085	Surveyed	-	Kanawha River	KR-SSD-24	NA	SE-031884-112807-DD-013	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.7

SWAC CALCULATION
STUDY AREA 02 - HALF MILE 08
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	Y Coordinate	Study Area	Half Mile	Quarter Mile	Location Name	All Depth (ft) - TOP	All Depth (ft) - BOT	Mid Depth (ft)	TCDD Study Area 2 Half Mile 8	Original Result	Chemical Name	Concentration Unit	RDL Half
1725397.751	524274.529	STUDY AREA 2	7	B	COR-39	0	0	0	3.4	3.4 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725397.751	524274.529	STUDY AREA 2	7	B	COR-39	0	1.4	0.7	22	22 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725397.751	524274.529	STUDY AREA 2	7	B	COR-39	1.4	2.8	2.1	33	33 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725254.851	523688.951	STUDY AREA 2	7	B	COR-40	0	0	0	0.059	0.059	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725254.851	523688.951	STUDY AREA 2	7	B	COR-40	0	2	1	0.01	0.01	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725254.851	523688.951	STUDY AREA 2	7	B	COR-40	0	2	1	0.049	0.049	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725254.851	523688.951	STUDY AREA 2	7	B	COR-40	2	3.3	2.65	0.0081	0.0081	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725254.851	523688.951	STUDY AREA 2	7	B	COR-40	2	4	3	0.00037	ND(0.00074)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00037
1725254.851	523688.951	STUDY AREA 2	7	B	COR-40	4	5.5	4.75	0.00015	ND(0.0003)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00015
1725241.351	523672.9788	STUDY AREA 2	7	B	KRSD-21	0	2	1	5.11	5.11	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725241.351	523672.9788	STUDY AREA 2	7	B	KRSD-21	0	2	1	0.479	0.479	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725241.351	523672.9788	STUDY AREA 2	7	B	KRSD-21	2	4	3	0.166	0.166	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725241.351	523672.9788	STUDY AREA 2	7	B	KRSD-21	4	6	5	0.00689	0.00689 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725290.249	523702.536	STUDY AREA 2	7	B	KRSO-25	0.6	-	0.6	0.279	0.279	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725334.599	523909.9307	STUDY AREA 2	7	B	KRSO-27	1.5	-	1.5	0.0162	0.0162	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725930.276	525251.9666	STUDY AREA 2	8	A	ASD-2	0	0.5	0.25	0.057	0.057	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725661.812	525318.21	STUDY AREA 2	8	A	BC-COR-37A	0	0.3	0.15	0.0013	ND(0.0026)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.0013
1725661.812	525318.21	STUDY AREA 2	8	A	BC-COR-37A	0	0.3	0.15	0.00022	ND(0.00044)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00022
1725661.812	525318.21	STUDY AREA 2	8	A	BC-COR-37A	0	0.3	0.15	0.000225	ND(0.00045)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.000225
1725661.812	525318.21	STUDY AREA 2	8	A	BC-COR-37B	0	0.2	0.1	0.0044	0.0044	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725661.812	525318.21	STUDY AREA 2	8	A	BC-COR-37B	0	0.2	0.1	0.0011	0.0011	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725661.812	525318.21	STUDY AREA 2	8	A	BC-COR-37B	0	0.2	0.1	0.0005	ND(0.001)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.0005
1725661.812	525318.21	STUDY AREA 2	8	A	COR-37	0	0	0	0.0031	0.0031	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725624.228	524781.605	STUDY AREA 2	8	A	COR-38	0	0	0	0.25	0.25	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725624.228	524781.605	STUDY AREA 2	8	A	COR-38	0	2	1	0.0087	0.0087	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725521.03	524433.4759	STUDY AREA 2	8	A	DSD-1	0	0.5	0.25	190	190 D E	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725591.764	524574.9435	STUDY AREA 2	8	A	DSD-2	0	0.5	0.25	0.083	0.083	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725642.288	524736.6206	STUDY AREA 2	8	A	DSD-3	0	0.5	0.25	0.038	0.038	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725728.179	524908.4026	STUDY AREA 2	8	A	DSD-4	0	0.5	0.25	3.6	3.6 E	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725809.018	525075.1322	STUDY AREA 2	8	A	DSD-5	0	0.5	0.25	4	4 E	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725834.28	525267.1238	STUDY AREA 2	8	A	Kanawha River - MP 42.2 east-upper layer	0	0.5	0.25	0.00864	0.00864	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725894.229	525320.3805	STUDY AREA 2	8	A	KRSD-20	0	0.5	0.25	0.0723	0.0723 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725894.229	525320.3805	STUDY AREA 2	8	A	KRSD-20	0	2	1	0.116	0.116 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725894.229	525320.3805	STUDY AREA 2	8	A	KRSD-20	2	4	3	0.00075	0.00075	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725894.229	525320.3805	STUDY AREA 2	8	A	KRSD-20	4	6	5	0.00024	0.00024 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725894.229	525320.3805	STUDY AREA 2	8	A	KRSD-20	6	8	7	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725496.058	524383.5436	STUDY AREA 2	8	A	KRSO-31	1.7	-	1.7	1.02	1.02 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725820.466	525097.23	STUDY AREA 2	8	A	KRSO-32	1.7	-	1.7	0.564	0.564 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725820.466	525097.23	STUDY AREA 2	8	A	KRSO-32	1.7	-	1.7	0.278	0.278	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.421
1725911.711	525259.6332	STUDY AREA 2	8	A	KRSO-33	0.8	-	0.8	0.106	0.106	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725288.684	525682.336	STUDY AREA 2	8	A	SSD-23	0	0	0	0.074	0.074	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1724912.695	524969.985	STUDY AREA 2	8	A	SSD-24	0	0	0	0.00085	ND(0.0017)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00085
1726243.525	525757.2077	STUDY AREA 2	8	B	ASD-10	0	0.5	0.25	1.1	1.1 E	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726152.582	525585.4258	STUDY AREA 2	8	B	ASD-7	0	0.5	0.25	1.3	1.3 E	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726529.974	526203.831	STUDY AREA 2	8	B	COR-35	0	0	0	0.055	0.055	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726529.974	526203.831	STUDY AREA 2	8	B	COR-35	0	2	1	0.0036	0.0036	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726529.974	526203.831	STUDY AREA 2	8	B	COR-35	0	2	1	0.003	0.003	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.0033
1726529.974	526203.831	STUDY AREA 2	8	B	COR-35	2	4	3	0.00017	ND(0.00034)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00017
1726529.974	526203.831	STUDY AREA 2	8	B	COR-35	4	4.5	4.25	0.00019	ND(0.00038)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00019

TABLE Q.7

SWAC CALCULATION
STUDY AREA 02 - HALF MILE 08
KANAWHA RIVER, WEST VIRGINIA

Coordinate Remark	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
Surveyed	Bank - Right	Kanawha River	KR-COR-39	42	SE-031884-112807-DD-011	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-39	42	SE-031884-120407-DD-083	12/4/2007	(0-17) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-39	42	SE-031884-120407-DD-084	12/4/2007	(17-33.5) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-40	42.1	SE-031884-112807-DD-010	11/28/2007	(0-0)	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-40	42.1	SE-031884-120407-DD-079	12/4/2007	(0-24) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-40	42.1	SE-031884-120908-SG-003	12/9/2008	(0-24) IN	-	Diox Fur	Sediment	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-40	42.1	SE-031884-120407-DD-080	12/4/2007	(24-40) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-40	42.1	SE-031884-120908-SG-004	12/9/2008	(24-48) IN	-	Diox Fur	Sediment	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-40	42.1	SE-031884-120908-SG-005	12/9/2008	(48-66) IN	-	Diox Fur	Sediment	KR
-	-	Kanawha River	KR-KRSD-21	42.1	R380975	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-21	42.1	R380978	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-21	42.1	R380976	5/17/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-21	42.1	R380977	5/17/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
Traced - 20130116	ACS Outfall 001	Kanawha River	KR-KRSO-25	42.5	R3109128	9/1/2001	(7-) IN	-	Diox Fur	Sediment	KR
Traced - 20130116	FMC Outfall 003	Kanawha River	KR-KRSO-27	42.5	R3109127	9/1/2001	(18-) IN	-	Diox Fur	Sediment	KR
-	-	Flexsys Solutia	SOL-ASD-2	NA	ASD-2-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Kanawha River	KR-BC-COR-37A	41.8	S-031884-022408-DD-459 (A)	3/28/2008	(0-3) IN	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-BC-COR-37A	41.8	S-031884-022408-DD-459 (B)	3/28/2008	(0-3) IN	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-BC-COR-37A	41.8	S-031884-022408-DD-459 (C)	3/28/2008	(0-3) IN	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-BC-COR-37B	41.8	S-031884-022408-DD-460 (A)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-BC-COR-37B	41.8	S-031884-022408-DD-460 (B)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-BC-COR-37B	41.8	S-031884-022408-DD-460 (C)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-37	41.8	SE-031884-112807-DD-015	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-38	41.9	SE-031884-112807-DD-012	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-38	41.9	SE-031884-120407-DD-085	12/4/2007	(0-24) IN	-	Diox Fur	SE	KR
-	-	Flexsys Solutia	SOL-DSD-1	42	DSD-1-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Flexsys Solutia	SOL-DSD-2	42	DSD-2-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Flexsys Solutia	SOL-DSD-3	41.9	DSD-3-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Flexsys Solutia	SOL-DSD-4	41.9	DSD-4-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Flexsys Solutia	SOL-DSD-5	41.8	DSD-5-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Kanawha River	KR-D-34	NA	D-34	5/12/1999	-	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-20	41.8	R380974	5/17/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-20	41.8	R380970	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-20	41.8	R380971	5/17/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-20	41.8	R380972	5/17/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-20	41.8	R380973	5/17/2000	(6-8) ft BGS	-	Diox Fur	SE	KR
Traced - 20130116	Flexsys/Solutia Outfall 007	Kanawha River	KR-KRSO-31	42.4	R3109126	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Traced - 20130116	Monsanto 002	Kanawha River	KR-KRSO-32	42.45	R3109124	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Traced - 20130116	Monsanto 002	Kanawha River	KR-KRSO-32	42.45	R3109125	9/1/2001	(20-) IN	Duplicate	Diox Fur	Sediment	KR
Traced - 20130116	Flexsys/Solutia Outfall 008	Kanawha River	KR-KRSO-33	42.2	R3109123	9/1/2001	(10-) IN	-	Diox Fur	Sediment	KR
Surveyed	-	Kanawha River	KR-SSD-23	NA	SE-031884-112807-DD-014	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
Surveyed	-	Kanawha River	KR-SSD-24	NA	SE-031884-112807-DD-013	11/28/2007	(0-0) IN	-	Diox Fur	SE	KR
-	-	Flexsys Solutia	SOL-ASD-10	41.7	ASD-10-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Flexsys Solutia	SOL-ASD-7	41.7	ASD-7-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
Surveyed	Bank - Right	Kanawha River	KR-COR-35	41.6	SE-031884-112907-DD-017	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-35	41.6	SE-031884-120507-DD-086	12/5/2007	(0-24) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-35	41.6	SE-031884-120507-DD-087	12/5/2007	(0-24) IN	Duplicate	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-35	41.6	SE-031884-120507-DD-088	12/5/2007	(24-48) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-35	41.6	SE-031884-120507-DD-089	12/5/2007	(48-54) IN	-	Diox Fur	SE	KR

TABLE Q.7

SWAC CALCULATION
STUDY AREA 02 - HALF MILE 08
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	Y Coordinate	Study Area	Half Mile	Quarter Mile	Location Name	All Depth (ft) - TOP	All Depth (ft) - BOT	Mid Depth (ft)	TCDD Study Area 2 Half Mile 8	Original Result	Chemical Name	Concentration Unit	RDL Half
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	0	0	0	0.0056	0.0056	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	0	2	1	0.027	0.027	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	0	2	1	0.15	0.15	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	2	4	3	3.3	3.3 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	2	4	3	2.3	2.3 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	2	4	3	1.6	1.6 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	1.95
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	4	6	5	25	25 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	4	6	5	18	18 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	6	8	7	3.8	3.8 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	8	9	8.5	0.21	0.21	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725482.782	525953.061	STUDY AREA 2	8	B	COR-36A	0	0.9	0.45	0.000325	ND(0.00065)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.000325
1726064.552	526781.794	STUDY AREA 2	8	B	COR-36B	0	1	0.5	0.025	0.025	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726324.364	525918.8849	STUDY AREA 2	8	B	ESD-1	0	0.5	0.25	1.7	1.7 E	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726516.355	526176.5579	STUDY AREA 2	8	B	ESD-2	0	0.5	0.25	0.041	0.041	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726662.875	526312.973	STUDY AREA 2	8	B	ESD-3	0	0.5	0.25	0.0031	0.0031	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726199.972	525699.3965	STUDY AREA 2	8	B	Kanawha R - near Monsanto MP 42.2	0	0.5	0.25	0.95168	0.95168	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726095.15	525818.87	STUDY AREA 2	8	B	KD-203	0	0.5	0.25	0.024	0.024	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725737.755	526428.3107	STUDY AREA 2	8	B	KRSD-19	0	0.5	0.25	0.00733	0.00733 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725737.755	526428.3107	STUDY AREA 2	8	B	KRSD-19	0	2	1	0.0232	0.0232 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725737.755	526428.3107	STUDY AREA 2	8	B	KRSD-19	2	4	3	0.0963	0.0963	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725737.755	526428.3107	STUDY AREA 2	8	B	KRSD-19	4	6	5	1.72	1.72	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726107.611	525629.948	STUDY AREA 2	8	B	KRSO-34	1.7	-	1.7	3.57	3.57	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726107.611	525629.948	STUDY AREA 2	8	B	KRSO-34	1.7	-	1.7	2.3	2.3 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	2.935
1729776.184	524403.2327	STUDY AREA 2	8	B	KRSO-49	1.7	-	1.7	0.0029	0.0029	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726471.539	527137.718	STUDY AREA 2	9	A	COR-33	0	0	0	0.015	0.015	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726471.539	527137.718	STUDY AREA 2	9	A	COR-33	0	1.8	0.9	0.19	0.19	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726738.95	526682.229	STUDY AREA 2	9	A	COR-34	0	0	0	0.021	0.021	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726186.614	526956.636	STUDY AREA 2	9	A	COR-36C	0	2	1	0.46	0.46 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726186.614	526956.636	STUDY AREA 2	9	A	COR-36C	2	3.3	2.65	0.16	0.16	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727588.705	526314.1448	STUDY AREA 2	9	A	Frmr AES property culvert, NE corner	0	0.5	0.25	0.694	0.694	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727147.907	526803.0569	STUDY AREA 2	9	A	FSD-2	0	0.5	0.25	0.009	0.009	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727365.161	526939.472	STUDY AREA 2	9	A	FSD-3	0	0.5	0.25	0.022	0.022	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727547.007	527048.0989	STUDY AREA 2	9	A	FSD-4	0	0.5	0.25	0.015	0.015	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727153.148	526797.7927	STUDY AREA 2	9	A	KRSD-18	0	0.5	0.25	0.0106	0.0106 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727153.148	526797.7927	STUDY AREA 2	9	A	KRSD-18	0	2	1	0.0839	0.0839	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727153.148	526797.7927	STUDY AREA 2	9	A	KRSD-18	0	2	1	0.00871	0.00871	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727153.148	526797.7927	STUDY AREA 2	9	A	KRSD-18	2	4	3	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727588.705	527023.5367	STUDY AREA 2	9	A	Old Nitro LF/Mon Dump,I64 S ditchline	0	0.5	0.25	0.274	0.274	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727722.915	527119.4004	STUDY AREA 3	9	A	Old Nitro LF/Mon Dump,I64 N ditchline	0	0.5	0.25	0.865	0.865	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-

TABLE Q.7

SWAC CALCULATION
STUDY AREA 02 - HALF MILE 08
KANAWHA RIVER, WEST VIRGINIA

Coordinate Remark	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-112907-DD-016	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-120507-DD-123	12/5/2007	(0-24) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-121008-SG-007	12/10/2008	(0-24) IN	-	Diox Fur	Sediment	KR
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-120507-DD-124	12/5/2007	(24-48) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-121008-SG-008	12/10/2008	(24-48) IN	-	Diox Fur	Sediment	KR
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-121008-SG-009	12/10/2008	(24-48) IN	Duplicate	Diox Fur	Sediment	KR
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-121008-SG-010	12/10/2008	(48-72) IN	-	Diox Fur	Sediment	KR
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-120507-DD-125	12/5/2007	(48-72) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-121008-SG-011	12/10/2008	(72-96) IN	-	Diox Fur	Sediment	KR
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-121008-SG-012	12/10/2008	(96-108) IN	-	Diox Fur	Sediment	KR
Surveyed	Bank - Left	Kanawha River	KR-COR-36A	41.7	SE-031884-121008-SG-006	12/10/2008	(0-10.5) IN	-	Diox Fur	Sediment	KR
Surveyed	Bank - Left	Kanawha River	KR-COR-36B	41.5	SE-031884-121008-SG-013	12/10/2008	(0-12) IN	-	Diox Fur	Sediment	KR
-	-	Flexsys Solutia	SOL-ESD-1	41.6	ESD-1-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Flexsys Solutia	SOL-ESD-2	41.5	ESD-2-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Flexsys Solutia	SOL-ESD-3	41.4	ESD-3-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Kanawha River	KR-D-08	NA	D-08	11/9/1998	-	-	Diox Fur	SE	KR
Traced	-	Kanawha River	KRKD-203	NA	SD-31884-10292004-KD-203	10/28/2004	-	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-19	41.5	R380956	5/16/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-19	41.5	R380953	5/16/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-19	41.5	R380954	5/16/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-19	41.5	R380955	5/16/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
Traced - 20130116	Flexsys/Solutia Outfall 006	Kanawha River	KR-KRSO-34	42.1	R3109122	9/1/2001	(20-) IN	Duplicate	Diox Fur	Sediment	KR
Traced - 20130116	Flexsys/Solutia Outfall 006	Kanawha River	KR-KRSO-34	42.1	R3109121	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Traced - 20130116	Nitro Sanitary Board Outfall 007	Kanawha River	KR-KRSO-49	AC	R3109146	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Surveyed	Bank - Left	Kanawha River	KR-COR-33	41.3	SE-031884-112907-DD-019	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Left	Kanawha River	KR-COR-33	41.3	SE-031884-120607-DD-128	12/6/2007	(0-21) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-34	41.4	SE-031884-112907-DD-018	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Left	Kanawha River	KR-COR-36C	41.4	SE-031884-121008-SG-014	12/10/2008	(0-24) IN	-	Diox Fur	Sediment	KR
Surveyed	Bank - Left	Kanawha River	KR-COR-36C	41.4	SE-031884-121008-SG-015	12/10/2008	(24-40) IN	-	Diox Fur	Sediment	KR
-	-	AES Property	AES-D-72	NA	D-72	6/16/1997	-	-	Diox Fur	SE	AES
-	-	Flexsys Solutia	SOL-FSD-2	41.3	FSD-2-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Flexsys Solutia	SOL-FSD-3	41.3	FSD-3-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Flexsys Solutia	SOL-FSD-4	41.2	FSD-4-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Kanawha River	KR-KRSD-18	41.4	R380969	5/17/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-18	41.4	R380969	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-18	41.4	R380967	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-18	41.4	R380968	5/17/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
-	-	AES Property	AES-D-71	NA	D-71	6/16/1997	-	-	Diox Fur	SE	AES
-	-	AES Property	AES-D-70	NA	D-70	6/16/1997	-	-	Diox Fur	SE	AES

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.8

SWAC CALCULATION
STUDY AREA 02 -HALF MILE 09
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	Y Coordinate	Study Area	Half Mile	Quarter Mile	Location Name	All Depth (ft) - TOP	All Depth (ft) - BOT	Mid Depth (ft)	TCDD Study Area 2 Half Mile 9	Original Result	Chemical Name	Concentration Unit	RDL Half
1726243.525	525757.2077	STUDY AREA 2	8	B	ASD-10	0	0.5	0.25	1.1	1.1 E	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726152.582	525585.4258	STUDY AREA 2	8	B	ASD-7	0	0.5	0.25	1.3	1.3 E	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726529.974	526203.831	STUDY AREA 2	8	B	COR-35	0	0	0	0.055	0.055	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726529.974	526203.831	STUDY AREA 2	8	B	COR-35	0	2	1	0.0036	0.0036	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726529.974	526203.831	STUDY AREA 2	8	B	COR-35	0	2	1	0.003	0.003	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.0033
1726529.974	526203.831	STUDY AREA 2	8	B	COR-35	2	4	3	0.00017	ND(0.00034)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00017
1726529.974	526203.831	STUDY AREA 2	8	B	COR-35	4	4.5	4.25	0.00019	ND(0.00038)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00019
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	0	0	0	0.0056	0.0056	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	0	2	1	0.027	0.027	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	0	2	1	0.15	0.15	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	2	4	3	3.3	3.3 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	2	4	3	2.3	2.3 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	2	4	3	1.6	1.6 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	1.95
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	4	6	5	25	25 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	4	6	5	18	18 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	6	8	7	3.8	3.8 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725671.896	526314.211	STUDY AREA 2	8	B	COR-36	8	9	8.5	0.21	0.21	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725482.782	525953.061	STUDY AREA 2	8	B	COR-36A	0	0.9	0.45	0.000325	ND(0.00065)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.000325
1726064.552	526781.794	STUDY AREA 2	8	B	COR-36B	0	1	0.5	0.025	0.025	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726324.364	525918.8849	STUDY AREA 2	8	B	ESD-1	0	0.5	0.25	1.7	1.7 E	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726516.355	526176.5579	STUDY AREA 2	8	B	ESD-2	0	0.5	0.25	0.041	0.041	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726662.875	526312.973	STUDY AREA 2	8	B	ESD-3	0	0.5	0.25	0.0031	0.0031	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726199.972	525699.3965	STUDY AREA 2	8	B	Kanawha R - near Monsanto MP 42.2	0	0.5	0.25	0.95168	0.95168	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726095.15	525818.87	STUDY AREA 2	8	B	KD-203	0	0.5	0.25	0.024	0.024	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725737.755	526428.3107	STUDY AREA 2	8	B	KRSD-19	0	0.5	0.25	0.00733	0.00733 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725737.755	526428.3107	STUDY AREA 2	8	B	KRSD-19	0	2	1	0.0232	0.0232 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725737.755	526428.3107	STUDY AREA 2	8	B	KRSD-19	2	4	3	0.0963	0.0963	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1725737.755	526428.3107	STUDY AREA 2	8	B	KRSD-19	4	6	5	1.72	1.72	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726107.611	525629.948	STUDY AREA 2	8	B	KRSO-34	1.7	-	1.7	3.57	3.57	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726107.611	525629.948	STUDY AREA 2	8	B	KRSO-34	1.7	-	1.7	2.3	2.3 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	2.935
1729776.184	524403.2327	STUDY AREA 2	8	B	KRSO-49	1.7	-	1.7	0.0029	0.0029	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726471.539	527137.718	STUDY AREA 2	9	A	COR-33	0	0	0	0.015	0.015	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726471.539	527137.718	STUDY AREA 2	9	A	COR-33	0	1.8	0.9	0.19	0.19	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726738.95	526682.229	STUDY AREA 2	9	A	COR-34	0	0	0	0.021	0.021	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726186.614	526956.636	STUDY AREA 2	9	A	COR-36C	0	2	1	0.46	0.46 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1726186.614	526956.636	STUDY AREA 2	9	A	COR-36C	2	3.3	2.65	0.16	0.16	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727588.705	526314.1448	STUDY AREA 2	9	A	Frmr AES property culvert, NE corner	0	0.5	0.25	0.694	0.694	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727147.907	526803.0569	STUDY AREA 2	9	A	FSD-2	0	0.5	0.25	0.009	0.009	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727365.161	526939.472	STUDY AREA 2	9	A	FSD-3	0	0.5	0.25	0.022	0.022	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727547.007	527048.0989	STUDY AREA 2	9	A	FSD-4	0	0.5	0.25	0.015	0.015	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727153.148	526797.7927	STUDY AREA 2	9	A	KRSD-18	0	0.5	0.25	0.0106	0.0106 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727153.148	526797.7927	STUDY AREA 2	9	A	KRSD-18	0	2	1	0.0839	0.0839	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727153.148	526797.7927	STUDY AREA 2	9	A	KRSD-18	0	2	1	0.00871	0.00871	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727153.148	526797.7927	STUDY AREA 2	9	A	KRSD-18	2	4	3	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727588.705	527023.5367	STUDY AREA 2	9	A	Old Nitro LF/Mon Dump,I64 S ditchline	0	0.5	0.25	0.274	0.274	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727722.915	527119.4004	STUDY AREA 3	9	A	Old Nitro LF/Mon Dump,I64 N ditchline	0	0.5	0.25	0.865	0.865	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1730785.38	525643.4533	STUDY AREA 3	9	B	Armour Creek I64 Bridge	0	0.5	0.25	0.0041	0.0041	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727874.335	528076.747	STUDY AREA 3	9	B	COR-32A	0	1.5	0.75	0.000275	ND(0.00055)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.000275
1728102.813	527404.2939	STUDY AREA 3	9	B	CSD-2	0	0.5	0.25	0.035	0.035	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1728405.957	527550.8138	STUDY AREA 3	9	B	CSD-7	0	0.5	0.25	0.097	0.097	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1728567.634	527636.7048	STUDY AREA 3	9	B	CSD-9	0	0.5	0.25	0.36	0.36	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1728655.989	527796.8377	STUDY AREA 3	9	B	Flexsys, swale, 150yds upgrad along E ba	0	0.5	0.25	0.0117	0.0117	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727835.035	527257.774	STUDY AREA 3	9	B	FSD-5	0	0.5	0.25	1	1 E	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-

TABLE Q.8

SWAC CALCULATION
STUDY AREA 02 -HALF MILE 09
KANAWHA RIVER, WEST VIRGINIA

Coordinate Remark	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*	
-	-	Flexsys Solutia	SOL-ASD-10	41.7	ASD-10-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
-	-	Flexsys Solutia	SOL-ASD-7	41.7	ASD-7-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
Surveyed	Bank - Right	Kanawha River	KR-COR-35	41.6	SE-031884-112907-DD-017	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	
Surveyed	Bank - Right	Kanawha River	KR-COR-35	41.6	SE-031884-120507-DD-086	12/5/2007	(0-24) IN	-	Diox Fur	SE	KR	
Surveyed	Bank - Right	Kanawha River	KR-COR-35	41.6	SE-031884-120507-DD-087	12/5/2007	(0-24) IN	Duplicate	Diox Fur	SE	KR	
Surveyed	Bank - Right	Kanawha River	KR-COR-35	41.6	SE-031884-120507-DD-088	12/5/2007	(24-48) IN	-	Diox Fur	SE	KR	
Surveyed	Bank - Right	Kanawha River	KR-COR-35	41.6	SE-031884-120507-DD-089	12/5/2007	(48-54) IN	-	Diox Fur	SE	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-112907-DD-016	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-120507-DD-123	12/5/2007	(0-24) IN	-	Diox Fur	SE	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-121008-SG-007	12/10/2008	(0-24) IN	-	Diox Fur	Sediment	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-120507-DD-124	12/5/2007	(24-48) IN	-	Diox Fur	SE	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-121008-SG-008	12/10/2008	(24-48) IN	-	Diox Fur	Sediment	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-121008-SG-009	12/10/2008	(24-48) IN	Duplicate	Diox Fur	Sediment	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-121008-SG-010	12/10/2008	(48-72) IN	-	Diox Fur	Sediment	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-120507-DD-125	12/5/2007	(48-72) IN	-	Diox Fur	SE	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-121008-SG-011	12/10/2008	(72-96) IN	-	Diox Fur	Sediment	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-36	41.6	SE-031884-121008-SG-012	12/10/2008	(96-108) IN	-	Diox Fur	Sediment	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-36A	41.7	SE-031884-121008-SG-006	12/10/2008	(0-10.5) IN	-	Diox Fur	Sediment	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-36B	41.5	SE-031884-121008-SG-013	12/10/2008	(0-12) IN	-	Diox Fur	Sediment	KR	
-	-	Flexsys Solutia	SOL-ESD-1	41.6	ESD-1-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
-	-	Flexsys Solutia	SOL-ESD-2	41.5	ESD-2-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
-	-	Flexsys Solutia	SOL-ESD-3	41.4	ESD-3-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
-	-	Kanawha River	KR-D-08	NA	D-08	11/9/1998	-	-	Diox Fur	SE	KR	
Traced	-	Kanawha River	KRKD-203	NA	SD-31884-10292004-KD-203	10/28/2004	-	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-19	41.5	R380956	5/16/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-19	41.5	R380953	5/16/2000	(0-2) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-19	41.5	R380954	5/16/2000	(2-4) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-19	41.5	R380955	5/16/2000	(4-6) ft BGS	-	Diox Fur	SE	KR	
Traced - 20130116	Flexsys/Solutia Outfall 006	Kanawha River	KR-KRSO-34	42.1	R3109122	9/1/2001	(20-) IN	Duplicate	Diox Fur	Sediment	KR	
Traced - 20130116	Flexsys/Solutia Outfall 006	Kanawha River	KR-KRSO-34	42.1	R3109121	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR	
Traced - 20130116	Nitro Sanitary Board Outfall 007	Kanawha River	KR-KRSO-49	AC	R3109146	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-33	41.3	SE-031884-112907-DD-019	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-33	41.3	SE-031884-120607-DD-128	12/6/2007	(0-21) IN	-	Diox Fur	SE	KR	
Surveyed	Bank - Right	Kanawha River	KR-COR-34	41.4	SE-031884-112907-DD-018	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-36C	41.4	SE-031884-121008-SG-014	12/10/2008	(0-24) IN	-	Diox Fur	Sediment	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-36C	41.4	SE-031884-121008-SG-015	12/10/2008	(24-40) IN	-	Diox Fur	Sediment	KR	
-	-	AES Property	AES-D-72	NA	D-72	6/16/1997	-	-	Diox Fur	SE	AES	
-	-	Flexsys Solutia	SOL-FSD-2	41.3	FSD-2-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
-	-	Flexsys Solutia	SOL-FSD-3	41.3	FSD-3-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
-	-	Flexsys Solutia	SOL-FSD-4	41.2	FSD-4-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
-	-	Kanawha River	KR-KRSD-18	41.4	R380969	5/17/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-18	41.4	R380969	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-18	41.4	R380967	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-18	41.4	R380968	5/17/2000	(2-4) ft BGS	-	Diox Fur	SE	KR	
-	-	AES Property	AES-D-71	NA	D-71	6/16/1997	-	-	Diox Fur	SE	AES	
-	-	AES Property	AES-D-70	NA	D-70	6/16/1997	-	-	Diox Fur	SE	AES	
-	-	Kanawha River	KR-ARM_CR-I-64BRIDGE	NA	R3809H9	5/17/2000	-	-	Diox Fur	SE	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-32A	41.1	SE-031884-121108-SG-021	12/11/2008	(0-18.5) IN	-	Diox Fur	Sediment	KR	
-	-	Flexsys Solutia	SOL-CSD-2	41.1	CSD-2-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
-	-	Flexsys Solutia	SOL-CSD-7	41.1	CSD-7-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
-	-	Flexsys Solutia	SOL-CSD-9	41	CSD-9-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
-	-	AES Property	AES-D-75	NA	D-75	6/16/1997	-	-	Diox Fur	SE	AES	
-	-	Flexsys Solutia	SOL-FSD-5	41.2	FSD-5-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	Avg Sample/Dup

TABLE Q.8

SWAC CALCULATION
STUDY AREA 02 -HALF MILE 09
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	Y Coordinate	Study Area	Half Mile	Quarter Mile	Location Name	All Depth (ft) - TOP	All Depth (ft) - BOT	Mid Depth (ft)	TCDD Study Area 2 Half Mile 9	Original Result	Chemical Name	Concentration Unit	RDL Half
1728835.412	527773.1199	STUDY AREA 3	9	B	GSD-1	0	0.5	0.25	0.0098	0.0098	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1729022.35	527655.0596	STUDY AREA 3	9	B	Kanawha R - near Monsanto MP 41.8	0	0.5	0.25	1.648202	1.648202	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1728385.748	527591.2331	STUDY AREA 3	9	B	Kanawha River - MP 41.8 east	0	0.5	0.25	0.038	0.038	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727892.43	527599.81	STUDY AREA 3	9	B	KD-202	0	0.5	0.25	0.071	0.071	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727843.605	527294.0923	STUDY AREA 3	9	B	KRSD-17	0	0.5	0.25	0.0591	0.0591	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727843.605	527294.0923	STUDY AREA 3	9	B	KRSD-17	0	2	1	0.0744	0.0744	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727843.605	527294.0923	STUDY AREA 3	9	B	KRSD-17	2	4	3	0.00054	0.00054 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1727740.365	527247.9854	STUDY AREA 3	9	B	KRSO-36	1.7	-	1.7	0.416	0.416 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1728652.417	527770.0613	STUDY AREA 3	9	B	KRSO-38	1.7	-	1.7	0.315	0.315 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1728722.026	527776.066	STUDY AREA 3	9	B	SSD-22	0	0	0	0.015	0.015	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1729351.571	528429.188	STUDY AREA 3	10	A	COR-31	0	0	0	0.0039	0.0039	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1728887.369	528174.214	STUDY AREA 3	10	A	COR-32	0	0	0	0.012	0.012	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1728994.707	527988.5652	STUDY AREA 3	10	A	Flexsys, E bank swale sediment	0	0.5	0.25	0.00962	0.00962	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1729812.745	527675.4103	STUDY AREA 3	10	A	Flexsys, NE fenceline drainage ditch	0	0.5	0.25	0.376	0.376	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1729026.662	527892.7014	STUDY AREA 3	10	A	Flexsys, swale comp 90 above riprap	0	0.5	0.25	0.0176	0.0176	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1728189.452	528372.0203	STUDY AREA 3	10	A	Flexsys, W bank swale	0	0.5	0.25	0.0132	0.0132	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1729017.299	527869.1158	STUDY AREA 3	10	A	GSD-2	0	0.5	0.25	0.01	0.01	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1729204.238	527965.1116	STUDY AREA 3	10	A	GSD-3	0	0.5	0.25	0.0018	0.0018	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1729376.02	528061.1074	STUDY AREA 3	10	A	GSD-4	0	0.5	0.25	0.0067	0.0067	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1729583.169	528187.4177	STUDY AREA 3	10	A	GSD-6	0	0.5	0.25	0.0067	0.0067	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1729777.74	528295.1182	STUDY AREA 3	10	A	KRSD-16	0	0.5	0.25	0.0957	0.0957	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1729777.74	528295.1182	STUDY AREA 3	10	A	KRSD-16	0	2	1	0.00286	0.00286 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1729777.74	528295.1182	STUDY AREA 3	10	A	KRSD-16	2	4	3	0.00068	0.00068 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.8

SWAC CALCULATION
STUDY AREA 02 -HALF MILE 09
KANAWHA RIVER, WEST VIRGINIA

Coordinate Remark	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
-	-	Flexsys Solutia	SOL-GSD-1	41	GSD-1-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Kanawha River	KR-D-10	NA	D-10	11/9/1998	-	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-D-36	NA	D-36	5/12/1999	-	-	Diox Fur	SE	KR
Traced	-	Kanawha River	KRKD-202	NA	SD-31884-10282004-KD-202	10/28/2004	-	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-17	40.7	R380946	5/15/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-17	40.7	R380944	5/15/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-17	40.7	R380945	5/15/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
Traced - 20130116	I-64 Stormwater Outfall	Kanawha River	KR-KRSO-36	41.85	R3109120	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Traced - 20130116	Flexsys/Solutia Outfall 001	Kanawha River	KR-KRSO-38	41.7	R3109119	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR
Surveyed	-	Kanawha River	KR-SSD-22	NA	SE-031884-112907-DD-020	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Centre	Kanawha River	KR-COR-31	40.8	SE-031884-112907-DD-023	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Centre	Kanawha River	KR-COR-32	40.9	SE-031884-112907-DD-021	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR
-	-	AES Property	AES-D-74	NA	D-74	6/16/1997	-	-	Diox Fur	SE	AES
-	-	AES Property	AES-D-73	NA	D-73	6/16/1997	-	-	Diox Fur	SE	AES
-	-	AES Property	AES-D-69	NA	D-69	6/16/1997	-	-	Diox Fur	SE	AES
-	-	AES Property	AES-D-76	NA	D-76	6/16/1997	-	-	Diox Fur	SE	AES
-	-	Flexsys Solutia	SOL-GSD-2	40.9	GSD-2-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Flexsys Solutia	SOL-GSD-3	40.9	GSD-3-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Flexsys Solutia	SOL-GSD-4	40.8	GSD-4-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Flexsys Solutia	SOL-GSD-6	40.7	GSD-6-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL
-	-	Kanawha River	KR-KRSD-16	40.7	R380966	5/17/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-16	40.7	R380964	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-16	40.7	R380965	5/17/2000	(2-4) ft BGS	-	Diox Fur	SE	KR

TABLE Q.9

SWAC CALCULATION
STUDY AREA 03 - HALF MILE 10
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	Y Coordinate	Study Area	Half Mile	Quarter Mile	Location Name	All Depth (ft) - TOP	All Depth (ft) - BOT	Mid Depth (ft)	TCDD Study Area 3 Half Mile 10	Original Result	Chemical Name
1730785.38	525643.4533	STUDY AREA 3	9	B	Armour Creek I64 Bridge	0	0.5	0.25	0.0041	0.0041	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1727874.335	528076.747	STUDY AREA 3	9	B	COR-32A	0	1.5	0.75	0.000275	ND(0.00055)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1728102.813	527404.2939	STUDY AREA 3	9	B	CSD-2	0	0.5	0.25	0.035	0.035	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1728405.957	527550.8138	STUDY AREA 3	9	B	CSD-7	0	0.5	0.25	0.097	0.097	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1728567.634	527636.7048	STUDY AREA 3	9	B	CSD-9	0	0.5	0.25	0.36	0.36	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1728655.989	527796.8377	STUDY AREA 3	9	B	Flexsys, swale, 150yds upgrad along E ba	0	0.5	0.25	0.0117	0.0117	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1727835.035	527257.774	STUDY AREA 3	9	B	FSD-5	0	0.5	0.25	1	1 E	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1728835.412	527773.1199	STUDY AREA 3	9	B	GSD-1	0	0.5	0.25	0.0098	0.0098	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1729022.35	527655.0596	STUDY AREA 3	9	B	Kanawha R - near Monsanto MP 41.8	0	0.5	0.25	1.648202	1.648202	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1728385.748	527591.2331	STUDY AREA 3	9	B	Kanawha River - MP 41.8 east	0	0.5	0.25	0.038	0.038	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1727892.43	527599.81	STUDY AREA 3	9	B	KD-202	0	0.5	0.25	0.071	0.071	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1727843.605	527294.0923	STUDY AREA 3	9	B	KRSD-17	0	0.5	0.25	0.0591	0.0591	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1727843.605	527294.0923	STUDY AREA 3	9	B	KRSD-17	0	2	1	0.0744	0.0744	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1727843.605	527294.0923	STUDY AREA 3	9	B	KRSD-17	2	4	3	0.00054	0.00054 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1727740.365	527247.9854	STUDY AREA 3	9	B	KRSO-36	1.7	-	1.7	0.416	0.416 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1728652.417	527770.0613	STUDY AREA 3	9	B	KRSO-38	1.7	-	1.7	0.315	0.315 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1728722.026	527776.066	STUDY AREA 3	9	B	SSD-22	0	0	0	0.015	0.015	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1729351.571	528429.188	STUDY AREA 3	10	A	COR-31	0	0	0	0.0039	0.0039	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1728887.369	528174.214	STUDY AREA 3	10	A	COR-32	0	0	0	0.012	0.012	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1728994.707	527988.5652	STUDY AREA 3	10	A	Flexsys, E bank swale sediment	0	0.5	0.25	0.00962	0.00962	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1729812.745	527675.4103	STUDY AREA 3	10	A	Flexsys, NE fenceline drainage ditch	0	0.5	0.25	0.376	0.376	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1729026.662	527892.7014	STUDY AREA 3	10	A	Flexsys, swale comp 90 above riprap	0	0.5	0.25	0.0176	0.0176	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1728189.452	528372.0203	STUDY AREA 3	10	A	Flexsys, W bank swale	0	0.5	0.25	0.0132	0.0132	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1729017.299	527869.1158	STUDY AREA 3	10	A	GSD-2	0	0.5	0.25	0.01	0.01	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1729204.238	527965.1116	STUDY AREA 3	10	A	GSD-3	0	0.5	0.25	0.0018	0.0018	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1729376.02	528061.1074	STUDY AREA 3	10	A	GSD-4	0	0.5	0.25	0.0067	0.0067	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1729583.169	528187.4177	STUDY AREA 3	10	A	GSD-6	0	0.5	0.25	0.0067	0.0067	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1729777.74	528295.1182	STUDY AREA 3	10	A	KRSD-16	0	0.5	0.25	0.0957	0.0957	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1729777.74	528295.1182	STUDY AREA 3	10	A	KRSD-16	0	2	1	0.00286	0.00286 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1729777.74	528295.1182	STUDY AREA 3	10	A	KRSD-16	2	4	3	0.00068	0.00068 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1729846.029	529173.875	STUDY AREA 3	10	B	COR-32B	0	2	1	0.000125	ND(0.00025)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1729846.029	529173.875	STUDY AREA 3	10	B	COR-32B	2	4	3	0.00021	ND(0.00042)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1729846.029	529173.875	STUDY AREA 3	10	B	COR-32B	4	6	5	0.00018	ND(0.00036)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1729846.029	529173.875	STUDY AREA 3	10	B	COR-32B	6	7.7	6.85	0.00039	ND(0.00039)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1731945.86	528219.6555	STUDY AREA 3	10	B	KRSD-59	0	0.5	0.25	0.0142	0.0142	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1731945.86	528219.6555	STUDY AREA 3	10	B	KRSD-59	0	1.7	0.85	0.0207	0.0207	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1731945.86	528219.6555	STUDY AREA 3	10	B	KRSD-59	1.7	3.3	2.5	0.0927	0.0927	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1730478.826	528742.4118	STUDY AREA 3	10	B	KRSO-41	1.7	-	1.7	0.0005	ND(0.001)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1730804.226	528968.935	STUDY AREA 3	10	B	SSD-21	0	0	0	0.01	0.01	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1732444.76	528632.8912	STUDY AREA 3	11	A	Armour Creek 01 - upgradient near I-64	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1732444.76	528610.6677	STUDY AREA 3	11	A	Armour Creek 02-cell and landfill drain	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1732466.984	528610.6677	STUDY AREA 3	11	A	Armour Creek 04-ditchline comp sample	0	0.5	0.25	0.01777	0.01777	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1732436.033	528638.6934	STUDY AREA 3	11	A	Armour Creek Kanawha Stone	0	0.5	0.25	0.013	0.013	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1732069.626	529389.6171	STUDY AREA 3	11	A	Armour Creek Landfill Runoff	0	0.5	0.25	0.0203	0.0203	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1731991.769	529666.211	STUDY AREA 3	11	A	Armour Creek Midwest Steel	0	0.5	0.25	0.0614	0.0614	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1732286.017	527973.2387	STUDY AREA 3	11	A	Armour Creek SR35	0	0.5	0.25	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1732444.76	528610.6677	STUDY AREA 3	11	A	Armour Creek03-ditchline N of road drain	0	0.5	0.25	0.03743	0.03743	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1731467.569	530067.191	STUDY AREA 3	11	A	COR-29	0	0	0	0.0013	0.0013	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1731506.211	529522.487	STUDY AREA 3	11	A	COR-30	0	0	0	0.013	0.013	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1731506.211	529522.487	STUDY AREA 3	11	A	COR-30	0	2	1	0.00018	ND(0.00036)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)

TABLE Q.9

SWAC CALCULATION
STUDY AREA 03 - HALF MILE 10
KANAWHA RIVER, WEST VIRGINIA

Concentration Unit	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*	
ug/kg	-	-	-	Kanawha River	KR-ARM_CR-I-64BRIDGE	NA	R3809H9	5/17/2000	-	-	Diox Fur	SE	KR	
ug/kg	0.000275	Surveyed	Bank - Left	Kanawha River	KR-COR-32A	41.1	SE-031884-121108-SG-021	12/11/2008	(0-18.5) IN	-	Diox Fur	Sediment	KR	
ug/kg	-	-	-	Flexsys Solutia	SOL-CSD-2	41.1	CSD-2-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
ug/kg	-	-	-	Flexsys Solutia	SOL-CSD-7	41.1	CSD-7-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
ug/kg	-	-	-	Flexsys Solutia	SOL-CSD-9	41	CSD-9-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
ug/kg	-	-	-	AES Property	AES-D-75	NA	D-75	6/16/1997	-	-	Diox Fur	SE	AES	
ug/kg	-	-	-	Flexsys Solutia	SOL-FSD-5	41.2	FSD-5-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	Avg Sample/Dup
ug/kg	-	-	-	Flexsys Solutia	SOL-GSD-1	41	GSD-1-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
ug/kg	-	-	-	Kanawha River	KR-D-10	NA	D-10	11/9/1998	-	-	Diox Fur	SE	KR	
ug/kg	-	-	-	Kanawha River	KR-D-36	NA	D-36	5/12/1999	-	-	Diox Fur	SE	KR	
ug/kg	-	Traced	-	Kanawha River	KRKD-202	NA	SD-31884-10282004-KD-202	10/28/2004	-	-	Diox Fur	SE	KR	
ug/kg	-	-	-	Kanawha River	KR-KRSD-17	40.7	R380946	5/15/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR	
ug/kg	-	-	-	Kanawha River	KR-KRSD-17	40.7	R380944	5/15/2000	(0-2) ft BGS	-	Diox Fur	SE	KR	
ug/kg	-	-	-	Kanawha River	KR-KRSD-17	40.7	R380945	5/15/2000	(2-4) ft BGS	-	Diox Fur	SE	KR	
ug/kg	-	Traced - 20130116	I-64 Stormwater Outfall	Kanawha River	KR-KRSO-36	41.85	R3109120	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR	
ug/kg	-	Traced - 20130116	Flexsys/Solutia Outfall 001	Kanawha River	KR-KRSO-38	41.7	R3109119	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR	
ug/kg	-	Surveyed		Kanawha River	KR-SSD-22	NA	SE-031884-112907-DD-020	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	
ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-31	40.8	SE-031884-112907-DD-023	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	
ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-32	40.9	SE-031884-112907-DD-021	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	
ug/kg	-	-	-	AES Property	AES-D-74	NA	D-74	6/16/1997	-	-	Diox Fur	SE	AES	
ug/kg	-	-	-	AES Property	AES-D-73	NA	D-73	6/16/1997	-	-	Diox Fur	SE	AES	
ug/kg	-	-	-	AES Property	AES-D-69	NA	D-69	6/16/1997	-	-	Diox Fur	SE	AES	
ug/kg	-	-	-	AES Property	AES-D-76	NA	D-76	6/16/1997	-	-	Diox Fur	SE	AES	
ug/kg	-	-	-	Flexsys Solutia	SOL-GSD-2	40.9	GSD-2-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
ug/kg	-	-	-	Flexsys Solutia	SOL-GSD-3	40.9	GSD-3-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
ug/kg	-	-	-	Flexsys Solutia	SOL-GSD-4	40.8	GSD-4-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
ug/kg	-	-	-	Flexsys Solutia	SOL-GSD-6	40.7	GSD-6-N	9/24/2001	-	-	Diox Fur	SEDIMENT	SOL	
ug/kg	-	-	-	Kanawha River	KR-KRSD-16	40.7	R380966	5/17/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR	
ug/kg	-	-	-	Kanawha River	KR-KRSD-16	40.7	R380964	5/17/2000	(0-2) ft BGS	-	Diox Fur	SE	KR	
ug/kg	-	-	-	Kanawha River	KR-KRSD-16	40.7	R380965	5/17/2000	(2-4) ft BGS	-	Diox Fur	SE	KR	
ug/kg	0.000125	Surveyed	Bank - Left	Kanawha River	KR-COR-32B	40.7	SE-031884-121108-SG-016	12/11/2008	(0-24) IN	-	Diox Fur	Sediment	KR	
ug/kg	0.00021	Surveyed	Bank - Left	Kanawha River	KR-COR-32B	40.7	SE-031884-121108-SG-017	12/11/2008	(24-48) IN	-	Diox Fur	Sediment	KR	
ug/kg	0.00018	Surveyed	Bank - Left	Kanawha River	KR-COR-32B	40.7	SE-031884-121108-SG-018	12/11/2008	(48-72) IN	-	Diox Fur	Sediment	KR	
ug/kg	0.000195	Surveyed	Bank - Left	Kanawha River	KR-COR-32B	40.7	SE-031884-121108-SG-019	12/11/2008	(72-92) IN	-	Diox Fur	Sediment	KR	
ug/kg	-	-	-	Kanawha River	KR-KRSD-59	NA	R3809H4	5/16/2000	-	-	Diox Fur	SE	KR	
ug/kg	-	-	-	Kanawha River	KR-KRSD-59	NA	R3809G4	5/12/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
ug/kg	-	-	-	Kanawha River	KR-KRSD-59	NA	R3809G5	5/12/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
ug/kg	0.0005	Traced - 20130116	Midwest Steel Area	Kanawha River	KR-KRSO-41	41.7	R3109134	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR	
ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-21	NA	SE-031884-112907-DD-022	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	
ug/kg	0	-	-	Kanawha River	KR-D-15	NA	D-15	11/9/1998	-	-	Diox Fur	SE	KR	
ug/kg	0	-	-	Kanawha River	KR-D-16	NA	D-16	11/9/1998	-	-	Diox Fur	SE	KR	Avg Sample/Dup
ug/kg	-	-	-	Kanawha River	KR-D-18	NA	D-18	11/9/1998	-	-	Diox Fur	SE	KR	
ug/kg	-	-	-	Kanawha River	KR-ARM_CK-KAN_STONE	NA	R3809I2	5/19/2000	-	-	Diox Fur	SE	KR	
ug/kg	-	-	-	Kanawha River	KR-ARM_CK_LF_RO	NA	R3809I0	5/18/2000	-	-	Diox Fur	SE	KR	
ug/kg	-	-	-	Kanawha River	KR-ARM_CK_MW_STEEL	NA	R3809I1	5/18/2000	-	-	Diox Fur	SE	KR	
ug/kg	-	-	-	Kanawha River	KR-ARM_CK-SR_35	NA	R3809I3	5/19/2000	-	-	Diox Fur	SE	KR	
ug/kg	-	-	-	Kanawha River	KR-D-17	NA	D-17	11/9/1998	-	-	Diox Fur	SE	KR	
ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-29	40.3	SE-031884-112907-DD-025	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	
ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-30	40.4	SE-031884-112907-DD-024	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	
ug/kg	0.00018	Surveyed	Bank - Right	Kanawha River	KR-COR-30	40.4	SE-031884-120707-DD-175	12/7/2007	(0-24) IN	-	Diox Fur	SE	KR	

TABLE Q.9

SWAC CALCULATION
STUDY AREA 03 - HALF MILE 10
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	Y Coordinate	Study Area	Half Mile	Quarter Mile	Location Name	All Depth (ft) - TOP	All Depth (ft) - BOT	Mid Depth (ft)	TCDD Study Area 3 Half Mile 10	Original Result	Chemical Name
1731506.211	529522.487	STUDY AREA 3	11	A	COR-30	2	2.5	2.25	0.0021	0.0021	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1731380.207	530548.381	STUDY AREA 3	11	A	KRSD-14	0	2	1	0.00108	0.00108 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1731380.207	530548.381	STUDY AREA 3	11	A	KRSD-14	2	4	3	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1731380.207	530548.381	STUDY AREA 3	11	A	KRSD-14	4	6	5	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1731990.723	529966.9235	STUDY AREA 3	11	A	KRSD-15	0	0.5	0.25	0.021	0.021 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1731990.723	529966.9235	STUDY AREA 3	11	A	KRSD-15	0	2	1	0.227	0.227	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1731990.723	529966.9235	STUDY AREA 3	11	A	KRSD-15	2	4	3	2.02	2.02 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1731990.723	529966.9235	STUDY AREA 3	11	A	KRSD-15	4	6	5	0.748	0.748 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1731990.723	529966.9235	STUDY AREA 3	11	A	KRSD-15	6	8	7	0.00456	0.00456 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1732222.051	528868.6798	STUDY AREA 3	11	A	KRSD-57	0	0.5	0.25	0.0177	0.0177	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1732222.051	528868.6798	STUDY AREA 3	11	A	KRSD-57	0	1.7	0.85	0.163	0.163	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1732222.051	528868.6798	STUDY AREA 3	11	A	KRSD-57	1.7	3.3	2.5	0.414	0.414	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1732220.723	528901.9262	STUDY AREA 3	11	A	KRSD-58	0	0.5	0.25	0.014	0.014	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1732220.723	528901.9262	STUDY AREA 3	11	A	KRSD-58	0	1.7	0.85	0.0182	0.0182	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1732220.723	528901.9262	STUDY AREA 3	11	A	KRSD-58	1.7	3.3	2.5	0.044	0.044	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
1731141.534	529203.5813	STUDY AREA 3	11	A	KRSO-42	1.7		1.7	0.0005	ND(0.001)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.9

SWAC CALCULATION
STUDY AREA 03 - HALF MILE 10
KANAWHA RIVER, WEST VIRGINIA

Concentration Unit	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-30	40.4	SE-031884-120707-DD-174	12/7/2007	(24-30) IN	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-14	40.2	R380941	5/15/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-14	40.2	R380942	5/15/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-14	40.2	R380943	5/15/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-15	40.3	R380952	5/16/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-15	40.3	R380948	5/15/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-15	40.3	R380949	5/15/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-15	40.3	R380950	5/15/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-15	40.3	R380951	5/15/2000	(6-8) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-57	NA	R3809H2	5/16/2000	-	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-57	NA	R3809G0	5/12/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	-	-	Kanawha River	KR-KRSD-57	NA	R3809G1	5/12/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	Traced - 20130116	-	Kanawha River	KR-KRSD-58	NA	R3809H3	5/16/2000	-	-	Diox Fur	SE	KR
ug/kg	-	Traced - 20130116	-	Kanawha River	KR-KRSD-58	NA	R3809G2	5/12/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR
ug/kg	-	Traced - 20130116	-	Kanawha River	KR-KRSD-58	NA	R3809G3	5/12/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR
ug/kg	0.0005	Traced - 20130116	Midwest Steel Area	Kanawha River	KR-KRSO-42	41.65	R3109135	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR

TABLE Q.10

SWAC CALCUATION
STUDY AREA 03 - HALF MILE 11
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 3 Half Mile 11*	*Original Result*	*Chemical Name*	*Concentration Unit*
1729846.029	529173.875	STUDY AREA 3	10	B	COR-32B	0	2	1	0.000125	ND(0.00025)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1729846.029	529173.875	STUDY AREA 3	10	B	COR-32B	2	4	3	0.00021	ND(0.00042)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1729846.029	529173.875	STUDY AREA 3	10	B	COR-32B	4	6	5	0.00018	ND(0.00036)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1729846.029	529173.875	STUDY AREA 3	10	B	COR-32B	6	7.7	6.85	0.00039	ND(0.00039)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731945.86	528219.6555	STUDY AREA 3	10	B	KRSD-59	0	0.5	0.25	0.0142	0.0142	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731945.86	528219.6555	STUDY AREA 3	10	B	KRSD-59	0	1.7	0.85	0.0207	0.0207	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731945.86	528219.6555	STUDY AREA 3	10	B	KRSD-59	1.7	3.3	2.5	0.0927	0.0927	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1730478.826	528742.4118	STUDY AREA 3	10	B	KRSO-41	1.7	-	1.7	0.0005	ND(0.001)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1730804.226	528968.935	STUDY AREA 3	10	B	SSD-21	0	0	0	0.01	0.01	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732444.76	528632.8912	STUDY AREA 3	11	A	Armour Creek 01 - upgradient near I-64	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732444.76	528610.6677	STUDY AREA 3	11	A	Armour Creek 02-cell and landfill drain	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732466.984	528610.6677	STUDY AREA 3	11	A	Armour Creek 04-ditchline comp sample	0	0.5	0.25	0.01777	0.01777	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732436.033	528638.6934	STUDY AREA 3	11	A	Armour Creek Kanawha Stone	0	0.5	0.25	0.013	0.013	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732069.626	529389.6171	STUDY AREA 3	11	A	Armour Creek Landfill Runoff	0	0.5	0.25	0.0203	0.0203	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731991.769	529666.211	STUDY AREA 3	11	A	Armour Creek Midwest Steel	0	0.5	0.25	0.0614	0.0614	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732286.017	527973.2387	STUDY AREA 3	11	A	Armour Creek SR35	0	0.5	0.25	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732444.76	528610.6677	STUDY AREA 3	11	A	Armour Creek03-ditchline N of road drain	0	0.5	0.25	0.03743	0.03743	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731467.569	530067.191	STUDY AREA 3	11	A	COR-29	0	0	0	0.0013	0.0013	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731506.211	529522.487	STUDY AREA 3	11	A	COR-30	0	0	0	0.013	0.013	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731506.211	529522.487	STUDY AREA 3	11	A	COR-30	0	2	1	0.00018	ND(0.00036)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731506.211	529522.487	STUDY AREA 3	11	A	COR-30	2	2.5	2.25	0.0021	0.0021	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731380.207	530548.381	STUDY AREA 3	11	A	KRSD-14	0	2	1	0.00108	0.00108 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731380.207	530548.381	STUDY AREA 3	11	A	KRSD-14	2	4	3	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731380.207	530548.381	STUDY AREA 3	11	A	KRSD-14	4	6	5	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731990.723	529966.9235	STUDY AREA 3	11	A	KRSD-15	0	0.5	0.25	0.021	0.021 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731990.723	529966.9235	STUDY AREA 3	11	A	KRSD-15	0	2	1	0.227	0.227	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731990.723	529966.9235	STUDY AREA 3	11	A	KRSD-15	2	4	3	2.02	2.02 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731990.723	529966.9235	STUDY AREA 3	11	A	KRSD-15	4	6	5	0.748	0.748 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731990.723	529966.9235	STUDY AREA 3	11	A	KRSD-15	6	8	7	0.00456	0.00456 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732222.051	528868.6798	STUDY AREA 3	11	A	KRSD-57	0	0.5	0.25	0.0177	0.0177	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732222.051	528868.6798	STUDY AREA 3	11	A	KRSD-57	0	1.7	0.85	0.163	0.163	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732222.051	528868.6798	STUDY AREA 3	11	A	KRSD-57	1.7	3.3	2.5	0.414	0.414	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732220.723	528901.9262	STUDY AREA 3	11	A	KRSD-58	0	0.5	0.25	0.014	0.014	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732220.723	528901.9262	STUDY AREA 3	11	A	KRSD-58	0	1.7	0.85	0.0182	0.0182	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732220.723	528901.9262	STUDY AREA 3	11	A	KRSD-58	1.7	3.3	2.5	0.044	0.044	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1731141.534	529203.5813	STUDY AREA 3	11	A	KRSO-42	1.7	-	1.7	0.0005	ND(0.001)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732586.614	530703.681	STUDY AREA 3	11	B	COR-28	0	0	0	0.0088	0.0088	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732586.614	530703.681	STUDY AREA 3	11	B	COR-28	0	2	1	0.0002	ND(0.0004)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732307.659	530361.864	STUDY AREA 3	11	B	COR-28A	0	0.5	0.25	0.0002	ND(0.0004)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732583.054	529658.592	STUDY AREA 3	11	B	SSD-20	0	0	0	0.017	0.017	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1732619.447	531418.909	STUDY AREA 3	12	A	COR-27	0	0	0	0.013	0.013	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1733067.224	532625.5801	STUDY AREA 3	12	A	KRSD-13	0	0.5	0.25	0.0072	0.0072 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg
1733450.325	531908.09	STUDY AREA 3	12	A	SSD-19	0	0	0	0.0018	0.0018	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg

Legend

- (yellow) Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
- (orange) Core data excluded as it is co-located with surficial samples
- (green) Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.10

SWAC CALCUATION
STUDY AREA 03 - HALF MILE 11
KANAWHA RIVER, WEST VIRGINIA

RDL Half	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*	
0.000125	Surveyed	Bank - Left	Kanawha River	KR-COR-32B	40.7	SE-031884-121108-SG-016	12/11/2008	(0-24) IN	-	Diox Fur	Sediment	KR	
0.00021	Surveyed	Bank - Left	Kanawha River	KR-COR-32B	40.7	SE-031884-121108-SG-017	12/11/2008	(24-48) IN	-	Diox Fur	Sediment	KR	
0.00018	Surveyed	Bank - Left	Kanawha River	KR-COR-32B	40.7	SE-031884-121108-SG-018	12/11/2008	(48-72) IN	-	Diox Fur	Sediment	KR	
0.000195	Surveyed	Bank - Left	Kanawha River	KR-COR-32B	40.7	SE-031884-121108-SG-019	12/11/2008	(72-92) IN	-	Diox Fur	Sediment	KR	
-	-	-	Kanawha River	KR-KRSD-59	NA	R3809H4	5/16/2000	-	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-KRSD-59	NA	R3809G4	5/12/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-KRSD-59	NA	R3809G5	5/12/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
0.0005	Traced - 20130116	Midwest Steel Area	Kanawha River	KR-KRSO-41	41.7	R3109134	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR	
-	Surveyed	-	Kanawha River	KR-SSD-21	NA	SE-031884-112907-DD-022	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	
0	-	-	Kanawha River	KR-D-15	NA	D-15	11/9/1998	-	-	Diox Fur	SE	KR	
0	-	-	Kanawha River	KR-D-16	NA	D-16	11/9/1998	-	-	Diox Fur	SE	KR	Avg Sample/Dup
-	-	-	Kanawha River	KR-D-18	NA	D-18	11/9/1998	-	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-ARM_CK-KAN_STONE	NA	R3809I2	5/19/2000	-	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-ARM_CK_LF_RO	NA	R3809I0	5/18/2000	-	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-ARM_CK_MW_STEEL	NA	R3809I1	5/18/2000	-	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-ARM_CK-SR_35	NA	R3809I3	5/19/2000	-	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-D-17	NA	D-17	11/9/1998	-	-	Diox Fur	SE	KR	
-	Surveyed	Bank - Centre	Kanawha River	KR-COR-29	40.3	SE-031884-112907-DD-025	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	
-	Surveyed	Bank - Right	Kanawha River	KR-COR-30	40.4	SE-031884-112907-DD-024	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	
0.00018	Surveyed	Bank - Right	Kanawha River	KR-COR-30	40.4	SE-031884-120707-DD-175	12/7/2007	(0-24) IN	-	Diox Fur	SE	KR	
-	Surveyed	Bank - Right	Kanawha River	KR-COR-30	40.4	SE-031884-120707-DD-174	12/7/2007	(24-30) IN	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-KRSD-14	40.2	R380941	5/15/2000	(0-2) ft BGS	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-KRSD-14	40.2	R380942	5/15/2000	(2-4) ft BGS	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-KRSD-14	40.2	R380943	5/15/2000	(4-6) ft BGS	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-KRSD-15	40.3	R380952	5/16/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-KRSD-15	40.3	R380948	5/15/2000	(0-2) ft BGS	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-KRSD-15	40.3	R380949	5/15/2000	(2-4) ft BGS	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-KRSD-15	40.3	R380950	5/15/2000	(4-6) ft BGS	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-KRSD-15	40.3	R380951	5/15/2000	(6-8) ft BGS	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-KRSD-57	NA	R3809H2	5/16/2000	-	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-KRSD-57	NA	R3809G0	5/12/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-KRSD-57	NA	R3809G1	5/12/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
-	Traced - 20130116	-	Kanawha River	KR-KRSD-58	NA	R3809H3	5/16/2000	-	-	Diox Fur	SE	KR	
-	Traced - 20130116	-	Kanawha River	KR-KRSD-58	NA	R3809G2	5/12/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	Traced - 20130116	-	Kanawha River	KR-KRSD-58	NA	R3809G3	5/12/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
0.0005	Traced - 20130116	Midwest Steel Area	Kanawha River	KR-KRSO-42	41.65	R3109135	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR	
-	Surveyed	Bank - Right	Kanawha River	KR-COR-28	40.1	SE-031884-112907-DD-027	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	
0.0002	Surveyed	Bank - Right	Kanawha River	KR-COR-28	40.1	SE-031884-120807-DD-176	12/8/2007	(0-24) IN	-	Diox Fur	SE	KR	
0.0002	Surveyed	Bank - Right	Kanawha River	KR-COR-28A	40.2	SE-031884-121108-SG-020	12/11/2008	(0-6) IN	-	Diox Fur	Sediment	KR	
-	Surveyed	-	Kanawha River	KR-SSD-20	NA	SE-031884-112907-DD-026	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	
-	Surveyed	Bank - Centre	Kanawha River	KR-COR-27	40	SE-031884-112907-DD-028	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	
-	-	-	Kanawha River	KR-KRSD-13	39.7	R380940	5/15/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR	
-	Surveyed	-	Kanawha River	KR-SSD-19	NA	SE-031884-112907-DD-029	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR	

TABLE Q.11

SWAC CALCULATION
STUDY AREA 03 - HALF MILE 12
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 3 Half Mile 12*
1732586.614	530703.681	STUDY AREA 3	11	B	COR-28	0	0	0	0.0088
1732586.614	530703.681	STUDY AREA 3	11	B	COR-28	0	2	1	0.0002
1732307.659	530361.864	STUDY AREA 3	11	B	COR-28A	0	0.5	0.25	0.0002
1732583.054	529658.592	STUDY AREA 3	11	B	SSD-20	0	0	0	0.017
1732619.447	531418.909	STUDY AREA 3	12	A	COR-27	0	0	0	0.013
1733067.224	532625.5801	STUDY AREA 3	12	A	KRSD-13	0	0.5	0.25	0.0072
1733450.325	531908.09	STUDY AREA 3	12	A	SSD-19	0	0	0	0.0018
1734332.823	533380.761	STUDY AREA 3	12	B	COR-25	0	0	0	0.002
1734332.823	533380.761	STUDY AREA 3	12	B	COR-25	0	0	0	0.0011
1734332.823	533380.761	STUDY AREA 3	12	B	COR-25	0	1.2	0.6	0.000225
1733547.829	532597.187	STUDY AREA 3	12	B	COR-26	0	0	0	0.0026
1735082.702	534747.771	STUDY AREA 3	13	A	SSD-18	0	0	0	0.052
1735059.017	534780.1968	STUDY AREA 3	13	B	Linbarger Creek Runoff	0	0.5	0.25	0.122
1734955.127	535152.828	STUDY AREA 3	13	B	SSD-17	0	0	0	0.035

Legend

Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
Core data excluded as it is co-located with surficial samples
Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.11

SWAC CALCULATION
STUDY AREA 03 - HALF MILE 12
KANAWHA RIVER, WEST VIRGINIA

Original Result	*Chemical Name*	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*
0.0088	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-28
ND(0.0004)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.0002	Surveyed	Bank - Right	Kanawha River	KR-COR-28
ND(0.0004)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.0002	Surveyed	Bank - Right	Kanawha River	KR-COR-28A
0.017	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-20
0.013	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-27
0.0072 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-13
0.0018	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-19
0.002	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00155	Surveyed	Bank - Right	Kanawha River	KR-COR-25
0.0011	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-25
ND(0.00045)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.000225	Surveyed	Bank - Right	Kanawha River	KR-COR-25
0.0026	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-26
0.052	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-18
0.122 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-LIN_BARKER_CREEK
0.035	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-17

TABLE Q.11

SWAC CALCULATION
STUDY AREA 03 - HALF MILE 12
KANAWHA RIVER, WEST VIRGINIA

River Marker	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
40.1	SE-031884-112907-DD-027	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR
40.1	SE-031884-120807-DD-176	12/8/2007	(0-24) IN	-	Diox Fur	SE	KR
40.2	SE-031884-121108-SG-020	12/11/2008	(0-6) IN	-	Diox Fur	Sediment	KR
NA	SE-031884-112907-DD-026	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR
40	SE-031884-112907-DD-028	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR
39.7	R380940	5/15/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
NA	SE-031884-112907-DD-029	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR
39.5	SE-031884-112907-DD-032	11/29/2007	(0-0) IN	Duplicate	Diox Fur	SE	KR
39.5	SE-031884-112907-DD-031	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR
39.5	SE-031884-120807-DD-178	12/8/2007	(0-14) IN	-	Diox Fur	SE	KR
39.7	SE-031884-112907-DD-030	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR
NA	SE-031884-113007-DD-033	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
NA	R3809I4	5/18/2000	-	-	Diox Fur	SE	KR
NA	SE-031884-113007-DD-034	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR

TABLE Q.12

SWAC CALCULATION
STUDY AREA 03 - HALF MILE 13
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 3 Half Mile 13*
1734332.823	533380.761	STUDY AREA 3	12	B	COR-25	0	0	0	0.002
1734332.823	533380.761	STUDY AREA 3	12	B	COR-25	0	0	0	0.0011
1734332.823	533380.761	STUDY AREA 3	12	B	COR-25	0	1.2	0.6	0.000225
1733547.829	532597.187	STUDY AREA 3	12	B	COR-26	0	0	0	0.0026
1735082.702	534747.771	STUDY AREA 3	13	A	SSD-18	0	0	0	0.052
1735059.017	534780.1968	STUDY AREA 3	13	B	Linbarger Creek Runoff	0	0.5	0.25	0.122
1734955.127	535152.828	STUDY AREA 3	13	B	SSD-17	0	0	0	0.035
1734966.885	537423.505	STUDY AREA 3	14	A	SSD-15	0	0	0	0.012
1734382.48	536903.993	STUDY AREA 3	14	A	SSD-16	0	0	0	0.0055

Legend

Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
Core data excluded as it is co-located with surficial samples
Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.12

SWAC CALCULATION
STUDY AREA 03 - HALF MILE 13
KANAWHA RIVER, WEST VIRGINIA

Original Result	*Chemical Name*	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*
0.002	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00155	Surveyed	Bank - Right	Kanawha River	KR-COR-25
0.0011	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-25
ND(0.00045)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.000225	Surveyed	Bank - Right	Kanawha River	KR-COR-25
0.0026	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-26
0.052	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-18
0.122 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-		-	Kanawha River	KR-LIN_BARKER_CREEK
0.035	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-17
0.012	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-15
0.0055	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-16

TABLE Q.12

SWAC CALCULATION
STUDY AREA 03 - HALF MILE 13
KANAWHA RIVER, WEST VIRGINIA

River Marker	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
39.5	SE-031884-112907-DD-032	11/29/2007	(0-0) IN	Duplicate	Diox Fur	SE	KR
39.5	SE-031884-112907-DD-031	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR
39.5	SE-031884-120807-DD-178	12/8/2007	(0-14) IN	-	Diox Fur	SE	KR
39.7	SE-031884-112907-DD-030	11/29/2007	(0-0) IN	-	Diox Fur	SE	KR
NA	SE-031884-113007-DD-033	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
NA	R3809I4	5/18/2000	-	-	Diox Fur	SE	KR
NA	SE-031884-113007-DD-034	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
NA	SE-031884-113007-DD-036	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
NA	SE-031884-113007-DD-035	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR

TABLE Q.13

SWAC CALCULATION
STUDY AREA 03 - HALF MILE 14
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 3 Half Mile 14*	*Original Result*	*Chemical Name*	*Concentration Unit*	*RDL Half*
1735059.017	534780.1968	STUDY AREA 3	13	B	Linbarger_Creek_Runoff	0	0.5	0.25	0.122	0.122 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1734955.127	535152.828	STUDY AREA 3	13	B	SSD-17	0	0	0	0.035	0.035	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1734966.885	537423.505	STUDY AREA 3	14	A	SSD-15	0	0	0	0.012	0.012	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1734382.48	536903.993	STUDY AREA 3	14	A	SSD-16	0	0	0	0.0055	0.0055	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1734061.138	538502.616	STUDY AREA 3	14	B	COR-24	0	0	0	0.0043	0.0043	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1734638.591	538674.464	STUDY AREA 3	14	B	KRSD-48	0	1.7	0.85	0.00074	0.00074 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1734638.591	538674.464	STUDY AREA 3	14	B	KRSD-48	1.7	3.3	2.5	0.00324	0.00324 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1735497.077	539381.8412	STUDY AREA 3	14	B	KRSD-50	0	1.7	0.85	0.00388	0.00388	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1735497.077	539381.8412	STUDY AREA 3	14	B	KRSD-50	1.7	3.3	2.5	0.0167	0.0167	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1735325.634	539345.6503	STUDY AREA 3	14	B	Poca_RR_Bridge	0	0.5	0.25	0.00327	0.00327	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	HCSD1	0	0.5	0.25	0.14	0.14	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	HCSD2	0	0.5	0.25	0.034	0.034	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	HCSD3	0	0.5	0.25	0.0065	0.0065	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1738861.217	542872.6708	STUDY AREA 3	14	C	KRSD-45	0	1.7	0.85	0.00105	0.00105	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1735756.158	540140.7701	STUDY AREA 3	14	C	KRSD-49	0	1.7	0.85	0.0025	0.0025	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1735756.158	540140.7701	STUDY AREA 3	14	C	KRSD-49	1.7	3.3	2.5	0.00077	0.00077	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1735541.273	542166.1893	STUDY AREA 3	14	C	KRSD-51	0	1.7	0.85	0.00098	0.00098 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1735541.273	542166.1893	STUDY AREA 3	14	C	KRSD-51	1.7	3.3	2.5	0.00332	0.00332 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1736368.883	541857.6368	STUDY AREA 3	14	C	KRSD-53	0	1.7	0.85	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1736368.883	541857.6368	STUDY AREA 3	14	C	KRSD-53	1.7	3.3	2.5	0.00083	0.00083 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737097.097	541069.5379	STUDY AREA 3	14	C	KRSD-54	0	1.7	0.85	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737097.097	541069.5379	STUDY AREA 3	14	C	KRSD-54	1.7	3.3	2.5	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737849.221	540826.5102	STUDY AREA 3	14	C	KRSD-55	0	0.5	0.25	0.00124	0.00124	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737849.221	540826.5102	STUDY AREA 3	14	C	KRSD-55	0	1.7	0.85	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737849.221	540826.5102	STUDY AREA 3	14	C	KRSD-55	1.7	3.3	2.5	0.00908	0.00908	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1738235.162	541911.8985	STUDY AREA 3	14	C	KRSD-56	0	1.7	0.85	0.00182	0.00182 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1738235.162	541911.8985	STUDY AREA 3	14	C	KRSD-56	1.7	3.3	2.5	0.00255	0.00255	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1739661.33	543494.0442	STUDY AREA 3	14	C	KRSD-63	0	0.5	0.25	0.00106	0.00106	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1739661.33	543494.0442	STUDY AREA 3	14	C	KRSD-63	0	1.7	0.85	0.00169	0.00169	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1739661.33	543494.0442	STUDY AREA 3	14	C	KRSD-63	1.7	3.3	2.5	0.00122	0.00122	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737097	541069.53	STUDY AREA 3	14	C	KRSO-54	0	0.5	0.25	0.00029	0.00029 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737097	541069.53	STUDY AREA 3	14	C	KRSO-54	1.7		1.7	0.00029 J	0.00029 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737849.2	540826.51	STUDY AREA 3	14	C	KRSO-55	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737849.2	540826.51	STUDY AREA 3	14	C	KRSO-55	1.7	-	1.7	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1738235.1	541911.89	STUDY AREA 3	14	C	KRSO-56	1.7	-	1.7	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	POND	0	0.5	0.25	480	ND(960)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	480
-	-	STUDY AREA 3	14	C	SD01	0	0.5	0.25	0.00188	0.00188 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-01	0	0.2	0.1	0.0138	0.0138	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD02	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-02	0	0.2	0.1	0.00942	0.00942	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD03	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-03	0	0.2	0.1	0.0078	0.0078	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD04	0	0.5	0.25	0.000689	0.000689 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-04	0	0.2	0.1	0.00679	0.00679	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD05	0	0.5	0.25	0.038	0.038	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-05	0	0.2	0.1	0.00837	0.00837	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-

TABLE Q.13

SWAC CALCULATION
STUDY AREA 03 - HALF MILE 14
KANAWHA RIVER, WEST VIRGINIA

Coordinate Remark	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*	
-	-	Kanawha River	KR-LIN_BARKER_CREEK	NA	R3809I4	5/18/2000	-	-	Diox Fur	SE	KR	
Surveyed	-	Kanawha River	KR-SSD-17	NA	SE-031884-113007-DD-034	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR	
Surveyed	-	Kanawha River	KR-SSD-15	NA	SE-031884-113007-DD-036	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR	
Surveyed	-	Kanawha River	KR-SSD-16	NA	SE-031884-113007-DD-035	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR	
Surveyed	Bank - Left	Kanawha River	KR-COR-24	38.6	SE-031884-113007-DD-037	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-48	NA	R3809E2	5/15/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-48	NA	R3809E3	5/15/2000	(1.667-3.33) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-50	NA	R3809E6	5/16/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-50	NA	R3809E7	5/16/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-POCA_RR_BRIDGE	NA	R3809H5	5/16/2000	-	-	Diox Fur	SE	KR	
-	-	Heizer Creek	HEI-HCSD1	NA	HCSD1	5/1/2000	-	-	Diox Fur	sediment	HEI	
-	-	Heizer Creek	HEI-HCSD2	NA	HCSD2	5/1/2000	-	-	Diox Fur	sediment	HEI	
-	-	Heizer Creek	HEI-HCSD3	NA	HCSD3	5/1/2000	-	-	Diox Fur	sediment	HEI	
-	-	Kanawha River	KR-KRSD-45	NA	R3809D1	5/14/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-49	NA	R3809E4	5/15/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-49	NA	R3809E5	5/15/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-51	NA	R3809E8	5/16/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-51	NA	R3809E9	5/16/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-53	NA	R3809F2	5/13/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-53	NA	R3809F3	5/11/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-54	NA	R3809F4	5/13/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-54	NA	R3809F5	5/13/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-55	NA	R3809H6	5/16/2000	-	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-55	NA	R3809F6	5/13/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-55	NA	R3809F7	5/13/2000	(1.667-3.33) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-56	NA	R3809F8	5/13/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-56	NA	R3809F9	5/12/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-63	NA	R3809H7	5/16/2000	-	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-63	NA	R3809H0	5/16/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-		Kanawha River	KR-KRSD-63	NA	R3809H1	5/16/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
-	Duplicate of KRSO-56 Background 1	Kanawha River	KR-KRSO-54	47	KRSO-54	9/22/2001	-	-	Diox Fur	SE	KR	
-	Duplicate of KRSO-56 Background 1	Kanawha River	KR-KRSO-54	47	R3109145	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR	
-	Background 1	Kanawha River	KR-KRSO-55	47	KRSO-55	9/22/2001	-	-	Diox Fur	SE	KR	
-	Background 1	Kanawha River	KR-KRSO-55	47	R3109142	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR	
-	Background 2	Kanawha River	KR-KRSO-56	47	R3109143	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR	
-	-	Manilla Creek	MAN-POND	NA	POND SEDIMENT	1/1/1901	-	-	Diox Fur	SE	MAN	
-	-	Manilla Creek	MAN-SD01	NA	R369733	1/1/1901	-	-	Diox Fur	SE	MAN	
-	From Intermittent Stream just priot to PPE - to Pocatalico River	Heizer Creek	HEI-SD-01	-	R382033	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI	
-	-	Manilla Creek	MAN-SD02	NA	R369717	1/1/1901	-	-	Diox Fur	SE	MAN	
-	From intermittent stream south of Midway	Heizer Creek	HEI-SD-02	-	R382034	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI	
-	-	Manilla Creek	MAN-SD03	NA	R369703	1/1/1901	-	-	Diox Fur	SE	MAN	
-	From intermittent stream south of Heizer Creek	Heizer Creek	HEI-SD-03	-	R382035	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI	Avg Sample/Dup
-	-	Manilla Creek	MAN-SD04	NA	R369722	1/1/1901	-	-	Diox Fur	SE	MAN	
-	From intermittent stream North of Heizer Creek	Heizer Creek	HEI-SD-04	-	R382036	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI	
-	-	Manilla Creek	MAN-SD05	NA	R369715	1/1/1901	-	-	Diox Fur	SE	MAN	
-	From Intermittent stream at base of Kandfill	Heizer Creek	HEI-SD-05	-	R382037	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI	

TABLE Q.13

SWAC CALCULATION
STUDY AREA 03 - HALF MILE 14
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 3 Half Mile 14*	*Original Result*	*Chemical Name*	*Concentration Unit*	*RDL Half*
-	-	STUDY AREA 3	14	C	SD06	0	0.5	0.25	0.000317	0.000317 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-06	0	0.2	0.1	0.085	0.085	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD07	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-07	0	0.2	0.1	0.895	0.895 +	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD08	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD09	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-09	0	0.2	0.1	0.00134	0.00134 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD10	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-10	0	0.2	0.1	0.00433	0.00433	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD11	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-11	0	0.2	0.1	0.00165	0.00165 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-11	0	0.2	0.1	0.00229	0.00229 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00197
-	-	STUDY AREA 3	14	C	SD12	0	0.5	0.25	0.00222	0.00222 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD13	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD14	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1734170.759	539287.6221	STUDY AREA 3	15	A	KRSD-11	0	0.5	0.25	0.00136	0.00136 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1732994.837	539471.0211	STUDY AREA 4	15	A	KRSD-10	0	2	1	0.00347	0.00347 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1732994.837	539471.0211	STUDY AREA 4	15	A	KRSD-10	2	4	3	0.0105	0.0105	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1732994.837	539471.0211	STUDY AREA 4	15	A	KRSD-10	4	6	5	0.0112	0.0112	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1732994.837	539471.0211	STUDY AREA 4	15	A	KRSD-10	6	8	7	0.0195	0.0195	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1733644.233	539874.121	STUDY AREA 4	15	A	SSD-14	0	0	0	0.023	0.023	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-

TABLE Q.13

SWAC CALCULATION
STUDY AREA 03 - HALF MILE 14
KANAWHA RIVER, WEST VIRGINIA

Coordinate Remark	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
-	-	Manilla Creek	MAN-SD06	NA	R369710	1/1/1901	-	-	Diox Fur	SE	MAN
-	Sediment sample of intermittent stream adjacent to Landfill	Heizer Creek	HEI-SD-06	-	R382038	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI
-	-	Manilla Creek	MAN-SD07	NA	R369712	1/1/1901	-	-	Diox Fur	SE	MAN
-	Background Sediment of Intermittent stream above landfill	Heizer Creek	HEI-SD-07	-	R382039	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI
-	-	Manilla Creek	MAN-SD-08	NA	R369705	1/1/1901	-	-	Diox Fur	SE	MAN
-	-	Manilla Creek	MAN-SD09	NA	R369708	1/1/1901	-	-	Diox Fur	SE	MAN
-	Background Sediment from Pocatalico River	Heizer Creek	HEI-SD-09	-	R382040	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI
-	-	Manilla Creek	MAN-SD10	NA	R369724	1/1/1901	-	-	Diox Fur	SE	MAN
-	PPE of Intermittent stream into Pocatalico River	Heizer Creek	HEI-SD-10	-	R382041	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI
-	-	Manilla Creek	MAN-SD11	NA	R369725	1/1/1901	-	Duplicate	Diox Fur	SE	MAN
-	Release sample from Pocatalico River	Heizer Creek	HEI-SD-11	-	R382043	5/10/2000	(0-0.25) ft BGS	Duplicate	Diox Fur	SE	HEI
-	Release sample from Pocatalico River	Heizer Creek	HEI-SD-11	-	R382042	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI
-	-	Manilla Creek	MAN-SD12	NA	R369735	1/1/1901	-	-	Diox Fur	SE	MAN
-	-	Manilla Creek	MAN-SD13	NA	R369737	1/1/1901	-	-	Diox Fur	SE	MAN
-	-	Manilla Creek	MAN-SD14	NA	R369734	1/1/1901	-	-	Diox Fur	SE	MAN
-	-	Kanawha River	KR-KRSD-11	38.5	R380947	5/16/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-10	38.3	R380933	5/13/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-10	38.3	R380934	5/13/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-10	38.3	R380935	5/13/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-10	38.3	R380936	5/13/2000	(6-8) ft BGS	-	Diox Fur	SE	KR
Surveyed	-	Kanawha River	KR-SSD-14	NA	SE-031884-113007-DD-038	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR

Legend

- Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
- Core data excluded as it is co-located with surficial samples
- Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.14

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 15
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 4 Half Mile 15*	*Original Result*	*Chemical Name*	*Concentration Unit*	*RDL Half*
1734061.138	538502.616	STUDY AREA 3	14	B	COR-24	0	0	0	0.0043	0.0043	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1734638.591	538674.464	STUDY AREA 3	14	B	KRSD-48	0	1.7	0.85	0.00074	0.00074 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1734638.591	538674.464	STUDY AREA 3	14	B	KRSD-48	1.7	3.3	2.5	0.00324	0.00324 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1735497.077	539381.8412	STUDY AREA 3	14	B	KRSD-50	0	1.7	0.85	0.00388	0.00388	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1735497.077	539381.8412	STUDY AREA 3	14	B	KRSD-50	1.7	3.3	2.5	0.0167	0.0167	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1735325.634	539345.6503	STUDY AREA 3	14	B	Poca_RR_Bridge	0	0.5	0.25	0.00327	0.00327	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	HCSD1	0	0.5	0.25	0.14	0.14	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	HCSD2	0	0.5	0.25	0.034	0.034	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	HCSD3	0	0.5	0.25	0.0065	0.0065	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1738861.217	542872.6708	STUDY AREA 3	14	C	KRSD-45	0	1.7	0.85	0.00105	0.00105	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1735756.158	540140.7701	STUDY AREA 3	14	C	KRSD-49	0	1.7	0.85	0.0025	0.0025	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1735756.158	540140.7701	STUDY AREA 3	14	C	KRSD-49	1.7	3.3	2.5	0.00077	0.00077	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1735541.273	542166.1893	STUDY AREA 3	14	C	KRSD-51	0	1.7	0.85	0.00098	0.00098 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1735541.273	542166.1893	STUDY AREA 3	14	C	KRSD-51	1.7	3.3	2.5	0.00332	0.00332 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1736368.883	541857.6368	STUDY AREA 3	14	C	KRSD-53	0	1.7	0.85	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1736368.883	541857.6368	STUDY AREA 3	14	C	KRSD-53	1.7	3.3	2.5	0.00083	0.00083 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737097.097	541069.5379	STUDY AREA 3	14	C	KRSD-54	0	1.7	0.85	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737097.097	541069.5379	STUDY AREA 3	14	C	KRSD-54	1.7	3.3	2.5	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737849.221	540826.5102	STUDY AREA 3	14	C	KRSD-55	0	0.5	0.25	0.00124	0.00124	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737849.221	540826.5102	STUDY AREA 3	14	C	KRSD-55	0	1.7	0.85	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737849.221	540826.5102	STUDY AREA 3	14	C	KRSD-55	1.7	3.3	2.5	0.00908	0.00908	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1738235.162	541911.8985	STUDY AREA 3	14	C	KRSD-56	0	1.7	0.85	0.00182	0.00182 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1738235.162	541911.8985	STUDY AREA 3	14	C	KRSD-56	1.7	3.3	2.5	0.00255	0.00255	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1739661.33	543494.0442	STUDY AREA 3	14	C	KRSD-63	0	0.5	0.25	0.00106	0.00106	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1739661.33	543494.0442	STUDY AREA 3	14	C	KRSD-63	0	1.7	0.85	0.00169	0.00169	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1739661.33	543494.0442	STUDY AREA 3	14	C	KRSD-63	1.7	3.3	2.5	0.00122	0.00122	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737097	541069.53	STUDY AREA 3	14	C	KRSO-54	0	0.5	0.25	0.00029	0.00029 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737097	541069.53	STUDY AREA 3	14	C	KRSO-54	1.7	-	1.7	0.00029 J	0.00029 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737849.2	540826.51	STUDY AREA 3	14	C	KRSO-55	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1737849.2	540826.51	STUDY AREA 3	14	C	KRSO-55	1.7	-	1.7	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1738235.1	541911.89	STUDY AREA 3	14	C	KRSO-56	1.7	-	1.7	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	POND	0	0.5	0.25	480	ND(960)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	480
-	-	STUDY AREA 3	14	C	SD01	0	0.5	0.25	0.00188	0.00188 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-01	0	0.2	0.1	0.0138	0.0138	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD02	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-02	0	0.2	0.1	0.00942	0.00942	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD03	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-03	0	0.2	0.1	0.0078	0.0078	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD04	0	0.5	0.25	0.000689	0.000689 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-04	0	0.2	0.1	0.00679	0.00679	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD05	0	0.5	0.25	0.038	0.038	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-05	0	0.2	0.1	0.00837	0.00837	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD06	0	0.5	0.25	0.000317	0.000317 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-

TABLE Q.14

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 15
KANAWHA RIVER, WEST VIRGINIA

Coordinate Remark	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*	
Surveyed	Bank - Left	Kanawha River	KR-COR-24	38.6	SE-031884-113007-DD-037	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-48	NA	R3809E2	5/15/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-48	NA	R3809E3	5/15/2000	(1.667-3.33) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-50	NA	R3809E6	5/16/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-50	NA	R3809E7	5/16/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-POCA_RR_BRIDGE	NA	R3809H5	5/16/2000	-	-	Diox Fur	SE	KR	
-	-	Heizer Creek	HEI-HCSD1	NA	HCSD1	5/1/2000	-	-	Diox Fur	sediment	HEI	
-	-	Heizer Creek	HEI-HCSD2	NA	HCSD2	5/1/2000	-	-	Diox Fur	sediment	HEI	
-	-	Heizer Creek	HEI-HCSD3	NA	HCSD3	5/1/2000	-	-	Diox Fur	sediment	HEI	
-	-	Kanawha River	KR-KRSD-45	NA	R3809D1	5/14/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-49	NA	R3809E4	5/15/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-49	NA	R3809E5	5/15/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-51	NA	R3809E8	5/16/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-51	NA	R3809E9	5/16/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-53	NA	R3809F2	5/13/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-53	NA	R3809F3	5/11/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-54	NA	R3809F4	5/13/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-54	NA	R3809F5	5/13/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-55	NA	R3809H6	5/16/2000	-	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-55	NA	R3809F6	5/13/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-55	NA	R3809F7	5/13/2000	(1.667-3.33) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-56	NA	R3809F8	5/13/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-56	NA	R3809F9	5/12/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-63	NA	R3809H7	5/16/2000	-	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-63	NA	R3809H0	5/16/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
-	-	Kanawha River	KR-KRSD-63	NA	R3809H1	5/16/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
-	Duplicate of KRSO-56 Background 1	Kanawha River	KR-KRSO-54	47	KRSO-54	9/22/2001	-	-	Diox Fur	SE	KR	
-	Duplicate of KRSO-56 Background 1	Kanawha River	KR-KRSO-54	47	R3109145	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR	
-	Background 1	Kanawha River	KR-KRSO-55	47	KRSO-55	9/22/2001	-	-	Diox Fur	SE	KR	
-	Background 1	Kanawha River	KR-KRSO-55	47	R3109142	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR	
-	Background 2	Kanawha River	KR-KRSO-56	47	R3109143	9/1/2001	(20-) IN	-	Diox Fur	Sediment	KR	
-	-	Manilla Creek	MAN-POND	NA	POND SEDIMENT	1/1/1901	-	-	Diox Fur	SE	MAN	
-	-	Manilla Creek	MAN-SD01	NA	R369733	1/1/1901	-	-	Diox Fur	SE	MAN	
-	From Intermittent Stream just priot to PPE - to Pocatalico River	Heizer Creek	HEI-SD-01	-	R382033	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI	
-	-	Manilla Creek	MAN-SD02	NA	R369717	1/1/1901	-	-	Diox Fur	SE	MAN	
-	From intermittent stream south of Midway	Heizer Creek	HEI-SD-02	-	R382034	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI	
-	-	Manilla Creek	MAN-SD03	NA	R369703	1/1/1901	-	-	Diox Fur	SE	MAN	
-	From intermittent stream south of Heizer Creek	Heizer Creek	HEI-SD-03	-	R382035	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI	Avg Sample/Dup
-	-	Manilla Creek	MAN-SD04	NA	R369722	1/1/1901	-	-	Diox Fur	SE	MAN	
-	From intermittent stream North of Heizer Creek	Heizer Creek	HEI-SD-04	-	R382036	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI	
-	-	Manilla Creek	MAN-SD05	NA	R369715	1/1/1901	-	-	Diox Fur	SE	MAN	
-	From Intermittent stream at base of Kandfill	Heizer Creek	HEI-SD-05	-	R382037	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI	
-	-	Manilla Creek	MAN-SD06	NA	R369710	1/1/1901	-	-	Diox Fur	SE	MAN	

TABLE Q.14

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 15
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 4 Half Mile 15*	*Original Result*	*Chemical Name*	*Concentration Unit*	*RDL Half*
-	-	STUDY AREA 3	14	C	SD-06	0	0.2	0.1	0.085	0.085	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD07	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-07	0	0.2	0.1	0.895	0.895 +	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD08	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD09	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-09	0	0.2	0.1	0.00134	0.00134 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD10	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-10	0	0.2	0.1	0.00433	0.00433	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD11	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-11	0	0.2	0.1	0.00165	0.00165 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD-11	0	0.2	0.1	0.00229	0.00229 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	0.00197
-	-	STUDY AREA 3	14	C	SD12	0	0.5	0.25	0.00222	0.00222 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD13	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
-	-	STUDY AREA 3	14	C	SD14	0	0.5	0.25	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1734170.759	539287.6221	STUDY AREA 3	15	A	KRSD-11	0	0.5	0.25	0.00136	0.00136 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1732994.837	539471.0211	STUDY AREA 4	15	A	KRSD-10	0	2	1	0.00347	0.00347 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1732994.837	539471.0211	STUDY AREA 4	15	A	KRSD-10	2	4	3	0.0105	0.0105	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1732994.837	539471.0211	STUDY AREA 4	15	A	KRSD-10	4	6	5	0.0112	0.0112	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1732994.837	539471.0211	STUDY AREA 4	15	A	KRSD-10	6	8	7	0.0195	0.0195	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1733644.233	539874.121	STUDY AREA 4	15	A	SSD-14	0	0	0	0.023	0.023	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1732572.025	540720.879	STUDY AREA 4	15	B	COR-23	0	0	0	0.066	0.066	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1732572.025	540720.879	STUDY AREA 4	15	B	COR-23	0	2.3	1.15	0.00029	ND(0.00052)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1731744.237	541288.687	STUDY AREA 4	16	A	COR-22	0	0	0	0.056	0.056	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1731744.237	541288.687	STUDY AREA 4	16	A	COR-22	0	2	1	3	3 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1731744.237	541288.687	STUDY AREA 4	16	A	COR-22	2	4.1	3.05	1.1	1.1 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-

Legend

- (yellow) Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
- (orange) Core data excluded as it is co-located with surficial samples
- (green) Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.14

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 15
KANAWHA RIVER, WEST VIRGINIA

Coordinate Remark	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
-	Sediment sample of intermittent stream adjacent to Landfill	Heizer Creek	HEI-SD-06	-	R382038	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI
-	-	Manilla Creek	MAN-SD07	NA	R369712	1/1/1901	-	-	Diox Fur	SE	MAN
-	Background Sediment of Intermittent stream above landfill	Heizer Creek	HEI-SD-07	-	R382039	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI
-	-	Manilla Creek	MAN-SD-08	NA	R369705	1/1/1901	-	-	Diox Fur	SE	MAN
-	-	Manilla Creek	MAN-SD09	NA	R369708	1/1/1901	-	-	Diox Fur	SE	MAN
-	Background Sediment from Pocatalico River	Heizer Creek	HEI-SD-09	-	R382040	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI
-	-	Manilla Creek	MAN-SD10	NA	R369724	1/1/1901	-	-	Diox Fur	SE	MAN
-	PPE of Intermittent stream into Pocatalico River	Heizer Creek	HEI-SD-10	-	R382041	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI
-	-	Manilla Creek	MAN-SD11	NA	R369725	1/1/1901	-	Duplicate	Diox Fur	SE	MAN
-	Release sample from Pocatalico River	Heizer Creek	HEI-SD-11	-	R382043	5/10/2000	(0-0.25) ft BGS	Duplicate	Diox Fur	SE	HEI
-	Release sample from Pocatalico River	Heizer Creek	HEI-SD-11	-	R382042	5/10/2000	(0-0.25) ft BGS	-	Diox Fur	SE	HEI
-	-	Manilla Creek	MAN-SD12	NA	R369735	1/1/1901	-	-	Diox Fur	SE	MAN
-	-	Manilla Creek	MAN-SD13	NA	R369737	1/1/1901	-	-	Diox Fur	SE	MAN
-	-	Manilla Creek	MAN-SD14	NA	R369734	1/1/1901	-	-	Diox Fur	SE	MAN
-	-	Kanawha River	KR-KRSD-11	38.5	R380947	5/16/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-10	38.3	R380933	5/13/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-10	38.3	R380934	5/13/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-10	38.3	R380935	5/13/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
-	-	Kanawha River	KR-KRSD-10	38.3	R380936	5/13/2000	(6-8) ft BGS	-	Diox Fur	SE	KR
Surveyed	-	Kanawha River	KR-SSD-14	NA	SE-031884-113007-DD-038	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-23	38.1	SE-031884-113007-DD-039	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-23	38.1	SE-031884-120807-DD-179	12/8/2007	(0-27) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-22	37.8	SE-031884-113007-DD-040	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-22	37.8	SE-031884-121007-DD-180	12/10/2007	(0-24) IN	-	Diox Fur	SE	KR
Surveyed	Bank - Right	Kanawha River	KR-COR-22	37.8	SE-031884-121007-DD-181	12/10/2007	(24-49) IN	-	Diox Fur	SE	KR

TABLE Q.15

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 16
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*
1732572.025	540720.879	STUDY AREA 4	15	B	COR-23	0	0	0
1732572.025	540720.879	STUDY AREA 4	15	B	COR-23	0	2.3	1.15
1731744.237	541288.687	STUDY AREA 4	16	A	COR-22	0	0	0
1731744.237	541288.687	STUDY AREA 4	16	A	COR-22	0	2	1
1731744.237	541288.687	STUDY AREA 4	16	A	COR-22	2	4.1	3.05
1731061.284	542078.493	STUDY AREA 4	16	B	COR-21	0	0	0
1731061.284	542078.493	STUDY AREA 4	16	B	COR-21	0	2	1
1731061.284	542078.493	STUDY AREA 4	16	B	COR-21	0	2	1
1731061.284	542078.493	STUDY AREA 4	16	B	COR-21	2	4	3
1731061.284	542078.493	STUDY AREA 4	16	B	COR-21	4	6.5	5.25
1730582.104	541502.2357	STUDY AREA 4	16	B	KRSD-08	0	2	1
1730582.104	541502.2357	STUDY AREA 4	16	B	KRSD-08	2	4	3
1730582.104	541502.2357	STUDY AREA 4	16	B	KRSD-08	4	6	5
1731043.682	542114.7831	STUDY AREA 4	16	B	KRSD-09	0	0.5	0.25
1731043.682	542114.7831	STUDY AREA 4	16	B	KRSD-09	0	2	1
1731043.682	542114.7831	STUDY AREA 4	16	B	KRSD-09	2	4	3
1730499.085	542790	STUDY AREA 4	17	A	COR-20	0	0	0
1730499.085	542790	STUDY AREA 4	17	A	COR-20	0	0	0
1730499.085	542790	STUDY AREA 4	17	A	COR-20	0	2	1
1730499.085	542790	STUDY AREA 4	17	A	COR-20	2	2.6	2.3

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.15

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 16
KANAWHA RIVER, WEST VIRGINIA

TCDD Study Area 4 Half Mile 16	*Original Result*	*Chemical Name*	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*
0.066	0.066	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right
0.00029	ND(0.00052)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right
0.056	0.056	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right
3	3 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right
1.1	1.1 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right
0.023	0.023	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right
2.7	2.7 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right
2.3	2.3 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right
0.088	0.088	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right
0.0018	0.0018	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right
0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
2.4	2.4 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1.33	1.33 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
5.02	5.02 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
0.0094	0.0094	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right
0.009	0.009	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right
0.014	0.014	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right
0.052	0.052	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right

TABLE Q.15

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 16
KANAWHA RIVER, WEST VIRGINIA

Subfacility Name	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
Kanawha River	KR-COR-23	38.1	SE-031884-113007-DD-039	11/30/2007	(0-0) IN		Diox Fur	SE	KR
Kanawha River	KR-COR-23	38.1	SE-031884-120807-DD-179	12/8/2007	(0-27) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-22	37.8	SE-031884-113007-DD-040	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-22	37.8	SE-031884-121007-DD-180	12/10/2007	(0-24) IN		Diox Fur	SE	KR
Kanawha River	KR-COR-22	37.8	SE-031884-121007-DD-181	12/10/2007	(24-49) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-21	37.7	SE-031884-113007-DD-041	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-21	37.7	SE-031884-121007-DD-213	12/10/2007	(0-24) IN		Diox Fur	SE	KR
Kanawha River	KR-COR-21	37.7	SE-031884-121007-DD-214	12/10/2007	(0-24) IN	Duplicate	Diox Fur	SE	KR
Kanawha River	KR-COR-21	37.7	SE-031884-121007-DD-215	12/10/2007	(24-48) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-21	37.7	SE-031884-121007-DD-216	12/10/2007	(48-78) IN	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-08	37.8	R380920	5/12/2000	(0-2) ft BGS		Diox Fur	SE	KR
Kanawha River	KR-KRSD-08	37.8	R380921	5/12/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-08	37.8	R380922	5/12/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-09	37.5	R380937	5/15/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-09	37.5	R380938	5/15/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-09	37.5	R380939	5/15/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-COR-20	37.5	SE-031884-113007-DD-043	11/30/2007	(0-0) IN	Duplicate	Diox Fur	SE	KR
Kanawha River	KR-COR-20	37.5	SE-031884-113007-DD-042	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-20	37.5	SE-031884-121107-DD-218	12/11/2007	(0-24) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-20	37.5	SE-031884-121107-DD-219	12/11/2007	(24-31.6) IN	-	Diox Fur	SE	KR

TABLE Q.16

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 17
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 4 Half Mile 17*
1731061.284	542078.493	STUDY AREA 4	16	B	COR-21	0	0	0	0.023
1731061.284	542078.493	STUDY AREA 4	16	B	COR-21	0	2	1	2.7
1731061.284	542078.493	STUDY AREA 4	16	B	COR-21	0	2	1	2.3
1731061.284	542078.493	STUDY AREA 4	16	B	COR-21	2	4	3	0.088
1731061.284	542078.493	STUDY AREA 4	16	B	COR-21	4	6.5	5.25	0.0018
1730582.104	541502.2357	STUDY AREA 4	16	B	KRSD-08	0	2	1	0.0000335
1730582.104	541502.2357	STUDY AREA 4	16	B	KRSD-08	2	4	3	0.0000335
1730582.104	541502.2357	STUDY AREA 4	16	B	KRSD-08	4	6	5	0.0000335
1731043.682	542114.7831	STUDY AREA 4	16	B	KRSD-09	0	0.5	0.25	2.4
1731043.682	542114.7831	STUDY AREA 4	16	B	KRSD-09	0	2	1	1.33
1731043.682	542114.7831	STUDY AREA 4	16	B	KRSD-09	2	4	3	5.02
1730499.085	542790	STUDY AREA 4	17	A	COR-20	0	0	0	0.0094
1730499.085	542790	STUDY AREA 4	17	A	COR-20	0	0	0	0.009
1730499.085	542790	STUDY AREA 4	17	A	COR-20	0	2	1	0.014
1730499.085	542790	STUDY AREA 4	17	A	COR-20	2	2.6	2.3	0.052
1729867.879	543822.587	STUDY AREA 4	17	B	COR-19	0	0	0	0.012
1729502.161	544413.604	STUDY AREA 4	17	B	SSD-13	0	0	0	0.038
1728712.195	545994.375	STUDY AREA 4	18	A	SSD-12	0	0	0	0.015

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.16

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 17
KANAWHA RIVER, WEST VIRGINIA

Original Result	*Chemical Name*	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*
0.023	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-21	37.7
2.7 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-21	37.7
2.3 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-21	37.7
0.088	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-21	37.7
0.0018	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-21	37.7
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-08	37.8
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-08	37.8
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-08	37.8
2.4 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-09	37.5
1.33 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-09	37.5
5.02 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-09	37.5
0.0094	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-20	37.5
0.009	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-20	37.5
0.014	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-20	37.5
0.052	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-20	37.5
0.012	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-19	37.2
0.038	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-13	NA
0.015	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-12	NA

TABLE Q.16

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 17
KANAWHA RIVER, WEST VIRGINIA

Sample Name	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
SE-031884-113007-DD-041	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
SE-031884-121007-DD-213	12/10/2007	(0-24) IN	-	Diox Fur	SE	KR
SE-031884-121007-DD-214	12/10/2007	(0-24) IN	Duplicate	Diox Fur	SE	KR
SE-031884-121007-DD-215	12/10/2007	(24-48) IN	-	Diox Fur	SE	KR
SE-031884-121007-DD-216	12/10/2007	(48-78) IN	-	Diox Fur	SE	KR
R380920	5/12/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
R380921	5/12/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
R380922	5/12/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
R380937	5/15/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
R380938	5/15/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
R380939	5/15/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
SE-031884-113007-DD-043	11/30/2007	(0-0) IN	Duplicate	Diox Fur	SE	KR
SE-031884-113007-DD-042	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
SE-031884-121107-DD-218	12/11/2007	(0-24) IN	-	Diox Fur	SE	KR
SE-031884-121107-DD-219	12/11/2007	(24-31.6) IN	-	Diox Fur	SE	KR
SE-031884-113007-DD-044	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
SE-031884-113007-DD-045	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
SE-031884-113007-DD-046	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR

TABLE Q.17

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 18
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 4 Half Mile 18*
1729867.879	543822.587	STUDY AREA 4	17	B	COR-19	0	0	0	0.012
1729502.161	544413.604	STUDY AREA 4	17	B	SSD-13	0	0	0	0.038
1728712.195	545994.375	STUDY AREA 4	18	A	SSD-12	0	0	0	0.015
1729116.843	546277.253	STUDY AREA 4	18	B	SSD-11	0	0	0	0.0052
1727172.695	547832.2135	STUDY AREA 4	19	A	KRSD-06	0	2	1	0.0483
1727172.695	547832.2135	STUDY AREA 4	19	A	KRSD-06	2	4	3	R
1727946.224	548081.3327	STUDY AREA 4	19	A	KRSD-07	0	2	1	0.0331
1727946.224	548081.3327	STUDY AREA 4	19	A	KRSD-07	2	4	3	R
1727946.224	548081.3327	STUDY AREA 4	19	A	KRSD-07	4	6	5	R
1727159.993	547567.204	STUDY AREA 4	19	A	SSD-10	0	0	0	0.0038

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.17

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 18
KANAWHA RIVER, WEST VIRGINIA

Original Result	*Chemical Name*	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*
0.012	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-19	37.2
0.038	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-13	NA
0.015	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-12	NA
0.0052	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-11	NA
0.0483	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-06	36.4
R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-06	36.4
0.0331 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-07	36.3
R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-07	36.3
R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-07	36.3
0.0038	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-10	NA

TABLE Q.17

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 18
KANAWHA RIVER, WEST VIRGINIA

Sample Name	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
SE-031884-113007-DD-044	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
SE-031884-113007-DD-045	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
SE-031884-113007-DD-046	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
SE-031884-113007-DD-047	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
R380915	5/11/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
R380916	5/12/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
R380917	5/12/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
R380918	5/12/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
R380919	5/12/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
SE-031884-113007-DD-048	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR

TABLE Q.18

SWAC CALCULATION
STUDY AREA 4 - HALF MILE 19
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 4 Half Mile 19*
1729116.843	546277.253	STUDY AREA 4	18	B	SSD-11	0	0	0	0.0052
1727172.695	547832.2135	STUDY AREA 4	19	A	KRSD-06	0	2	1	0.0483
1727172.695	547832.2135	STUDY AREA 4	19	A	KRSD-06	2	4	3	R
1727946.224	548081.3327	STUDY AREA 4	19	A	KRSD-07	0	2	1	0.0331
1727946.224	548081.3327	STUDY AREA 4	19	A	KRSD-07	2	4	3	R
1727946.224	548081.3327	STUDY AREA 4	19	A	KRSD-07	4	6	5	R
1727159.993	547567.204	STUDY AREA 4	19	A	SSD-10	0	0	0	0.0038
1727159.179	550370.023	STUDY AREA 4	20	A	COR-18	0	0	0	0.0036
1727159.179	550370.023	STUDY AREA 4	20	A	COR-18	0	2	1	0.000235

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.18

SWAC CALCULATION
STUDY AREA 4 - HALF MILE 19
KANAWHA RIVER, WEST VIRGINIA

Original Result	*Chemical Name*	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*
0.0052	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-11
0.0483	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-06
R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-06
0.0331 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-07
R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-07
R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-07
0.0038	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-10
ND(0.0072)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-18
ND(0.00047)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-18

TABLE Q.18

SWAC CALCULATION
STUDY AREA 4 - HALF MILE 19
KANAWHA RIVER, WEST VIRGINIA

River Marker	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
NA	SE-031884-113007-DD-047	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
36.4	R380915	5/11/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
36.4	R380916	5/12/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
36.3	R380917	5/12/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
36.3	R380918	5/12/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
36.3	R380919	5/12/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
NA	SE-031884-113007-DD-048	11/30/2007	(0-0) IN	-	Diox Fur	SE	KR
35.9	SE-031884-120107-DD-049	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
35.9	SE-031884-121107-DD-221	12/11/2007	(0-24) IN	-	Diox Fur	SE	KR

TABLE Q.19

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 20
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*
1727172.695	547832.2135	STUDY AREA 4	19	A	KRSD-06	0	2
1727172.695	547832.2135	STUDY AREA 4	19	A	KRSD-06	2	4
1727946.224	548081.3327	STUDY AREA 4	19	A	KRSD-07	0	2
1727946.224	548081.3327	STUDY AREA 4	19	A	KRSD-07	2	4
1727946.224	548081.3327	STUDY AREA 4	19	A	KRSD-07	4	6
1727159.993	547567.204	STUDY AREA 4	19	A	SSD-10	0	0
1727159.179	550370.023	STUDY AREA 4	20	A	COR-18	0	0
1727159.179	550370.023	STUDY AREA 4	20	A	COR-18	0	2
1726947.265	552121.377	STUDY AREA 4	20	B	SSD-09	0	0
1726469.83	552661.6632	STUDY AREA 4	21	A	KRSD-05	0	0.5
1726469.83	552661.6632	STUDY AREA 4	21	A	KRSD-05	0	2
1726469.83	552661.6632	STUDY AREA 4	21	A	KRSD-05	2	4
1726469.83	552661.6632	STUDY AREA 4	21	A	KRSD-05	4	6
1726469.83	552661.6632	STUDY AREA 4	21	A	KRSD-05	6	8

Legend

Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
Core data excluded as it is co-located with surficial samples
Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.19

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 20
KANAWHA RIVER, WEST VIRGINIA

Mid Depth (ft)	*TCDD Study Area 4 Half Mile 20*	*Original Result*	*Chemical Name*	*Concentration Unit*	*RDL Half*
1	0.0483	0.0483	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
3	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1	0.0331	0.0331 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
3	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
5	R	R	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
0	0.0038	0.0038	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
0	0.0036	ND(0.0072)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1	0.000235	ND(0.00047)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
0	0.0125	ND(0.025)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
0.25	0.0131	0.0131	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
1	0.504	0.504	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
3	0.421	0.421	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
5	1.59	1.59	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-
7	0.139	0.139	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-

TABLE Q.19

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 20
KANAWHA RIVER, WEST VIRGINIA

Coordinate Remark	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*
-	-	Kanawha River	KR-KRSD-06	36.4	R380915	5/11/2000
-	-	Kanawha River	KR-KRSD-06	36.4	R380916	5/12/2000
-	-	Kanawha River	KR-KRSD-07	36.3	R380917	5/12/2000
-	-	Kanawha River	KR-KRSD-07	36.3	R380918	5/12/2000
-	-	Kanawha River	KR-KRSD-07	36.3	R380919	5/12/2000
Surveyed	-	Kanawha River	KR-SSD-10	NA	SE-031884-113007-DD-048	11/30/2007
Surveyed	Bank - Right	Kanawha River	KR-COR-18	35.9	SE-031884-120107-DD-049	12/1/2007
Surveyed	Bank - Right	Kanawha River	KR-COR-18	35.9	SE-031884-121107-DD-221	12/11/2007
Surveyed	-	Kanawha River	KR-SSD-09	NA	SE-031884-120107-DD-050	12/1/2007
-	-	Kanawha River	KR-KRSD-05	35.3	R380931	5/13/2000
-	-	Kanawha River	KR-KRSD-05	35.3	R380923	5/13/2000
-	-	Kanawha River	KR-KRSD-05	35.3	R380924	5/13/2000
-	-	Kanawha River	KR-KRSD-05	35.3	R380925	5/13/2000
-	-	Kanawha River	KR-KRSD-05	35.3	R380926	5/13/2000

TABLE Q.19

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 20
KANAWHA RIVER, WEST VIRGINIA

Depth-Original	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
(0-2) ft BGS	-	Diox Fur	SE	KR
(2-4) ft BGS	-	Diox Fur	SE	KR
(0-2) ft BGS	-	Diox Fur	SE	KR
(2-4) ft BGS	-	Diox Fur	SE	KR
(4-6) ft BGS	-	Diox Fur	SE	KR
(0-0) IN	-	Diox Fur	SE	KR
(0-0) IN	-	Diox Fur	SE	KR
(0-24) IN	-	Diox Fur	SE	KR
(0-0) IN	-	Diox Fur	SE	KR
(0-0.5) ft BGS	-	Diox Fur	SE	KR
(0-2) ft BGS	-	Diox Fur	SE	KR
(2-4) ft BGS	-	Diox Fur	SE	KR
(4-6) ft BGS	-	Diox Fur	SE	KR
(6-8) ft BGS	-	Diox Fur	SE	KR

TABLE Q.20

SWAC CALCULTION
STUDY ARE 04 - HALF MILE 21
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 4 Half Mile 21*
1726947.265	552121.377	STUDY AREA 4	20	B	SSD-09	0	0		0.0125
1726469.83	552661.6632	STUDY AREA 4	21	A	KRSD-05	0	0.5	0.25	0.0131
1726469.83	552661.6632	STUDY AREA 4	21	A	KRSD-05	0	2	1	0.504
1726469.83	552661.6632	STUDY AREA 4	21	A	KRSD-05	2	4	3	0.421
1726469.83	552661.6632	STUDY AREA 4	21	A	KRSD-05	4	6	5	1.59
1726469.83	552661.6632	STUDY AREA 4	21	A	KRSD-05	6	8	7	0.139
1724896.805	554383.678	STUDY AREA 4	21	B	COR-17	0	0	0	0.0014
1723814.271	555109.208	STUDY AREA 4	22	A	COR-15	0	0	0	0.00345
1723814.271	555109.208	STUDY AREA 4	22	A	COR-15	0	1.6	0.8	0.013
1723814.271	555109.208	STUDY AREA 4	22	A	COR-15	0	1.6	0.8	0.0042
1723814.271	555109.208	STUDY AREA 4	22	A	COR-15	0	1.6	0.8	0.0049
1724952.883	554805.452	STUDY AREA 4	22	A	COR-16	0	0	0	0.0026
1724952.883	554805.452	STUDY AREA 4	22	A	COR-16	0	1.3	0.65	0.00076
1724952.883	554805.452	STUDY AREA 4	22	A	COR-16	0	1.3	0.65	0.00076
1724952.883	554805.452	STUDY AREA 4	22	A	COR-16	0	1.3	0.65	0.00077

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.20

SWAC CALCULTION
STUDY ARE 04 - HALF MILE 21
KANAWHA RIVER, WEST VIRGINIA

Original Result	*Chemical Name*	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*
ND(0.025)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-09	NA
0.0131	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-05	35.3
0.504	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-05	35.3
0.421	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-05	35.3
1.59	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-05	35.3
0.139	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-05	35.3
ND(0.0028)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-17	35
ND(0.0069)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-15	34.8
0.013	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-15	34.8
0.0042	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-15	34.8
0.0049	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-15	34.8
ND(0.0052)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-16	35
0.00076 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-16	35
0.00076 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-16	35
0.00077 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-16	35

TABLE Q.20

SWAC CALCULTION
STUDY ARE 04 - HALF MILE 21
KANAWHA RIVER, WEST VIRGINIA

Sample Name	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
SE-031884-120107-DD-050	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
R380931	5/13/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
R380923	5/13/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
R380924	5/13/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
R380925	5/13/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
R380926	5/13/2000	(6-8) ft BGS	-	Diox Fur	SE	KR
SE-031884-120107-DD-051	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
SE-031884-120107-DD-053	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-406 (A)	3/31/2008	(0-19) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-406 (B)	3/31/2008	(0-19) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-406 (C)	3/31/2008	(0-19) IN	-	Diox Fur	SE	KR
SE-031884-120107-DD-052	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-407 (A)	3/31/2008	(0-16) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-407 (B)	3/31/2008	(0-16) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-407 (C)	3/31/2008	(0-16) IN	-	Diox Fur	SE	KR

TABLE Q.21

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 22
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 4 Half Mile 22*
1724896.805	554383.678	STUDY AREA 4	21	B	COR-17	0	0	0	0.0014
1723814.271	555109.208	STUDY AREA 4	22	A	COR-15	0	0	0	0.00345
1723814.271	555109.208	STUDY AREA 4	22	A	COR-15	0	1.6	0.8	0.013
1723814.271	555109.208	STUDY AREA 4	22	A	COR-15	0	1.6	0.8	0.0042
1723814.271	555109.208	STUDY AREA 4	22	A	COR-15	0	1.6	0.8	0.0049
1724952.883	554805.452	STUDY AREA 4	22	A	COR-16	0	0	0	0.0026
1724952.883	554805.452	STUDY AREA 4	22	A	COR-16	0	1.3	0.65	0.00076
1724952.883	554805.452	STUDY AREA 4	22	A	COR-16	0	1.3	0.65	0.00076
1724952.883	554805.452	STUDY AREA 4	22	A	COR-16	0	1.3	0.65	0.00077
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13A	0	0.2	0.1	0.13
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13A	0	0.2	0.1	0.0046
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13A	0	0.2	0.1	0.013
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13B	0	0.2	0.1	0.0079
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13B	0	0.2	0.1	0.0006
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13B	0	0.2	-	0.074
1722462.494	557056.444	STUDY AREA 4	23	A	COR-13	0	0	0	0.01
1723149.64	556751.033	STUDY AREA 4	23	A	COR-14	0	0	0	0.012
1721890.566	557206.4348	STUDY AREA 4	23	A	KRSD-04	0	2	1	0.0238
1721890.566	557206.4348	STUDY AREA 4	23	A	KRSD-04	0	4	2	0.00048

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.21

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 22
KANAWHA RIVER, WEST VIRGINIA

Original Result	*Chemical Name*	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*
ND(0.0028)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-17	35
ND(0.0069)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-15	34.8
0.013	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-15	34.8
0.0042	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-15	34.8
0.0049	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-15	34.8
ND(0.0052)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-16	35
0.00076 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-16	35
0.00076 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-16	35
0.00077 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-16	35
0.13	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13A	34.3
0.0046	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13A	34.3
0.013	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13A	34.3
0.0079	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13B	34.3
ND(0.0012)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13B	34.3
0.074	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13B	34.3
0.01	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-13	34.3
0.012	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-14	34.5
0.0238	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-04	34.3
0.00048 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-04	34.3

TABLE Q.21

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 22
KANAWHA RIVER, WEST VIRGINIA

Sample Name	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
SE-031884-120107-DD-051	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
SE-031884-120107-DD-053	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-406 (A)	3/31/2008	(0-19) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-406 (B)	3/31/2008	(0-19) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-406 (C)	3/31/2008	(0-19) IN	-	Diox Fur	SE	KR
SE-031884-120107-DD-052	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-407 (A)	3/31/2008	(0-16) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-407 (B)	3/31/2008	(0-16) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-407 (C)	3/31/2008	(0-16) IN	-	Diox Fur	SE	KR
S-031884-022408-DD-457 (A)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
S-031884-022408-DD-457 (B)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
S-031884-022408-DD-457 (C)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
S-031884-022408-DD-458 (B)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
S-031884-022408-DD-458 (C)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
S-031884-022408-DD-458 (A)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
SE-031884-120107-DD-055	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
SE-031884-120107-DD-054	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
R380913	5/12/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
R380914	5/12/2000	(0-4) ft BGS	-	Diox Fur	SE	KR

TABLE Q.22

SWAC CALCULATION
STUDY AREA 04 - HALF MILES 23
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 4 Half Mile 23*
1723814.271	555109.208	STUDY AREA 4	22	A	COR-15	0	0	0	0.00345
1723814.271	555109.208	STUDY AREA 4	22	A	COR-15	0	1.6	0.8	0.013
1723814.271	555109.208	STUDY AREA 4	22	A	COR-15	0	1.6	0.8	0.0042
1723814.271	555109.208	STUDY AREA 4	22	A	COR-15	0	1.6	0.8	0.0049
1724952.883	554805.452	STUDY AREA 4	22	A	COR-16	0	0	0	0.0026
1724952.883	554805.452	STUDY AREA 4	22	A	COR-16	0	1.3	0.65	0.00076
1724952.883	554805.452	STUDY AREA 4	22	A	COR-16	0	1.3	0.65	0.00076
1724952.883	554805.452	STUDY AREA 4	22	A	COR-16	0	1.3	0.65	0.00077
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13A	0	0.2	0.1	0.13
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13A	0	0.2	0.1	0.0046
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13A	0	0.2	0.1	0.013
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13B	0	0.2	0.1	0.0079
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13B	0	0.2	0.1	0.0006
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13B	0	0.2	-	0.074
1722462.494	557056.444	STUDY AREA 4	23	A	COR-13	0	0	0	0.01
1723149.64	556751.033	STUDY AREA 4	23	A	COR-14	0	0	0	0.012
1721890.566	557206.4348	STUDY AREA 4	23	A	KRSD-04	0	2	1	0.0238
1721890.566	557206.4348	STUDY AREA 4	23	A	KRSD-04	0	4	2	0.00048
1720952.404	559487.96	STUDY AREA 4	24	A	COR-11	0	0	0	0.01
1720952.404	559487.96	STUDY AREA 4	24	A	COR-11	0	2	1	0.15
1720993.534	558404.586	STUDY AREA 4	24	A	COR-12	0	0	0	0.023
1720993.534	558404.586	STUDY AREA 4	24	A	COR-12	0	1.8	0.9	0.002

Legend

Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
Core data excluded as it is co-located with surficial samples
Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.22

SWAC CALCULATION
STUDY AREA 04 - HALF MILES 23
KANAWHA RIVER, WEST VIRGINIA

Original Result	*Chemical Name*	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*
ND(0.0069)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-15	34.8
0.013	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-15	34.8
0.0042	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-15	34.8
0.0049	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-15	34.8
ND(0.0052)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-16	35
0.00076 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-16	35
0.00076 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-16	35
0.00077 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-16	35
0.13	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13A	34.3
0.0046	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13A	34.3
0.013	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13A	34.3
0.0079	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13B	34.3
ND(0.0012)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13B	34.3
0.074	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13B	34.3
0.01	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-13	34.3
0.012	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-14	34.5
0.0238	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-04	34.3
0.00048 B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-04	34.3
0.01	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-11	33.8
0.15	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-11	33.8
0.023	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-12	34
0.002	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-12	34

TABLE Q.22

SWAC CALCULATION
STUDY AREA 04 - HALF MILES 23
KANAWHA RIVER, WEST VIRGINIA

Sample Name	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
SE-031884-120107-DD-053	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-406 (A)	3/31/2008	(0-19) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-406 (B)	3/31/2008	(0-19) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-406 (C)	3/31/2008	(0-19) IN	-	Diox Fur	SE	KR
SE-031884-120107-DD-052	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-407 (A)	3/31/2008	(0-16) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-407 (B)	3/31/2008	(0-16) IN	-	Diox Fur	SE	KR
S-031884-022308-DD-407 (C)	3/31/2008	(0-16) IN	-	Diox Fur	SE	KR
S-031884-022408-DD-457 (A)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
S-031884-022408-DD-457 (B)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
S-031884-022408-DD-457 (C)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
S-031884-022408-DD-458 (B)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
S-031884-022408-DD-458 (C)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
S-031884-022408-DD-458 (A)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
SE-031884-120107-DD-055	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
SE-031884-120107-DD-054	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
R380913	5/12/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
R380914	5/12/2000	(0-4) ft BGS	-	Diox Fur	SE	KR
SE-031884-120107-DD-057	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
SE-031884-121507-DD-331	12/15/2007	(0-24) IN	-	Diox Fur	SE	KR
SE-031884-120107-DD-056	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
SE-031884-121507-DD-334	12/15/2007	(0-22) IN	-	Diox Fur	SE	KR

TABLE Q.23

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 24
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	Y Coordinate	Study Area	Half Mile	Quarter Mile	Location Name	All Depth (ft) - TOP	All Depth (ft) - BOT	Mid Depth (ft)	TCDD Study Area 4 Half Mile 24	Original Result
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13A	0	0.2	0.1	0.13	0.13
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13A	0	0.2	0.1	0.0046	0.0046
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13A	0	0.2	0.1	0.013	0.013
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13B	0	0.2	0.1	0.0079	0.0079
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13B	0	0.2	0.1	0.0006	ND(0.0012)U
1722462.494	557056.444	STUDY AREA 4	23	A	BC-COR-13B	0	0.2	-	0.074	0.074
1722462.494	557056.444	STUDY AREA 4	23	A	COR-13	0	0	0	0.01	0.01
1723149.64	556751.033	STUDY AREA 4	23	A	COR-14	0	0	0	0.012	0.012
1721890.566	557206.4348	STUDY AREA 4	23	A	KRSD-04	0	2	1	0.0238	0.0238
1721890.566	557206.4348	STUDY AREA 4	23	A	KRSD-04	0	4	2	0.00048	0.00048 B
1720952.404	559487.96	STUDY AREA 4	24	A	COR-11	0	0	0	0.01	0.01
1720952.404	559487.96	STUDY AREA 4	24	A	COR-11	0	2	1	0.15	0.15
1720993.534	558404.586	STUDY AREA 4	24	A	COR-12	0	0	0	0.023	0.023
1720993.534	558404.586	STUDY AREA 4	24	A	COR-12	0	1.8	0.9	0.002	0.002
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10A	0	0.5	0.25	0.0032	0.0032
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10A	0	0.5	0.25	0.0036	0.0036
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10A	0	0.5	0.25	0.042	0.042
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10B	0	0.2	0.1	0.049	0.049
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10B	0	0.2	0.1	0.0014	0.0014
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10B	0	0.2	0.1	0.0078	0.0078
1719592.689	561425.534	STUDY AREA 4	25	A	COR-09	0	0	0	0.014	0.014
1719592.689	561425.534	STUDY AREA 4	25	A	COR-09	0	2	1	0.0086	0.0086
1719592.689	561425.534	STUDY AREA 4	25	A	COR-09	2	2.8	2.4	0.000275	ND(0.00055)
1719458.457	560988.973	STUDY AREA 4	25	A	COR-10	0	0	0	0.0019	ND(0.0038)U
1719637.865	561496.3967	STUDY AREA 4	25	A	KRSD-03	0	0.5	0.25	0.0203	0.0203
1719637.865	561496.3967	STUDY AREA 4	25	A	KRSD-03	0	2	1	0.513	0.513 J
1719637.865	561496.3967	STUDY AREA 4	25	A	KRSD-03	2	4	3	0.0107	0.0107
1719637.865	561496.3967	STUDY AREA 4	25	A	KRSD-03	4	6	5	0.0000335	ND(0.000067)
1719637.865	561496.3967	STUDY AREA 4	25	A	KRSD-03	6	8	7	0.0000335	ND(0.000067)

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.23

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 24
KANAWHA RIVER, WEST VIRGINIA

Chemical Name	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13A	34.3	S-031884-022408-DD-457 (A)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13A	34.3	S-031884-022408-DD-457 (B)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13A	34.3	S-031884-022408-DD-457 (C)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13B	34.3	S-031884-022408-DD-458 (B)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13B	34.3	S-031884-022408-DD-458 (C)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-13B	34.3	S-031884-022408-DD-458 (A)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-13	34.3	SE-031884-120107-DD-055
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-14	34.5	SE-031884-120107-DD-054
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-04	34.3	R380913
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-04	34.3	R380914
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-11	33.8	SE-031884-120107-DD-057
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-11	33.8	SE-031884-121507-DD-331
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-12	34	SE-031884-120107-DD-056
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-12	34	SE-031884-121507-DD-334
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-10A	33.4	S-031884-022408-DD-455 (B)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-10A	33.4	S-031884-022408-DD-455 (C)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-10A	33.4	S-031884-022408-DD-455 (A)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-10B	33.4	S-031884-022408-DD-456 (A)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-10B	33.4	S-031884-022408-DD-456 (B)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-10B	33.4	S-031884-022408-DD-456 (C)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-09	33.4	SE-031884-120107-DD-059
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-09	33.4	SE-031884-121507-DD-332
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-09	33.4	SE-031884-121507-DD-333
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-COR-10	33.4	SE-031884-120107-DD-058
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-03	33.3	R3809I0
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-03	33.3	R380909
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-03	33.3	R380910
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-03	33.3	R380911
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-03	33.3	R380912

TABLE Q.23

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 24
KANAWHA RIVER, WEST VIRGINIA

Sample Date	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
5/12/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
5/12/2000	(0-4) ft BGS	-	Diox Fur	SE	KR
12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
12/15/2007	(0-24) IN	-	Diox Fur	SE	KR
12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
12/15/2007	(0-22) IN	-	Diox Fur	SE	KR
3/28/2008	(0-6) IN	-	Diox Fur	SE	KR
3/28/2008	(0-6) IN	-	Diox Fur	SE	KR
3/28/2008	(0-6) IN	-	Diox Fur	SE	KR
3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
12/15/2007	(0-24) IN	-	Diox Fur	SE	KR
12/15/2007	(24-34) IN	-	Diox Fur	SE	KR
12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
5/12/2000	-	-	Diox Fur	SE	KR
5/12/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
5/12/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
5/12/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
5/11/2000	(6-8) ft BGS	-	Diox Fur	SE	KR

TABLE Q.24

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 25
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 4 Half Mile 25*
1720952.404	559487.96	STUDY AREA 4	24	A	COR-11	0	0	0	0.01
1720952.404	559487.96	STUDY AREA 4	24	A	COR-11	0	2	1	0.15
1720993.534	558404.586	STUDY AREA 4	24	A	COR-12	0	0	0	0.023
1720993.534	558404.586	STUDY AREA 4	24	A	COR-12	0	1.8	0.9	0.002
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10A	0	0.5	0.25	0.0032
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10A	0	0.5	0.25	0.0036
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10A	0	0.5	0.25	0.042
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10B	0	0.2	0.1	0.049
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10B	0	0.2	0.1	0.0014
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10B	0	0.2	0.1	0.0078
1719592.689	561425.534	STUDY AREA 4	25	A	COR-09	0	0	0	0.014
1719592.689	561425.534	STUDY AREA 4	25	A	COR-09	0	2	1	0.0086
1719592.689	561425.534	STUDY AREA 4	25	A	COR-09	2	2.8	2.4	0.000275
1719458.457	560988.973	STUDY AREA 4	25	A	COR-10	0	0	0	0.0019
1719637.865	561496.3967	STUDY AREA 4	25	A	KRSD-03	0	0.5	0.25	0.0203
1719637.865	561496.3967	STUDY AREA 4	25	A	KRSD-03	0	2	1	0.513
1719637.865	561496.3967	STUDY AREA 4	25	A	KRSD-03	2	4	3	0.0107
1719637.865	561496.3967	STUDY AREA 4	25	A	KRSD-03	4	6	5	0.0000335
1719637.865	561496.3967	STUDY AREA 4	25	A	KRSD-03	6	8	7	0.0000335
1717137.45	562409.832	STUDY AREA 4	26	A	COR-08	0	0	0	0.0041
1717137.45	562409.832	STUDY AREA 4	26	A	COR-08	0	2	1	0.0093
1717137.45	562409.832	STUDY AREA 4	26	A	COR-08	2	4	3	1.4
1717677.66	562425.934	STUDY AREA 4	26	A	SSD-7	0	0	0	0.017

Legend

- (Yellow) Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
- (Orange) Core data excluded as it is co-located with surficial samples
- (Green) Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.24

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 25
KANAWHA RIVER, WEST VIRGINIA

Original Result	*Chemical Name*	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*
0.01	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River
0.15	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River
0.023	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River
0.002	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River
0.0032	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River
0.0036	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River
0.042	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River
0.049	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River
0.0014	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River
0.0078	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River
0.014	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River
0.0086	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River
ND(0.00055)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River
ND(0.0038)U	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River
0.0203	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River
0.513 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River
0.0107	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River
0.0041	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River
0.0093	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River
1.4 J	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River
0.017	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River

TABLE Q.24

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 25
KANAWHA RIVER, WEST VIRGINIA

System Location Code	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
KR-COR-11	33.8	SE-031884-120107-DD-057	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
KR-COR-11	33.8	SE-031884-121507-DD-331	12/15/2007	(0-24) IN	-	Diox Fur	SE	KR
KR-COR-12	34	SE-031884-120107-DD-056	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
KR-COR-12	34	SE-031884-121507-DD-334	12/15/2007	(0-22) IN	-	Diox Fur	SE	KR
KR-BC-COR-10A	33.4	S-031884-022408-DD-455 (B)	3/28/2008	(0-6) IN	-	Diox Fur	SE	KR
KR-BC-COR-10A	33.4	S-031884-022408-DD-455 (C)	3/28/2008	(0-6) IN	-	Diox Fur	SE	KR
KR-BC-COR-10A	33.4	S-031884-022408-DD-455 (A)	3/28/2008	(0-6) IN	-	Diox Fur	SE	KR
KR-BC-COR-10B	33.4	S-031884-022408-DD-456 (A)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
KR-BC-COR-10B	33.4	S-031884-022408-DD-456 (B)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
KR-BC-COR-10B	33.4	S-031884-022408-DD-456 (C)	3/28/2008	(0-2) IN	-	Diox Fur	SE	KR
KR-COR-09	33.4	SE-031884-120107-DD-059	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
KR-COR-09	33.4	SE-031884-121507-DD-332	12/15/2007	(0-24) IN	-	Diox Fur	SE	KR
KR-COR-09	33.4	SE-031884-121507-DD-333	12/15/2007	(24-34) IN	-	Diox Fur	SE	KR
KR-COR-10	33.4	SE-031884-120107-DD-058	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
KR-KRSD-03	33.3	R3809I0	5/12/2000	-	-	Diox Fur	SE	KR
KR-KRSD-03	33.3	R380909	5/12/2000	(0-2) ft BGS	-	Diox Fur	SE	KR
KR-KRSD-03	33.3	R380910	5/12/2000	(2-4) ft BGS	-	Diox Fur	SE	KR
KR-KRSD-03	33.3	R380911	5/12/2000	(4-6) ft BGS	-	Diox Fur	SE	KR
KR-KRSD-03	33.3	R380912	5/11/2000	(6-8) ft BGS	-	Diox Fur	SE	KR
KR-COR-08	32.9	SE-031884-120107-DD-061	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
KR-COR-08	32.9	SE-031884-121307-DD-279	12/13/2007	(0-24) IN	-	Diox Fur	SE	KR
KR-COR-08	32.9	SE-031884-121307-DD-280	12/13/2007	(24-48) IN	-	Diox Fur	SE	KR
KR-SSD-7	NA	SE-031884-120107-DD-060	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR

TABLE Q.25

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 26
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 4 Half Mile 26*	*Original Result*
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10A	0	0.5	0.25	0.042	0.042
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10A	0	0.5	0.25	0.0032	0.0032
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10A	0	0.5	0.25	0.0036	0.0036
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10B	0	0.2	0.1	0.049	0.049
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10B	0	0.2	0.1	0.0014	0.0014
1719458.457	560988.973	STUDY AREA 4	25	A	BC-COR-10B	0	0.2	0.1	0.0078	0.0078
1719592.689	561425.534	STUDY AREA 4	25	A	COR-09	0	0	0	0.014	0.014
1719592.689	561425.534	STUDY AREA 4	25	A	COR-09	0	2	1	0.0086	0.0086
1719592.689	561425.534	STUDY AREA 4	25	A	COR-09	2	2.8	2.4	0.000275	ND(0.00055)
1719458.457	560988.973	STUDY AREA 4	25	A	COR-10	0	0	0	0.0019	ND(0.0038)U
1719637.865	561496.3967	STUDY AREA 4	25	A	KRSD-03	0	0.5	0.25	0.0203	0.0203
1719637.865	561496.3967	STUDY AREA 4	25	A	KRSD-03	0	2	1	0.513	0.513 J
1719637.865	561496.3967	STUDY AREA 4	25	A	KRSD-03	2	4	3	0.0107	0.0107
1719637.865	561496.3967	STUDY AREA 4	25	A	KRSD-03	4	6	5	0.0000335	ND(0.000067)
1719637.865	561496.3967	STUDY AREA 4	25	A	KRSD-03	6	8	7	0.0000335	ND(0.000067)
1717137.45	562409.832	STUDY AREA 4	26	A	COR-08	0	0	0	0.0041	0.0041
1717137.45	562409.832	STUDY AREA 4	26	A	COR-08	0	2	1	0.0093	0.0093
1717137.45	562409.832	STUDY AREA 4	26	A	COR-08	2	4	3	1.4	1.4 J
1717677.66	562425.934	STUDY AREA 4	26	A	SSD-7	0	0	0	0.017	0.017
1715781.459	563173.704	STUDY AREA 4	26	B	COR-06	0	0	0	0.0031	0.0031
1715757.471	563513.888	STUDY AREA 4	26	B	COR-07	0	0	0	0.048	0.048
1715757.471	563513.888	STUDY AREA 4	26	B	COR-07	0	2	1	0.000155	ND(0.00031)
1715757.471	563513.888	STUDY AREA 4	26	B	COR-07	2	3	2.5	0.000135	ND(0.00027)
1716410.294	562949.6256	STUDY AREA 4	26	B	KD-200	0	0.5	0.25	0.015	0.015
1716410.294	562949.6256	STUDY AREA 4	26	B	KD-201	0	0.5	0.25	0.28	0.28
1716036.679	563781.505	STUDY AREA 4	26	B	SSD-06	0	0	0	0.038	0.038
1714213.196	563022.593	STUDY AREA 4	27	A	COR-05	0	0	0	0.02	0.02
1714213.196	563022.593	STUDY AREA 4	27	A	COR-05	0	0	0	0.0057	0.0057

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.25

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 26
KANAWHA RIVER, WEST VIRGINIA

Chemical Name	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*	*Sample Name*
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-10A	33.4	S-031884-022408-DD-455 (A)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-10A	33.4	S-031884-022408-DD-455 (B)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-10A	33.4	S-031884-022408-DD-455 (C)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-10B	33.4	S-031884-022408-DD-456 (A)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-10B	33.4	S-031884-022408-DD-456 (B)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-BC-COR-10B	33.4	S-031884-022408-DD-456 (C)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-09	33.4	SE-031884-120107-DD-059
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-09	33.4	SE-031884-121507-DD-332
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-09	33.4	SE-031884-121507-DD-333
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-COR-10	33.4	SE-031884-120107-DD-058
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-03	33.3	R3809I0
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-03	33.3	R380909
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-03	33.3	R380910
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-03	33.3	R380911
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-03	33.3	R380912
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-08	32.9	SE-031884-120107-DD-061
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-08	32.9	SE-031884-121307-DD-279
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-08	32.9	SE-031884-121307-DD-280
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-7	NA	SE-031884-120107-DD-060
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-06	32.6	SE-031884-120107-DD-062
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-07	32.6	SE-031884-120107-DD-063
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-07	32.6	SE-031884-121407-DD-282
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-07	32.6	SE-031884-121407-DD-283
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced	-	Kanawha River	KRKD-200	NA	SD-31884-10282004-KD-200
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced	-	Kanawha River	KRKD-201	NA	SD-31884-10282004-KD-201
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-06	NA	SE-031884-120107-DD-064
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-05	32.3	SE-031884-120107-DD-065
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-05	32.3	SE-031884-120107-DD-066

TABLE Q.25

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 26
KANAWHA RIVER, WEST VIRGINIA

Sample Date	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*	
3/28/2008	(0-6) IN	-	Diox Fur	SE	KR	
3/28/2008	(0-6) IN	-	Diox Fur	SE	KR	
3/28/2008	(0-6) IN	-	Diox Fur	SE	KR	
3/28/2008	(0-2) IN	-	Diox Fur	SE	KR	
3/28/2008	(0-2) IN	-	Diox Fur	SE	KR	
3/28/2008	(0-2) IN	-	Diox Fur	SE	KR	
12/1/2007	(0-0) IN	-	Diox Fur	SE	KR	
12/15/2007	(0-24) IN	-	Diox Fur	SE	KR	
12/15/2007	(24-34) IN	-	Diox Fur	SE	KR	
12/1/2007	(0-0) IN	-	Diox Fur	SE	KR	
5/12/2000	-	-	Diox Fur	SE	KR	
5/12/2000	(0-2) ft BGS	-	Diox Fur	SE	KR	
5/12/2000	(2-4) ft BGS	-	Diox Fur	SE	KR	
5/12/2000	(4-6) ft BGS	-	Diox Fur	SE	KR	
5/11/2000	(6-8) ft BGS	-	Diox Fur	SE	KR	
12/1/2007	(0-0) IN	-	Diox Fur	SE	KR	
12/13/2007	(0-24) IN	-	Diox Fur	SE	KR	
12/13/2007	(24-48) IN	-	Diox Fur	SE	KR	
12/1/2007	(0-0) IN	-	Diox Fur	SE	KR	
12/1/2007	(0-0) IN	-	Diox Fur	SE	KR	
12/1/2007	(0-0) IN	-	Diox Fur	SE	KR	
12/14/2007	(0-24) IN	-	Diox Fur	SE	KR	
12/14/2007	(24-36) IN	-	Diox Fur	SE	KR	
10/28/2004	-	-	Diox Fur	SE	KR	
10/28/2004	-	-	Diox Fur	SE	KR	Avg Sample/Dup
12/1/2007	(0-0) IN	-	Diox Fur	SE	KR	
12/1/2007	(0-0) IN	-	Diox Fur	SE	KR	
12/1/2007	(0-0) IN	Duplicate	Diox Fur	SE	KR	

TABLE Q.26

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 27
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 4 Half Mile 27*
1715781.459	563173.704	STUDY AREA 4	26	B	COR-06	0	0	0	0.0031
1715757.471	563513.888	STUDY AREA 4	26	B	COR-07	0	0	0	0.048
1715757.471	563513.888	STUDY AREA 4	26	B	COR-07	0	2	1	0.000155
1715757.471	563513.888	STUDY AREA 4	26	B	COR-07	2	3	2.5	0.000135
1716410.294	562949.6256	STUDY AREA 4	26	B	KD-200	0	0.5	0.25	0.015
1716410.294	562949.6256	STUDY AREA 4	26	B	KD-201	0	0.5	0.25	0.28
1716036.679	563781.505	STUDY AREA 4	26	B	SSD-06	0	0	0	0.038
1714213.196	563022.593	STUDY AREA 4	27	A	COR-05	0	0	0	0.02
1714213.196	563022.593	STUDY AREA 4	27	A	COR-05	0	0	0	0.0057
1713567.333	561847.685	STUDY AREA 4	27	B	COR-04	0	0	0	0.0073
1713567.333	561847.685	STUDY AREA 4	27	B	COR-04	0	2	1	0.013
1713567.333	561847.685	STUDY AREA 4	27	B	COR-04	2	4	3	0.0098
1713567.333	561847.685	STUDY AREA 4	27	B	COR-04	4	6	5	0.0086
1712999.825	561018.481	STUDY AREA 4	28	A	COR-03	0	0	0	0.01
1712999.825	561018.481	STUDY AREA 4	28	A	COR-03	0	2	1	0.0083
1712999.825	561018.481	STUDY AREA 4	28	A	COR-03	2	4	3	0.011
1712999.825	561018.481	STUDY AREA 4	28	A	COR-03	4	6.8	5.4	0.019
1712992.506	560984.1945	STUDY AREA 4	28	A	KRSD-02	0	0.5	0.25	0.00291
1712992.506	560984.1945	STUDY AREA 4	28	A	KRSD-02	0	1.7	0.85	0.00519
1712992.506	560984.1945	STUDY AREA 4	28	A	KRSD-02	1.7	3.3	2.5	0.00582
1712992.506	560984.1945	STUDY AREA 4	28	A	KRSD-02	3.3	5	4.15	0.00468
1712992.506	560984.1945	STUDY AREA 4	28	A	KRSD-02	7.3	9.6	8.45	0.0000335
1713251.364	560887.391	STUDY AREA 4	28	A	SSD-05	0	0	0	0.024

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.26

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 27
KANAWHA RIVER, WEST VIRGINIA

Original Result	*Chemical Name*	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*
0.0031	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-06
0.048	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-07
ND(0.00031)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-07
ND(0.00027)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Right	Kanawha River	KR-COR-07
0.015	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced	-	Kanawha River	KRKD-200
0.28	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Traced	-	Kanawha River	KRKD-201
0.038	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-06
0.02	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-05
0.0057	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-05
0.0073	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-04
0.013	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-04
0.0098	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-04
0.0086	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-04
0.01	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-03
0.0083	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-03
0.011	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-03
0.019	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-03
0.00291	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-02
0.00519	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-02
0.00582	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-02
0.00468	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-02
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-02
0.024	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-05

TABLE Q.26

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 27
KANAWHA RIVER, WEST VIRGINIA

River Marker	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*	
32.6	SE-031884-120107-DD-062	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR	
32.6	SE-031884-120107-DD-063	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR	
32.6	SE-031884-121407-DD-282	12/14/2007	(0-24) IN	-	Diox Fur	SE	KR	
32.6	SE-031884-121407-DD-283	12/14/2007	(24-36) IN	-	Diox Fur	SE	KR	
NA	SD-31884-10282004-KD-200	10/28/2004	-	-	Diox Fur	SE	KR	
NA	SD-31884-10282004-KD-201	10/28/2004	-	-	Diox Fur	SE	KR	Avg Sample/Dup
NA	SE-031884-120107-DD-064	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR	
32.3	SE-031884-120107-DD-065	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR	
32.3	SE-031884-120107-DD-066	12/1/2007	(0-0) IN	Duplicate	Diox Fur	SE	KR	
32.1	SE-031884-120107-DD-067	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR	
32.1	SE-031884-121207-DD-269	12/12/2007	(0-24) IN	-	Diox Fur	SE	KR	
32.1	SE-031884-121207-DD-270	12/12/2007	(24-48) IN	-	Diox Fur	SE	KR	
32.1	SE-031884-121207-DD-271	12/12/2007	(48-72) IN	-	Diox Fur	SE	KR	
32	SE-031884-120207-DD-068	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR	
32	SE-031884-121307-DD-274	12/13/2007	(0-24) IN	-	Diox Fur	SE	KR	
32	SE-031884-121307-DD-275	12/13/2007	(24-48) IN	-	Diox Fur	SE	KR	
32	SE-031884-121307-DD-276	12/13/2007	(48-81.6) IN	-	Diox Fur	SE	KR	
32	R380908	5/11/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR	
32	R380904	5/11/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR	
32	R380905	5/11/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR	
32	R380906	5/11/2000	(3.333-5) ft BGS	-	Diox Fur	SE	KR	
32	R380907	5/11/2000	(7.333-9.583) ft BGS	-	Diox Fur	SE	KR	
NA	SE-031884-120207-DD-069	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR	

TABLE Q.27

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 28
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 4 Half Mile 28*
1713567.333	561847.685	STUDY AREA 4	27	B	COR-04	0	0	0	0.0073
1713567.333	561847.685	STUDY AREA 4	27	B	COR-04	0	2	1	0.013
1713567.333	561847.685	STUDY AREA 4	27	B	COR-04	2	4	3	0.0098
1713567.333	561847.685	STUDY AREA 4	27	B	COR-04	4	6	5	0.0086
1712999.825	561018.481	STUDY AREA 4	28	A	COR-03	0	0	0	0.01
1712999.825	561018.481	STUDY AREA 4	28	A	COR-03	0	2	1	0.0083
1712999.825	561018.481	STUDY AREA 4	28	A	COR-03	2	4	3	0.011
1712999.825	561018.481	STUDY AREA 4	28	A	COR-03	4	6.8	5.4	0.019
1712992.506	560984.1945	STUDY AREA 4	28	A	KRSD-02	0	0.5	0.25	0.00291
1712992.506	560984.1945	STUDY AREA 4	28	A	KRSD-02	0	1.7	0.85	0.00519
1712992.506	560984.1945	STUDY AREA 4	28	A	KRSD-02	1.7	3.3	2.5	0.00582
1712992.506	560984.1945	STUDY AREA 4	28	A	KRSD-02	3.3	5	4.15	0.00468
1712992.506	560984.1945	STUDY AREA 4	28	A	KRSD-02	7.3	9.6	8.45	0.0000335
1713251.364	560887.391	STUDY AREA 4	28	A	SSD-05	0	0	0	0.024
1710952.925	559745.125	STUDY AREA 4	29	A	COR-02	0	0	0	0.048

Legend

(yellow)	Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
(orange)	Core data excluded as it is co-located with surficial samples
(green)	Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.27

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 28
KANAWHA RIVER, WEST VIRGINIA

Original Result	*Chemical Name*	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*	*Subfacility Name*	*System Location Code*	*River Marker*
0.0073	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-04	32.1
0.013	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-04	32.1
0.0098	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-04	32.1
0.0086	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-04	32.1
0.01	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-03	32
0.0083	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-03	32
0.011	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-03	32
0.019	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left	Kanawha River	KR-COR-03	32
0.00291	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-02	32
0.00519	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-02	32
0.00582	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-02	32
0.00468	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-02	32
ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-	Kanawha River	KR-KRSD-02	32
0.024	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-	Kanawha River	KR-SSD-05	NA
0.048	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre	Kanawha River	KR-COR-02	31.5

TABLE Q.27

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 28
KANAWHA RIVER, WEST VIRGINIA

Sample Name	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
SE-031884-120107-DD-067	12/1/2007	(0-0) IN	-	Diox Fur	SE	KR
SE-031884-121207-DD-269	12/12/2007	(0-24) IN	-	Diox Fur	SE	KR
SE-031884-121207-DD-270	12/12/2007	(24-48) IN	-	Diox Fur	SE	KR
SE-031884-121207-DD-271	12/12/2007	(48-72) IN	-	Diox Fur	SE	KR
SE-031884-120207-DD-068	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR
SE-031884-121307-DD-274	12/13/2007	(0-24) IN	-	Diox Fur	SE	KR
SE-031884-121307-DD-275	12/13/2007	(24-48) IN	-	Diox Fur	SE	KR
SE-031884-121307-DD-276	12/13/2007	(48-81.6) IN	-	Diox Fur	SE	KR
R380908	5/11/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
R380904	5/11/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR
R380905	5/11/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR
R380906	5/11/2000	(3.333-5) ft BGS	-	Diox Fur	SE	KR
R380907	5/11/2000	(7.333-9.583) ft BGS	-	Diox Fur	SE	KR
SE-031884-120207-DD-069	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR
SE-031884-120207-DD-070	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR

TABLE Q.28

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 29
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	Y Coordinate	Study Area	Half Mile	Quarter Mile	Location Name	All Depth (ft) - TOP	All Depth (ft) - BOT	Mid Depth (ft)	TCDD Study Area 4 Half Mile 29	Original Result	Chemical Name	Concentration Unit	RDL Half	Coordinate Remark	Location Description
1712999.825	561018.481	STUDY AREA 4	28	A	COR-03	0	0	0	0.01	0.01	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left
1712999.825	561018.481	STUDY AREA 4	28	A	COR-03	0	2	1	0.0083	0.0083	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left
1712999.825	561018.481	STUDY AREA 4	28	A	COR-03	2	4	3	0.011	0.011	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left
1712999.825	561018.481	STUDY AREA 4	28	A	COR-03	4	6.8	5.4	0.019	0.019	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Left
1712992.506	560984.1945	STUDY AREA 4	28	A	KRSD-02	0	0.5	0.25	0.00291	0.00291	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1712992.506	560984.1945	STUDY AREA 4	28	A	KRSD-02	0	1.7	0.85	0.00519	0.00519	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1712992.506	560984.1945	STUDY AREA 4	28	A	KRSD-02	1.7	3.3	2.5	0.00582	0.00582	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1712992.506	560984.1945	STUDY AREA 4	28	A	KRSD-02	3.3	5	4.15	0.00468	0.00468	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1712992.506	560984.1945	STUDY AREA 4	28	A	KRSD-02	7.3	9.6	8.45	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1713251.364	560887.391	STUDY AREA 4	28	A	SSD-05	0	0	0	0.024	0.024	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-
1710952.925	559745.125	STUDY AREA 4	29	A	COR-02	0	0	0	0.048	0.048	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre
1710131.123	558931.634	STUDY AREA 4	29	B	COR-01	0	0	0	0.014	0.014	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre
1709497.451	558996.2	STUDY AREA 4	29	B	RIV 1	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1709174.619	558561.0784	STUDY AREA 4	29	B	RIV 10	0	0.5	0.25	0.15	ND(0.3)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1709558.275	558944.734	STUDY AREA 4	29	B	RIV 2	0	0.5	0.25	0.1	ND(0.2)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1709408.556	558935.3766	STUDY AREA 4	29	B	RIV 4	0	0.5	0.25	0.1	ND(0.2)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1709071.687	558668.6891	STUDY AREA 4	29	B	RIV 8	0	0.5	0.25	0.35	ND(0.7)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1709118.475	558621.9019	STUDY AREA 4	29	B	RIV 9	0	0.5	0.25	0.1	ND(0.2)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1709296.992	558306.87	STUDY AREA 4	29	B	SSD-01	0	0	0	0.0026	0.0026	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-
1709035.561	558937.103	STUDY AREA 4	29	B	SSD-02	0	0	0	0.0065	0.0065	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-
1709419.352	559143.065	STUDY AREA 4	29	B	SSD-03	0	0	0	0.0046	0.0046	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-
1709734.676	559335.253	STUDY AREA 4	29	B	SSD-04	0	0	0	0.0041	0.0041	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-
1709082.56	557703.1711	STUDY AREA 4	30	A	KRSD-01	0	1.7	0.85	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1709082.56	557703.1711	STUDY AREA 4	30	A	KRSD-01	1.7	3.3	2.5	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1709082.56	557703.1711	STUDY AREA 4	30	A	KRSD-01	3.3	5	4.15	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1708814.357	558476.8613	STUDY AREA 4	30	A	RIV 11	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1708926.647	558369.2506	STUDY AREA 4	30	A	RIV 13	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1708744.176	558416.0379	STUDY AREA 4	30	A	RIV 14	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1708636.566	558238.2462	STUDY AREA 4	30	A	RIV 15	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
-	-	STUDY AREA 4	30	A	RIV 16	0	0.5	0.25	0.2	ND(0.4)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1708266.946	558083.8482	STUDY AREA 4	30	A	RIV 17	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1708327.77	558032.3823	STUDY AREA 4	30	A	RIV 18	0	0.5	0.25	0.1	ND(0.2)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1707990.901	557812.4821	STUDY AREA 4	30	A	RIV 19	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1707939.435	557873.3055	STUDY AREA 4	30	A	RIV 20	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1708042.367	557756.3374	STUDY AREA 4	30	A	RIV 21	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
-	-	STUDY AREA 4	30	A	RIV 6	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
-	-	STUDY AREA 4	30	A	RIV 7	0	0.5	0.25	0.1	ND(0.2)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
-	-	STUDY AREA 4	30	A	SED-1	0	0.5	0.25	0.05	ND(0.1)X	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
-	-	STUDY AREA 4	30	A	SED-1	0	0.5	0.25	0.05	ND(0.1)X	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
-	-	STUDY AREA 4	30	A	SED-2	0	0.5	0.25	0.05	ND(0.1)SJH	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
-	-	STUDY AREA 4	30	A	SED-4	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
-	-	STUDY AREA 4	30	A	SED-5	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-

Legend

- (yellow) Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
- (orange) Core data excluded as it is co-located with surficial samples
- (green) Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.28

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 29
KANAWHA RIVER, WEST VIRGINIA

Subfacility Name	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
Kanawha River	KR-COR-03	32	SE-031884-120207-DD-068	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-03	32	SE-031884-121307-DD-274	12/13/2007	(0-24) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-03	32	SE-031884-121307-DD-275	12/13/2007	(24-48) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-03	32	SE-031884-121307-DD-276	12/13/2007	(48-81.6) IN	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-02	32	R380908	5/11/2000	(0-0.5) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-02	32	R380904	5/11/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-02	32	R380905	5/11/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-02	32	R380906	5/11/2000	(3.333-5) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-02	32	R380907	5/11/2000	(7.333-9.583) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-SSD-05	NA	SE-031884-120207-DD-069	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-02	31.5	SE-031884-120207-DD-070	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-COR-01	31.3	SE-031884-120207-DD-071	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR
Winfield Locks & Dam	WLD-RIV1	NA	RIV 1,3,12	12/12/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV10	NA	RIV 10	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV2	NA	RIV 2	12/12/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV4	NA	RIV 4	12/12/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV8	NA	RIV 8	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV9	NA	RIV 9	12/6/1991	-	-	Diox Fur	SE	WLD
Kanawha River	KR-SSD-01	NA	SE-031884-120207-DD-075	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-SSD-02	NA	SE-031884-120207-DD-074	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-SSD-03	NA	SE-031884-120207-DD-073	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-SSD-04	NA	SE-031884-120207-DD-072	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-01	31	R380901	5/11/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-01	31	R380902	5/11/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-01	31	R380903	5/11/2000	(3.333-5) ft BGS	-	Diox Fur	SE	KR
Winfield Locks & Dam	WLD-RIV11	NA	RIV 11	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV13	NA	RIV 13	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV14	NA	RIV 14	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV15	NA	DUP (RIV 15)	12/6/1991	-	(other)	Diox Fur	Sediment	WLD
Winfield Locks & Dam	WLD-RIV16	NA	RIV 16	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV17	NA	RIV 17	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV18	NA	RIV 18	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV19	NA	RIV 19	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV20	NA	RIV 20	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV21	NA	RIV 21	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV6	NA	RIV 6	12/9/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV7	NA	RIV 7	12/12/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-SED1	NA	SED-1	1/1/1901	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-SED1	NA	SED-1 DUP	1/1/1901	-	Duplicate	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-SED2	NA	SED-2	1/1/1901	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-SED4	NA	SED-4	1/1/1901	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-SED5	NA	SED-3	1/1/1901	-	-	Diox Fur	SE	WLD

TABLE Q.29

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 30
KANAWHA RIVER, WEST VIRGINIA

X Coordinate	*Y Coordinate*	*Study Area*	*Half Mile*	*Quarter Mile*	*Location Name*	*All Depth (ft) - TOP*	*All Depth (ft) - BOT*	*Mid Depth (ft)*	*TCDD Study Area 4 Half Mile 30*	*Original Result*	*Chemical Name*	*Concentration Unit*	*RDL Half*	*Coordinate Remark*	*Location Description*
1710131.123	558931.634	STUDY AREA 4	29	B	COR-01	0	0	0	0.014	0.014	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	Bank - Centre
1709497.451	558996.2	STUDY AREA 4	29	B	RIV 1	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1709174.619	558561.0784	STUDY AREA 4	29	B	RIV 10	0	0.5	0.25	0.15	ND(0.3)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1709558.275	558944.734	STUDY AREA 4	29	B	RIV 2	0	0.5	0.25	0.1	ND(0.2)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1709408.556	558935.3766	STUDY AREA 4	29	B	RIV 4	0	0.5	0.25	0.1	ND(0.2)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1709071.687	558668.6891	STUDY AREA 4	29	B	RIV 8	0	0.5	0.25	0.35	ND(0.7)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1709118.475	558621.9019	STUDY AREA 4	29	B	RIV 9	0	0.5	0.25	0.1	ND(0.2)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1709296.992	558306.87	STUDY AREA 4	29	B	SSD-01	0	0	0	0.0026	0.0026	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-
1709035.561	558937.103	STUDY AREA 4	29	B	SSD-02	0	0	0	0.0065	0.0065	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-
1709419.352	559143.065	STUDY AREA 4	29	B	SSD-03	0	0	0	0.0046	0.0046	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-
1709734.676	559335.253	STUDY AREA 4	29	B	SSD-04	0	0	0	0.0041	0.0041	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	Surveyed	-
1709082.56	557703.1711	STUDY AREA 4	30	A	KRSD-01	0	1.7	0.85	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1709082.56	557703.1711	STUDY AREA 4	30	A	KRSD-01	1.7	3.3	2.5	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1709082.56	557703.1711	STUDY AREA 4	30	A	KRSD-01	3.3	5	4.15	0.0000335	ND(0.000067)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1708814.357	558476.8613	STUDY AREA 4	30	A	RIV 11	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1708926.647	558369.2506	STUDY AREA 4	30	A	RIV 13	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1708744.176	558416.0379	STUDY AREA 4	30	A	RIV 14	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1708636.566	558238.2462	STUDY AREA 4	30	A	RIV 15	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
-	-	STUDY AREA 4	30	A	RIV 16	0	0.5	0.25	0.2	ND(0.4)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1708266.946	558083.8482	STUDY AREA 4	30	A	RIV 17	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1708327.77	558032.3823	STUDY AREA 4	30	A	RIV 18	0	0.5	0.25	0.1	ND(0.2)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1707990.901	557812.4821	STUDY AREA 4	30	A	RIV 19	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1707939.435	557873.3055	STUDY AREA 4	30	A	RIV 20	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
1708042.367	557756.3374	STUDY AREA 4	30	A	RIV 21	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
-	-	STUDY AREA 4	30	A	RIV 6	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
-	-	STUDY AREA 4	30	A	RIV 7	0	0.5	0.25	0.1	ND(0.2)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
-	-	STUDY AREA 4	30	A	SED-1	0	0.5	0.25	0.05	ND(0.1)X	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
-	-	STUDY AREA 4	30	A	SED-1	0	0.5	0.25	0.05	ND(0.1)X	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
-	-	STUDY AREA 4	30	A	SED-2	0	0.5	0.25	0.05	ND(0.1)SJH	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
-	-	STUDY AREA 4	30	A	SED-4	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-
-	-	STUDY AREA 4	30	A	SED-5	0	0.5	0.25	0.05	ND(0.1)	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ug/kg	-	-	-

Legend

- Data from adjacent upstream or downstream half-miles included to eliminate edge effects.
- Core data excluded as it is co-located with surficial samples
- Data excluded as only the maximum was taken in cases of splits and duplicates.

TABLE Q.29

SWAC CALCULATION
STUDY AREA 04 - HALF MILE 30
KANAWHA RIVER, WEST VIRGINIA

Subfacility Name	*System Location Code*	*River Marker*	*Sample Name*	*Sample Date*	*Depth-Original*	*Sample Type*	*Fraction Code*	*Matrix Code*	*Subfacility Code*
Kanawha River	KR-COR-01	31.3	SE-031884-120207-DD-071	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR
Winfield Locks & Dam	WLD-RIV1	NA	RIV 1,3,12	12/12/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV10	NA	RIV 10	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV2	NA	RIV 2	12/12/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV4	NA	RIV 4	12/12/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV8	NA	RIV 8	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV9	NA	RIV 9	12/6/1991	-	-	Diox Fur	SE	WLD
Kanawha River	KR-SSD-01	NA	SE-031884-120207-DD-075	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-SSD-02	NA	SE-031884-120207-DD-074	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-SSD-03	NA	SE-031884-120207-DD-073	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-SSD-04	NA	SE-031884-120207-DD-072	12/2/2007	(0-0) IN	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-01	31	R380901	5/11/2000	(0-1.667) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-01	31	R380902	5/11/2000	(1.667-3.333) ft BGS	-	Diox Fur	SE	KR
Kanawha River	KR-KRSD-01	31	R380903	5/11/2000	(3.333-5) ft BGS	-	Diox Fur	SE	KR
Winfield Locks & Dam	WLD-RIV11	NA	RIV 11	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV13	NA	RIV 13	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV14	NA	RIV 14	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV15	NA	DUP (RIV 15)	12/6/1991	-	(other)	Diox Fur	Sediment	WLD
Winfield Locks & Dam	WLD-RIV16	NA	RIV 16	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV17	NA	RIV 17	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV18	NA	RIV 18	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV19	NA	RIV 19	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV20	NA	RIV 20	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV21	NA	RIV 21	12/6/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV6	NA	RIV 6	12/9/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-RIV7	NA	RIV 7	12/12/1991	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-SED1	NA	SED-1	1/1/1901	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-SED1	NA	SED-1 DUP	1/1/1901	-	Duplicate	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-SED2	NA	SED-2	1/1/1901	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-SED4	NA	SED-4	1/1/1901	-	-	Diox Fur	SE	WLD
Winfield Locks & Dam	WLD-SED5	NA	SED-3	1/1/1901	-	-	Diox Fur	SE	WLD