September 21, 2001

STREAM INVESTIGATION
FIELD SAMPLING PLAN

GM POWERTRAIN – BEDFORD PLANT
105 GM DRIVE
BEDFORD, INDIANA

EPA ID# IND 006036099

Prepared For:
GENERAL MOTORS CORPORATION

September 21, 2001

STREAM INVESTIGATION FIELD SAMPLING PLAN

GM POWERTRAIN – BEDFORD PLANT
105 GM DRIVE
BEDFORD, INDIANA

EPA ID# IND 006036099

Prepared for:
GENERAL MOTORS CORPORATION

Exponent

15375 SE 30th Place, Suite 250
Bellevue, Washington 98007

Office: (425) 643-9803
Fax: (425) 643-9827

Contents

List of Figures

Figure 1 is presented following the main text.

List of Tables

Table 1 is presented following the main text.

Acronyms and Abbreviations

COC	chain-of-custody
FSP	field sampling plan
GM	General Motors
HSP	health and safety plan
PCB	polychlorinated biphenyl
QAPP	quality assurance project plan
SAR	sample analysis request
SOP	standard operating procedure
SVOC	semivolatile organic compound
TAL	target analyte list
TCL	target compound list
U.S. EPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

1 Introduction

This field sampling plan (FSP) describes procedures for collecting data to support the RFI stream investigation taking place at the General Motors (GM) Powertrain facility in Bedford, Indiana. The FSP will be used as a reference for conducting all field activities proposed in the stream investigation work plan (Exponent 2001), currently scheduled for early October 2001. The geographic extent of the study area and sampling objectives are provided in the work plan (Exponent 2001). Field sampling procedures for surface water, surface sediment, floodplain soil, and aquatic biota are included in this FSP.

An ecological reconnaissance of the study area was conducted on August 6–8, 2001, to identify candidate sample locations based on stream geomorphology and habitat. A summary of the field observations, as well as the results of trial fishing efforts, are attached to this FSP (Appendix A).

Field activities to be conducted during the stream investigation include:

- Collection of 10 surface water samples from 9 stations in Salt Creek, Pleasant Run, Bailey's Branch, and unnamed tributaries near the site and from 1 reference area in Gullets Creek during high and low flow events (20 samples total, 10 each at high and low flow)
- Collection of 33 surface sediment samples from 31 sample stations in Salt Creek, Pleasant Run, Bailey's Branch, and unnamed tributaries near the site and from 2 reference areas in Gullets Creek (35 surface sediment samples total)
- Collection of 23 floodplain soil samples from 6 transects and 6 bank soil samples from 3 additional stations across Pleasant Run, Bailey's Branch, and unnamed tributaries east of the site (29 floodplain and bank soil samples total)
- Collection of 11 whole-body crayfish samples, 22 whole-body forage fish tissue samples (11 each of 2 species), and up to 11 game fish fillet samples where available from 10 stations in Salt Creek, Pleasant Run, Bailey's Branch, and unnamed tributaries near the site and from 1 reference area in Gullets Creek (11 biota stations total).

Field sampling locations and procedures are described in Section 2, and the use of quality control samples is described in Section 3. Field data reporting and field custody procedures are discussed in Sections 4 and 5, respectively. Sample packaging and shipping requirements are outlined in Section 6. The proposed schedule and personnel for the sampling event is provided in Section 7. Safety concerns are discussed in Section 8.

Descriptions of laboratory analytical methods and procedures for data management, analysis, and reporting are presented in the project's quality assurance project plan (QAPP) (CRA 2001a). To ensure that the data collected under the specifications of this FSP achieve an acceptable level of quality, rigorous quality assurance and quality control procedures will be followed at all stages of sample collection and analysis. Standard operating procedures (SOPs) for field activities are provided in Appendix B and include the following:

- SOP 2—Sample Packaging and Shipping
- SOP 4—Field Documentation
- SOP 5—Sample Custody
- SOP 17—Surface Water Sampling
- SOP 51A—Station Positioning Using the Trimble Pathfinder™ Pro XRS
- SOP 51B—Post-Collection Processing and Corrections Using Pathfinder Software
- SOP 99—Surface Sediment Sampling Using an Ekman Grab Sampler
- SOP 111—Fish Collection Procedures for Using a Seine Net
- SOP 112—Fish Collection Procedures while Using an Electroshocker
- SOP 114—Fish Collection Procedures Using Fish Traps
- SOP 115—Fish Processing Procedures
- SOP 116—Crayfish Collection Procedures
- SOP116A—Aquatic Invertebrate Processing Procedures.

If determined to be necessary as a result of conditions encountered in the field, procedures specified in the referenced SOPs may be modified in the field. Any such modifications will be noted in the field logbook. Example field data forms are provided in Appendix C.

Site-specific health and safety issues are presented in the supplemental health and safety plan (HSP) (provided in Appendix D), which augments the project HSP (CRA 2001b). The supplemental HSP establishes procedures and practices to protect Exponent employees and its subcontractors from potential hazards posed by field activities at the site. The supplemental HSP provides measures to minimize potential exposure, accidents, and physical injuries that may occur during daily onsite activities and to minimize the hazards of adverse conditions. Contingency arrangements are also provided in the supplemental HSP for emergency situations.

2 Field Sampling

A description of sampling station locations and sample analytes is provided in this section. Procedures are included for the following tasks:

- Documenting the locations of stations
- Collecting and compositing (if applicable) samples
- Processing samples to ensure proper subsampling of each matrix
- Cleaning equipment, work surfaces, and sampling implements prior to commencing sampling and between stations.

2.1 Station Locations

Station locations for all field sampling will be determined using a differential global positioning system, which is capable of providing latitude and longitude coordinates with an accuracy of approximately 2 m. Water depth (when applicable) will be measured with either a ruler or a lead line (with a flat disk attached to its bottom to keep it from sinking into soft sediments) at all stations and recorded in the field logbook. All sample locations will also be documented with photographs. The exact locations of the stations in the study area drainage and at the reference area will be determined in the field by the field team leader.

Approximate sample station locations for the stream investigation are shown in Figure 1. Station locations in the streams comprising the primary study area (i.e., tributary from Outfall 002, Bailey's Branch, Pleasant Run, and Salt Creek) are designated ST-1 through ST-23. Media sampled at a given station location may include surface water, sediment, floodplain soils, and/or biota. Six floodplain transects, designated T-1 through T-6, will be located perpendicular to the stream channel at selected stations where significant floodplains occur. The floodplain transects will consist of 4 to 6 discrete soil samples, spaced in such a manner as to best representatively sample the floodplain (i.e., samples located equidistant along the width of the floodplain). Surface water and sediment samples from the spring-fed headwater areas of both the secondary eastern and western tributaries are designated SP-1 through SP-8. The two reference stations in Gullet's Creek are designated R-1 and R-2. A description of each sample station location and the media to be sampled at each station is provided below. A summary of the target media by station is provided in Table 1.

2.1.1 Stream Samples

A total of 23 sample stations from the study area drainage are shown in Figure 1.

Station ST-1 is located in the unnamed tributary from Outfall 002 near a small wooden footbridge across the stream. Surface water, stream sediment, and biota will be sampled. Bank soil samples from both stream banks will also be collected.

Station ST-2 is the flooded quarry pit adjacent to the unnamed tributary stream, located just upstream of the confluence with Bailey's Branch. Stream sediments are minimal to non-existent at this location. However, the stream may overflow into the quarry pond during high rainfall events, resulting in a manmade depositional area. Bank soil samples will be collected from both banks, and a sediment sample will be collected from the quarry pond.

Station ST-3 will be located in the main stem of Bailey's Branch, downstream of the confluence with the Outfall 002 tributary. A depositional area will be targeted for sediment sampling.

Station ST-4 will be located immediately upstream of the Broomsage Road bridge in Bailey's Branch. Surface water, stream sediments, and biota will be sampled at this station, as well as floodplain soils on both sides of the stream.

Station ST-5 will be located downstream of the Broomsage Road bridge, in an area where the stream gradient begins to drop and small depositional areas become more common. A stream sediment sample will be collected from a depositional area.

Station ST-6 will be located just downstream of the high voltage power line crossing on Bailey's Branch. A stream sediment sample will be collected from a depositional area.

Station ST-7 will be located in Bailey's Branch. Transect T-1 will be located in a line approximately perpendicular to the stream channel at this point. In addition to a stream sediment sample from a depositional area, the transect will include a total of three floodplain samples, one from the narrow floodplain southwest of the stream and two from the wider floodplain northeast of the stream.

Station ST-8 will be located in Bailey's Branch, approximately 100 m upstream of the confluence with Pleasant Run. Stream sediment and biota will be sampled. Transect T-2 will be located in a line approximately perpendicular to the stream channel at this point. In addition to the sediment samples from stations ST-8 and ST-11, the transect will include three floodplain soil samples: one from the southwest bank of Bailey's Branch, one from the area between the Bailey's Branch and Pleasant Run channels, and one from the floodplain northeast of Pleasant Run.

Station ST-9 will be located in Bailey's Branch, immediately upstream of the confluence with Pleasant Run. A stream sediment sample will be collected from a depositional area.

Station ST-10 will be located in Pleasant Run, just upstream of the Mount Pleasant Road bridge. This area contains several large pools, which were found to support several fish species during the ecological reconnaissance. Surface water, stream sediment, and biota will be sampled.

Station ST-11 will be located in Pleasant Run, upstream of the confluence with Bailey's Branch. The sample will be field-located in a depositional area as close as possible to the line of Transect T-2.

Station ST-12 will be located in Pleasant Run, approximately 100 m downstream of the confluence with Bailey's Branch. A stream sediment sample will be collected from a depositional area.

Station ST-13 will be located in Pleasant Run, in an area with numerous pools of significant size, many with depths up to several feet deep at extreme low water and containing large woody debris. Stream sediment and biota will be collected.

Station ST-14 will be located in Pleasant Run, just upstream of the Peerless Road bridge. Transect T-3 will be located in a line approximately perpendicular to the stream channel at this point. In addition to a sediment sample, the transect will include four floodplain samples, two from each bank.

Station ST-15 will be located in Pleasant Run, just downstream of the Peerless Road bridge. The stream channel develops a braided character in this reach, with two primary channels. Several significant pools exist in this area. Stream sediment and biota samples will be collected.

Station ST-16 will be located in the braided channel portion of Pleasant Run. This area has two primary channels, both showing signs of heavy use by cattle. Surface water and stream sediment will be collected. Transect T-4 will be located in a line approximately perpendicular to the stream channel at this point. In addition to the sediment sample in the south branch, the transect will include four samples: one located south of the braided channels, one located between the two primary channels, a sediment sample from the north branch, and a floodplain sample located north of the stream channels.

Station ST-17 will be located in the braided channel portion of Pleasant Run, downstream of the area currently used for pasture. This is the most extensive area of floodplain in the study area. Transect T-5 will be located in a line approximately perpendicular to the stream channel at this point. In addition to the sediment sample from the south branch, the transect will include six samples: two floodplain samples located southwest of the braided channels, one located between the two primary channels, a sediment sample from the north branch, and two samples located northeast of the braided channels.

Station ST-18 will be located just downstream of the braided channel reach, in the vicinity of a concrete cattle crossing over the stream. Stream sediments and biota will be collected. Transect T-6 will be located in a line approximately perpendicular to the stream channel at this point. In addition to the sediment sample, the transect will include three floodplain samples: two located southwest of the stream channel, and one located northeast of the channel.

Station ST-19 will be located just downstream of the site of the former Murdock railroad bridge. A large pool with a depth of several feet at extreme low water occurs at this point. Surface water, stream sediment, and biota will be collected.

Station ST-20 will be located in Salt Creek, approximately 500 m upstream of the confluence with Pleasant Run. A stream sediment sample will be collected.

Station ST-21 will be located in Salt Creek, in the vicinity of the Peerless-Needmore Road bridge. Surface water, stream sediment, and biota will be collected.

Station ST-22 will be located in Salt Creek, approximately 500 m downstream of the confluence with Pleasant Run, but upstream of the confluence with Gullets Creek. Stream sediment will be collected.

Station ST-23 will be located in Salt Creek, approximately 1.5 km downstream of the confluence with Pleasant Run. Surface water, stream sediment, and biota will be collected.

2.1.2 Headwater Spring Samples

A total of 8 stations are located in spring areas east and west of the Bedford facility (see Figure 1).

Stations SP-1 through SP-4 are in the spring-fed headwaters of the secondary eastern drainage, which flows into Bailey's Branch. All sample stations are located west of Bailey's Scales Road. Three sediment samples will be field-located in each of the three primary channels, which converge in the low area just west of Bailey Scales Road. Sediment and surface water will be collected at Station SP-4, to be located immediately upstream of the culvert beneath the road.

Stations SP-5 through SP-8 are in the spring-fed headwaters of the unnamed western tributary, which flows directly into Salt Creek. All sample stations are located east of M Street. Three sediment samples will be field-located in the lowest points of the spring area. Sediment and surface water will be collected at Station SP-8, to be located immediately upstream of the culvert beneath M Street.

2.1.3 Reference Stream Samples

Two reference stations have been identified in Gullets Creek.

Station R-1 will be located in the vicinity of the Peerless-Needmore Road bridge over Gullets Creek, southeast of the village of Needmore. Surface water, stream sediment, and biota samples will be collected.

Station R-2 will be located in the vicinity of the bridge immediately north of the village of Needmore. Stream sediment will be collected.

2.2 Number of Samples and Analytical Parameters

The number and type of aquatic samples to be collected during the stream investigation and the chemical analyses to be performed on these samples are summarized below:

- **Surface Water Samples—**Two rounds of water sampling will be conducted at a total of 10 stations: one under low-flow conditions and one under high-flow conditions. It is anticipated that the October 2001 sampling event will capture low-flow conditions in the study area drainage. A field duplicate sample for chemistry analyses will be collected from one of the stations in the study area drainage. Unfiltered surface water samples will be collected and submitted for analysis of target compound list (TCL) volatile organic compounds (VOCs), TCL semivolatile organic compounds (SVOCs), TCL total polychlorinated biphenyls (PCBs), and target analyte list (TAL) total metals (except earth metals [calcium, magnesium, potassium, and sodium]). Filtered samples will also be collected and submitted for analysis of TCL-dissolved PCBs and TAL-dissolved metals (except earth metals). Surface water will also be analyzed for total and amenable cyanide, total Kjeldahl nitrogen, ammonia, pH, total suspended solids, total dissolved solids, and hardness (as calcium carbonate).

- **Surface Sediment Samples—**A sample of surface sediment (0–10 cm sediment horizon, or until refusal) will be collected from a total of 35 stations (i.e., 33 stations in the study area drainage and 2 reference area stations). A field duplicate sample for chemistry analyses will be collected from four of the stations in the study area drainage. Subsamples from each surface sediment sample will be analyzed for TCL VOCs, TCL SVOCs, TCL PCBs, and TAL metals (except earth metals), total and amenable cyanide, and conventional parameters (grain size distribution, total organic content, and total solids).

- **Floodplain and Bank Soil Samples—**A sample of surface floodplain soil will be collected from six transects in the study area drainage. Bank soils at three additional locations will be sampled. The top soil in the 0–10 cm sediment horizon will be collected at each station. This interval may be modified if a layer of different soil stratification (e.g., clay) is encountered or until refusal. In floodplain areas, discrete samples will be collected along a transect line approximately perpendicular to the stream channel. Along each transect, stations on the bank of the creek and in the floodplain adjacent to the creek will be sampled (as described above for each specific transect), as well as sediment from the stream channel. A field duplicate sample for chemistry analyses will be collected from three of the stations in the study area drainage. Subsamples from each soil sample will be analyzed for selected chemical compounds (TCL VOCs, TCL SVOCs, TCL PCBs, TAL metals

[except earth metals], total and amenable cyanide), and conventional parameters (grain size distribution, total organic content, and total solids).

- **Biota Tissue Samples—**Individual composite samples of crayfish and fish tissue (whole body) will be collected for chemical analysis from 10 stations in the study area drainage and from 1 station in the reference area. Crayfish and selected species of forage fishes will be targeted to be representative of the aquatic community present. When present, game fish of a size that is suitable for human consumption will also be collected. Subsamples from each composited biota tissue sample will be analyzed for TCL PCBs, mercury, and lipid and moisture content.

- **Archive Samples—**Subsamples from all surface sediment, floodplain soil, and biota samples (if extra tissue is available) will be archived for possible future chemical analyses from each station.

2.3 Surface Water Sampling

Two rounds of surface water sampling will be conducted, one under low-flow conditions and one under high-flow conditions. It is anticipated that the October 2001 sampling event will capture low-flow conditions in the study area drainage. High-flow sampling will likely take place in Spring 2002. The following sections describe the procedures to be followed in collecting the surface water samples.

2.3.1 Surface Water Sampling Equipment and Procedures

Surface water samples will be co-located with sediment samples and will be collected before collection of sediment and biota (if applicable) samples at each location.

Surface water samples will be collected as grab samples following the procedures in SOP 17. In shallow, wadeable water (e.g., Bailey's Branch and Pleasant Run), the person collecting the surface water sample will carefully enter the stream from downstream of where the sample will be collected. This is to ensure that bed sediments will not be suspended at the sample collection point. The sampler will stand downstream of the sample collection point and quickly submerge the opening of the sample bottle below the air/water interface with the bottle opening pointed upstream. The water will be collected directly into the sample bottle. If the water velocity is very slow at a given station, then the sampler will move slowly upstream with the sample bottle submerged so that an undisturbed sample is consistently collected. In deeper water, a depth integrated sampler will be used to collect the surface water sample. A 2-L Teflon® bottle will be used in conjunction with the depth integrated sampler. The Teflon® bottle will be pre-cleaned by the testing laboratory by placing it in 4N hydrochloric acid for 12 hours. A new, laboratory pre-cleaned Teflon® bottle will be used at each deeper water station.

After all sampling has been completed, field measurements (pH, Eh, temperature, dissolved oxygen, and conductivity) will be collected at each surface water station and the results will be

recorded in the field logbook. The water meters used to collect these field measurements will be calibrated daily prior to use and the calibration will be verified after a maximum of 10 stations. Specific information concerning calibration frequency, acceptance criteria, and the conditions that require more frequent calibration are provided in the QAPP (CRA 2001a).

After the sample containers are filled, they will be placed on ice in a cooler at 4±2°C. Prior to shipment to the laboratory, subsamples for dissolved PCBs and dissolved metals analyses will be filtered using a 0.45 μm capsule filter and preserved in the field trailer.

Chain-of-custody (COC) and sample analysis request (SAR) forms (see Section 6) will be completed and signed by the field team leader at the end of each day and shipped with the samples to the analytical laboratories. All sample containers will be shipped on ice in a cooler at 4±2°C.

2.3.2 Surface Water Sample Container, Preservation, and Handling Procedures

The approximate laboratory subsample amount required for analysis, along with the sample container, preservation and handling, and maximum holding time (from date of collection) requirements for the subsamples are provided in the QAPP (CRA 2001a). Pre-cleaned containers, shipped from the analytical laboratory, will be used for all sampling. Certificates of analysis that document cleanliness will be kept on file at the laboratory for every lot of sample containers purchased and will be available upon request. The certificates of analysis will document that any possible contamination of the sample containers will be less than the limit of quantitation for the specific analyses. Depending on the compatibility of sample handling requirements, the analytical laboratory will identify subsamples for specific analyses that can be included in the sample containers.

2.3.3 Decontamination of Surface Water Sampling Equipment

Because only new or laboratory pre-cleaned bottles will be used for sample collection, no field equipment decontamination is required for surface water sample collection. All sample bottles will be protected from possible contamination during transport and storage.

2.3.4 Sampling Order

Subsamples for analysis of mercury and TCL VOCs will be collected first. Sample containers for SVOCs will be filled next, followed by containers for other organic analyses (i.e., TCL PCBs), and then the containers for metals analyses will be filled, and finally containers for conventional analyses will be filled. After all sampling has been completed at each station, field measurements will be collected.

2.4 Surface Sediment, Floodplain, and Bank Soil Sampling

The following sections describe the procedures to be followed in collecting the surface sediment, floodplain, and bank soil samples.

2.4.1 Sampling Equipment and Procedures

The sampling equipment and procedures to be used for surface sediment and floodplain soil sampling are described in the following sections.

2.4.1.1 Surface Sediment Sampling

Surface sediment samples will be collected using either a Ekman grab sampler or modified petite Ponar grab sampler in accordance with standard methods recommended by the U.S. Environmental Protection Agency (U.S. EPA) (U.S. EPA 1990). If a Ponar grab sampler is used, then the grab sampler will be modified with a door on top of the sampler to allow collection of an undisturbed surface sediment sample.

Material collected in the grab sampler will be accepted if the following criteria are met:

- The sampler is not overfilled
- Overlying water is present
- The overlying water is not excessively turbid
- The sediment surface is relatively undisturbed
- A sediment penetration depth of at least 11 cm is attained.

The field team leader will evaluate all samples collected. If a sample fails to meet the above criteria, it will be rejected and discarded into the river away from the station. A second grab sample will then be collected. If acceptable grab samples cannot be collected at a specific location after several attempts, the station will be slightly repositioned (3–5 ft) and the sampling effort repeated, if possible.

After a sediment sample is judged to be acceptable, the overlying water will be siphoned off and the upper 10 cm of sediment will be removed in accordance with U.S. EPA (1990) guidelines. Stainless-steel spoons will be used to remove the sediment. A stainless-steel ruler will be used to ensure that the sampling criterion for adequate penetration depth is met and that the correct amount (i.e., 10 cm) of sediment has been removed. Sediment touching the sides of the grab sampler will not be included in the sample.

The surface (top 10 cm) sediment will be removed from each grab sample. A specialized zero headspace sampling tool (EnCore Sampler™) will be used to remove the sediment sample from

the grab sampler for TCL VOC analysis unless the sediments are noncohesive or are saturated with water, in which case subsamples will be immediately transferred to appropriate sample containers with no headspace for analyses of TCL VOCs.

The remaining sediments will be described as the sample is removed from the grab sampler and transferred to a stainless-steel bowl, noting any stratification that may be present. The color of the sediment (based on the EarthColors™ soil color book), grain sizes, approximate percentages of moisture content, organic and/or shell material, and any other noteworthy observations will be recorded in the field logbook. Prior to compositing the sediments in the stainless-steel bowl and subsequent collection of the remaining subsamples for analyses, the sediments in the bowl will be photographed.

Sediments from the grab samples will then be composited to achieve a more representative sample of average surface sediment characteristics at that station. The sediment grab samples at each station will be composited in a stainless-steel bowl and covered with aluminum foil until a sufficient volume of sediment is collected. Sediment in the bowl will then be mixed using a large stainless-steel spoon to achieve a uniform texture and color before subsamples are taken and transferred to appropriate sample containers for the remaining analyses.

Immediately after they are filled, all sample containers will be placed on ice in a cooler. Samples will be stored at 4±2°C. All samples that are to be analyzed upon receipt at the chemical testing laboratory will be maintained at 4±2°C. Sufficient headspace will be left in containers that are to be frozen (i.e., only archive samples) to accommodate expansion during freezing. COC and SAR forms (see Section 6) will be completed and signed by the field team leader at the end of each day and shipped with the samples to the analytical laboratories.

2.4.1.2 Floodplain and Bank Soil Sampling

Soil samples will be collected using stainless steel spoons and scoops in accordance with standard methods recommended by U.S. EPA (1990). A specialized zero headspace sampling tool (EnCore Sampler™) will be used to remove the soil for TCL VOC analysis unless the soil is noncohesive or is saturated with water, in which case subsamples will be immediately transferred to appropriate sample containers with no headspace for analyses of TCL VOCs. A stainless-steel ruler will be used to ensure that the sampling criterion for adequate penetration depth is met and that the correct amount (i.e., 10 cm) of soil has been removed.

The soil will be placed into a stainless-steel bowl, noting any stratification that may be present. The color of the soil (based on the EarthColors™ soil color book), grain sizes, approximate percentages of moisture content, organic material, and any other noteworthy observations will be recorded in the field logbook. Prior to compositing the soils in the stainless-steel bowl and subsequent collection of the remaining subsamples for analyses, the soil in the bowl will be photographed.

The soil collected at each sample location on a transect will be composited in a stainless-steel bowl and covered with aluminum foil until a sufficient volume of soil has been collected. Soil

in the bowl will then be mixed using a large stainless-steel spoon to achieve a uniform texture and color before subsamples are taken and transferred to appropriate sample containers for the remaining analyses. Each sample location along any given floodplain transect will have a unique sample (i.e., soil will not be composited across stations on the transect).

Immediately after sample containers are filled, they will be placed on ice in a cooler. Samples will be stored at 4±2°C. All samples that are to be analyzed upon receipt at the chemical testing laboratory will be maintained at 4±2°C. Sufficient headspace will be left in containers that are to be frozen (i.e., only archive samples) to accommodate expansion during freezing. COC and SAR forms (see Section 6) will be completed and signed by the field team leader at the end of each day and shipped with the samples to the analytical laboratories.

2.4.2 Sediment and Soil Sample Container, Preservation, and Handling Procedures

The approximate laboratory subsample amount required for analysis, along with the sample container, preservation and handling, and maximum holding time (from date of collection) requirements for the subsamples are provided in the QAPP (CRA 2001a). Pre-cleaned containers, shipped from the analytical laboratory, will be used for all samples. Certificates of analysis that document cleanliness will be kept on file at the laboratory for every lot of sample containers purchased and will be available upon request. The certificates of analysis will document that any possible contamination of the sample containers will be less than the limit of quantitation for the specific analyses. Depending on the compatibility of sample handling requirements, the analytical laboratory will identify subsamples for specific analyses that can be included in the sample containers.

2.4.3 Decontamination of Sediment and Soil Sampling Equipment

All field equipment will be decontaminated in a manner appropriate to the matrix being sampled, the type and anticipated concentration of chemicals, the required detection limit, and the anticipated quantity of sample material. Equipment will be decontaminated using the following general sequence: site water rinse, detergent scrub and rinse, organic solvent rinse (acetone followed by hexane for sampling organic constituents), site water or distilled/deionized water rinse, and air dry. The hexane and acetone rinsates will be collected in a container and properly disposed of. If there is a significant lapse of time between decontamination of the sampling equipment and collection of the sample, then the decontaminated sampling equipment will be protected from additional contamination by wrapping the decontaminated equipment in foil, placing the equipment in clean bags, and placing the clean bags in clean containers for transport or storage.

2.4.4 Sampling Order

Subsamples for analysis of TCL VOCs will be placed in sample containers prior to compositing. The remaining sediments or floodplain soils will then be composited in a stainless-steel bowl

using a stainless-steel spoon to mix to uniform appearance. Sample containers for SVOCs will be filled next, followed by containers for other organic analyses (i.e., TCL PCBs), and then the containers for metals analyses will be filled, and finally containers for conventional analyses will be filled.

2.5 Biota Sampling

2.5.1 Target Species

Based on recent observations of aquatic species abundance and diversity in the study area streams (see Appendix A), the following species will be targeted for sampling:

- Crayfish will be targeted at all biota sample stations. Field observations indicate that they are present in sufficient quantity to sample throughout the study area. The largest crayfish captured will be preferentially selected to make up composites.
- Two species of forage fish will be targeted at all biota sample stations:
  - A cyprinid species, either blacknose dace (*Rhinichthys atratulus*), creek chub (*Semotilus atromaculatus*), central stoneroller (*Campostoma anomalum)*, or bluntnose minnow (*Pimephales* sp.), will be the primary forage fish target species. The target size class will be 2 to 8 cm. The primary target will be selected in the field, based on the relative abundance of the four candidate species at the two upstream biota sample stations above Broomsage Road. The other three species will be potential alternates if the primary target is not captured at other stations.
  - Sunfish (*Lepomis* sp.) will be the secondary target forage fish species. The target size class will be 6 to 12 cm. Shiner (*Notropis* sp.) will be the alternate secondary target forage fish species, in the event *Lepomis* are not captured at any station.

Whole body composite samples will be collected, with a minimum mass of 50 g per sample. A scientific collection permit has been obtained for this activity from IDNR. While it is desirable to sample the same species throughout the study area, local variations in species diversity and habitat limitations may preclude this possibility. In the event that none of the target species is present at any station, the field team will attempt to collect the most abundant observed fish species.

When present, discrete samples of game fish of edible size will be retained for fillet analysis and assessment of potential human health exposure. Larger fish will be preferentially retained and sent to the laboratory for filleting and analysis. The target sample size for fillets is 100 g

(minimum). Fish species regulated as game fishes by the IDNR (2001) are listed in Appendix E. Game fish species of edible size are not expected to be present in the study area, with the exception of the stations in Salt Creek.

2.5.2 Sampling Equipment and Procedures

A combination of electroshocking, seining, and traps will be used to obtain biota species. Each of these alternative techniques is likely to provide different species of crayfish or fish for analysis. The following information will be recorded as soon as possible after sample collection for each individual biota sample collected:

- Species identification
- Total length and weight
- Presence of grossly visible abnormalities.

2.5.3 Biota Sample Container, Preservation, and Handling Procedures

After length and weight measurements have been made for crayfish and fish, they will be double-bagged in plastic Ziploc® bags containing a sample identification label on the inner bag and an external sample identification tag affixed to the outer bag. Chemical analyses of game fish collected for the purpose of assessing potential risks to human health will be performed on fish fillets only. These fish will be filleted at the chemical testing laboratory in accordance with U.S. EPA and IDEM recommended methods (U.S. EPA 2000). Chemical analyses of crayfish and forage fish collected for the purpose of the ecological assessment will be performed on composited whole-body samples.

Sample processing will be conducted in accordance with SOPs 115 and 116A. Composite samples will be bagged together to represent one sample for analytical purposes. Immediately after samples are processed, they will be placed in a cooler on ice. Samples will be stored and shipped at 4±2°C.

2.5.4 Decontamination of Biota Sampling Equipment

Because only whole-animal biota samples will be sent to the laboratory (i.e., no field filleting), no equipment decontamination is required for the biota sampling. All samples will be protected from possible contamination during transport and storage. Sampling equipment will be rinsed with site water after biota sample collection is completed at each station.

2.5.5 Sampling Order

Biota samples will be collected in the same drainage study areas and reference areas as the surface water and sediment samples. The biota sampling will occur at all locations after surface water and sediment sampling have been completed.

3 Quality Control Sample Procedures

Field quality control samples will include field duplicates, equipment rinsate blanks, and trip blanks. The following is a summary of quality control samples, which will be collected in the field and then analyzed by the analytical laboratories with the natural samples. For a full discussion of quality control procedures, refer to the QAPP (CRA 2001a).

- **Field Duplicates—**Field duplicate sediment samples will be collected and analyzed to assess the variability of chemical concentrations at a location. Field duplicates provide a measure of the total analytical bias (field and laboratory variance), including bias resulting from the heterogeneity of the replicate sample set itself. For each sample type (i.e., sediment, floodplain soil, and surface water), field duplicates will be collected at a minimum frequency of 1 per 10 samples or once per sampling event, whichever is more frequent.

- **Equipment Rinsate Blanks—**Equipment rinsate blanks will be collected for surface water, sediment, and floodplain soil samples to help identify possible contamination from the sampling environment or from the sampling equipment (e.g., grab, bowl, spoon for sediments and soil; collection bottle for surface water). For surface water samples, the equipment rinsate blank will consist of running distilled/deionized water through the depth-integrated sampler's collection bottle, after decontamination and prior to collecting field samples. For each type of sediment and floodplain soil sampling (i.e., grab, spoon, and bowl), equipment rinsate blanks will consist of running distilled/deionized water over the sampling equipment. The equipment rinsate blanks will be stored with the associated surface water, sediment, or floodplain soil samples during both shipment from the field and during laboratory storage. For each sample type (i.e., surface water, surface sediment, floodplain soil), an equipment rinsate blank will be collected from the field at a frequency of 1 in 10 field samples or once per sampling event, whichever is more frequent.

- **Trip Blanks—**Trip blanks will be carried with sample coolers when sampling surface water, sediment, and floodplain soils for TCL VOCs and will be used to assess possible contamination during sample transport. Trip blanks will be prepared at the laboratory. The VOC trip blank will consist of American Society for Testing and Materials Type II water that has been purged with an inert gas in clean volatile organic analysis vials. Trip blanks will remain unopened during the sampling event. The trip blank will be included in each cooler used for transporting TCL VOC samples and will remain sealed during sample collection and transport. Trip blanks will be shipped at a frequency of once per matrix per sample shipment that contains samples for TCL VOC analysis.

- An extra volume of sample matrix (i.e., surface water, sediment, floodplain soil, biota) will be collected for matrix spike/matrix spike duplicate analysis. The extra volume of sample matrix will be collected at a frequency of 1 in 20 field samples. The extra volume of sample matrix will be designated as "extra volume" on the COC/SAR form.

4 Field Data Reporting

The integrity of each sample from the time of collection to the point of data reporting must be maintained throughout the study. Proper record-keeping will be implemented in the field to allow samples to be traced from collection to final disposition. The various logs and labels required to adequately identify and catalog station and sample information include the following:

- **Field Logbook—**A bound, waterproof field logbook with consecutively numbered pages will be completed for this sampling event. All daily field activities will be documented in indelible ink in this logbook; all entries will be signed and dated and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark which is signed and dated by the sampler. Field logbooks will be stored in a secure manner when not in use. The field team leader will record the following information daily in the field logbook:
  - Person to whom the logbook is assigned
  - Logbook number
  - Project name, project location, and project number
  - Project start date and end date
  - Date and time of entry (24-hour clock)
  - Time and duration of daily sampling activities
  - Weather conditions
  - Level of personal protection being used
  - Name of person making entries and other field personnel
  - Onsite visitors, if any
  - The sample identifier and analysis code for each sample to be submitted for laboratory analysis
  - The station name, date, gear, water depth (if applicable), and station location coordinates
  - Specific information on each type of sampling activity
  - Identification of all equipment used to make measurements, along with the date of calibration, if appropriate

  - The sample type (i.e., surface water, sediment, floodplain soil, or biota), sample number, and sample tag number
  - A description of the sample (source and appearance; e.g., sediment/soil type, color, and odor)
  - A description of the riparian habitat, avian species, and signs of any wildlife in the area
  - The number of photographs taken at the station
  - Variations, if any, from specified sampling protocols and reasons for deviations
  - The signature of the person making the entry.

- **Sample Label—**A sample label (example provided in Appendix C) will be completed for each sample, as described in the QAPP (CRA 2001a). All sample label entries will be made with indelible ink. Sample containers will be labeled at the time of sampling with the following information: sample identifier, site name, sampling date and time, sampling personnel, and preservative (if appropriate).
- **Sample Tag—**A sample tag (example provided in Appendix C) will be completed for each sample. A sample tag will be attached to each individual sample container with a rubber band around the container neck through a reinforced hole in the tag. All sample tag entries will be made with indelible ink. Sample containers will be tagged at the time of sampling with the following information: field sample number, site name, sampling date and time, sampling personnel, preservative (if appropriate), and type of analysis. A space for the laboratory sample number (provided by the laboratory at log-in) will also be provided on the sample tag.

The field team leader is responsible for properly completing all forms. The field logbook must be completed at the time the observations are made. In addition, a station map will be updated during sampling and will be maintained throughout the sampling event.

5 Field Custody Procedures

The integrity of each sample from the time of collection to the point of data reporting must be maintained throughout the study. Proper record-keeping and COC procedures will be implemented to allow samples to be traced from collection to final disposition. The various forms required to adequately identify and catalog station and sample information include the following:

- **COC Form—**The sample identifier and tag numbers of each sample container will be recorded on a COC form (example provided in Appendix C). The signed COC form will be secured to the inside top of each cooler in a Ziploc™ bag. The COC form will also identify the sample collection date and time, the type of sample, the project, and the field team leader. The COC form will be sent to the laboratory along with the sample. COC forms will be completed in triplicate, with one copy retained by the field team leader.

- **SAR Form—**Each set of samples sent to a laboratory will be accompanied by an SAR form (example provided in Appendix C). The SAR form will identify samples by sample identifier and sample tag. For each sample tag, the SAR form will identify the preservative or other sample pretreatment applied and the analyses to be conducted by referencing a list of specific analytes or the statement of work for the laboratory. One copy of this form will be retained by the field team leader, and the original form will accompany the shipment. A combined COC and SAR form may be used.

- **Custody Seal—**Custody seals will be affixed with custody packing tape to each sample container, across the lid and the sides of the sample container. Two custody seals (example provided in Appendix C) will also be placed across the lid of the cooler (front right and back left) prior to shipping.

At the end of each day and prior to shipping or storage, COC entries will be made for all samples. Finally, information on the labels and tags will be checked against field logbook entries and samples will be re-counted.

The field team leader is responsible for properly completing all forms. COC and SAR forms will be completed and signed before the end of each sampling day and before the samples are removed from the vessel or pass from the control of the field team leader. COC forms will be signed at each additional point of transfer of samples between the field and the laboratory and within the laboratory. Copies of all forms will be retained by the field team leader.

Whenever samples are split with an Agency representative, a separate COC/SAR form will be prepared for those samples and marked to indicate with whom the samples are being split. The

person relinquishing the samples to Agency personnel will request the Agency representative's signature on the COC/SAR form acknowledging sample receipt.

If the samples are sent by commercial carrier (e.g., Federal Express), a bill of landing will be used. A copy of the bill of landing will be retained by the field team leader as part of the permanent documentation that will be filed with the original logbooks and COC/SAR forms at Exponent's Bellevue office. Commercial carriers are not required to sign the custody record as long as the COC/SAR form is sealed inside the sample cooler and the custody seals remain intact. COC seals will be placed across the cooler lids. A copy of the form, signed upon receipt at the laboratory, will be returned to the field sampling contractor and filed in the project file.

6 Sample Packaging and Shipping

All sample containers will be provided by the laboratory and prepared in accordance with U.S. EPA (1990) prior to field operations. Only new sample containers (e.g., I-CHEM 200 or Industrial Glassware or the equivalent) will be used for sample collection. The laboratory will provide the appropriate size and type of sample container with the applicable preservative (if appropriate). Certificates of analyses will be maintained by each testing laboratory for each container lot to document conformance to U.S. EPA specifications. Sample containers will be kept closed and in a cooler or in the shipping package until use. As they are collected, subsamples will be fully labeled and recorded in the field notebook along with other pertinent collection data. Immediately after they are filled and labeled, all sample containers will be placed on ice in a cooler at 4±2°C. Additional subsamples will be collected and archived frozen, in the event that such analyses are later determined to be necessary. For those archived samples, sufficient headspace will be left in each jar to accommodate expansion during freezing.

All surface water sample coolers will be delivered to the testing laboratory by an overnight delivery service (e.g., Federal Express) at the end of each day's sampling, or as soon as practical. All other coolers will be held on ice (4±2°C) in a secure environment and shipped as soon as possible after the cooler has been filled with samples. Commercial carriers will not be required to sign off on the COC form because the custody forms will be sealed inside the sample cooler and the custody seals will remain intact. When the samples are sent by a delivery service, the shipping form will be used as part of the permanent documentation.

Surface water, sediment, floodplain soil, and biota samples for all chemical analyses will be shipped on ice (4±2°C) to the testing laboratories and will be stored at 4±2°C until analysis and final disposition of the samples. Maximum sample holding times are stipulated in the QAPP (CRA 2001a). All field samples, except archived chemical samples, will be analyzed as soon as possible after receipt at the laboratory. Archived sediment samples will be placed at an angle to minimize breakage and will be placed in a plastic bag to avoid cross contamination should breakage occur. The archived samples for possible future chemical analyses will be held frozen (i.e., –20°C) at the laboratory pending a decision to begin analyses within the specified holding time for frozen samples.

Samples in glass jars or bottles that are shipped or sent by courier will be packed in bubble-wrap plastic to prevent breakage. All sample jars and bottles will be placed in individual resealable plastic bags (e.g., Ziplocs®). All samples will be placed in an upright position and packing will be limited to one layer of samples for all surface water samples and equipment rinsate blanks. After all sample containers and ice are placed in the cooler, additional bubble wrap or packing material will be added to fill any space. Combined COC/SAR forms will be enclosed in the coolers, and COC seals will be placed across the right and left sides of the cooler lids. A copy of the form, signed upon receipt at the laboratory, will be returned to the field sampling contractor and filed in the project file. Sample packaging and shipping requirements are described in SOP 2 (provided in Appendix B).

7 Schedule and Personnel

Sampling for the stream investigation is anticipated to take place during the weeks of October 1 and 8, 2001. Sampling is estimated to require 7 to 12 days. The sequence of sample collection will be arranged to maximize efficiency while minimizing potential cross-sample contamination. All samples will be collected in a downstream-to-upstream direction. Surface water samples will be collected prior to all other stream sampling activities (i.e., sediment, floodplain soil, and biota collection). After all of the surface water samples have been collected, the sediment and floodplain soil samples will be collected, followed by the biota collection activities. The actual sequence in which the stations will be visited will be determined in the field by the field team leader.

During the sampling event, the sampling team will consist of a vessel operator (biota sampling only), a field team leader, and at least one field team member. The field team leader will be responsible for all decisions concerning sample collection. If a significant deviation from this FSP needs to be considered because of conditions encountered during sampling (e.g., repositioning of a station location), the field team leader will notify the Exponent project manager and the GM project manager.

The anticipated Exponent field team will include the following:

Field team leader	Steve Klein
Field team members	Sheryl Law Johanna Salatas Brian Estes Cristin Krachon

8 Sampling Safety

All aspects of the project HSP (CRA 2001b) will be followed. Safety hazards are associated with the equipment and supplies that will be used, as well as with the general rigors of work on the water. The supplemental HSP provided in Appendix D is to identify potential hazards, institute procedures for minimizing those hazards, document the proper responses in case of accident and injury, and make this information known to all shipboard personnel. Before sampling begins, a health and safety briefing will be held before boarding the sampling vessel.

To ensure safe and efficient boating operations, the field team leader will be designated the safety officer responsible for all boating operations, including evaluating hazardous conditions, ensuring compliance with safety precautions, and suspending shipboard operations if necessary. A halt to or suspension of operations can also be dictated by the vessel operator.

8.1 Hazards

Hazards encountered during sampling are generally classified as either chemical or physical. Chemical hazards are primarily associated with the materials used to clean sampling gear. Physical hazards are associated with the gear and conditions of work on the water.

8.1.1 Chemical Hazards

Stations to be sampled during the survey are not expected to contain concentrations of chemicals (including natural sulfide) that pose an acute hazard to human health. Nitrile gloves will be worn during sampling. If excessive odor, nonaqueous liquids, or organic enrichment is observed during field operations, the sampling plan will be reassessed. Precautionary steps may include artificially ventilating the rear deck, instituting suitable protective measures for the crew, or relocating or eliminating the sampling station.

Acetone and hexane will be used to clean the sampling equipment. Both are clear, colorless, volatile solvents with strong odors. Acetone and hexane will be used only on in the open air, and personnel must wear protective gloves when handling these liquids.

Material safety data sheets for acetone and hexane are included in the supplemental HSP (Appendix D).

8.1.2 Physical Hazards

Lines, mud, and uneven deck surfaces present tripping, slipping, and falling hazards. Every member of the sampling team will be instructed to be alert for these types of hazards.

A drowning hazard exists for personnel working from a boat on Salt Creek, primarily from tripping (discussed above). Flotation vests will be worn by all personnel onboard a vessel.

Fatigue presents a hazard when working in the field or on the water and can be compounded by the motion of the vessel, exposure, heat stress, or hypothermia. Personnel will monitor their own conditions and capabilities and are responsible for taking appropriate measures to relieve fatigue or exposure. The field team leader may also direct any member of the field team to cease working.

8.2 Safe Work Practices

Precautions for handling chemicals include wearing gloves, storing and dispensing the chemicals from narrow-mouth bottles or squirt bottles, and exercising care in use. Solvent rinsate from sampling gear will be collected in a container so excess solvent is not spilled.

Hands and feet must never be placed underneath sediment sampling gear. Special safety precautions must be observed when working with the electroshocker. These safety procedures are provided in SOP 112.

Weather conditions will be monitored by the field team leader and vessel operator. Food and water will be available in the field for the sampling team. Each team member will be required to bring clothing appropriate for the weather to minimize the hazards of exposure, heat stress, and hypothermia.

8.3 Emergency Planning

If an emergency or accident occurs during sampling, the field team leader and vessel operator will determine the appropriate response. They will assess the severity of the incident and, if appropriate, contact emergency assistance. The vessel operator is responsible for moving the boat into position to receive emergency aid, if necessary. A basic first-aid kit will be kept with each field team to treat minor cuts or scrapes. At least one member of the field team will have received first-aid and CPR training. All accidents must be reported to the field team leader and will be recorded in the logbook. Contact information for local emergency services, hospitals, and ambulance services will be with each field team and the location will be known to and accessible to all personnel. Emergency contact information is provided in the supplemental HSP (Appendix D).

9 References

CRA. 2001a. Quality assurance project plan. Preliminary RCRA facility investigation activities. GM Powertrain–Bedford Plant, Bedford, Indiana. EPA ID# IND006036099. Prepared for General Motors Corporation. Conestoga-Rovers & Associates, Romulus, MI.

CRA. 2001b. Health and safety plan. GM Powertrain–Bedford Plant, Bedford, Indiana. EPA ID# IND006036099. Prepared for General Motors Corporation. Conestoga-Rovers & Associates, Chicago, IL.

Exponent. 2001. Stream investigation work plan, GM Powertrain–Bedford Plant, Bedford, Indiana. EPA ID# IND 006036099. Prepared for General Motors Corporation. Exponent, Bellevue, WA.

IDNR. 2001. Fish species list provided on Indiana Department of Natural Resources website. www.ai.org/dnr/fishwild/fishng/general.htm. Accessed on September 3, 2001. Indiana Department of Natural Resources.

U.S. EPA. 1990. Recommended protocols for measuring selected environmental variables in Puget Sound. U.S. Environmental Protection Agency, Region 10, Seattle, WA.

U.S. EPA. 2000. Guidance for assessing chemical contaminant data for use in fish advisories. Volume 1: Fish sampling and analysis. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

Figure

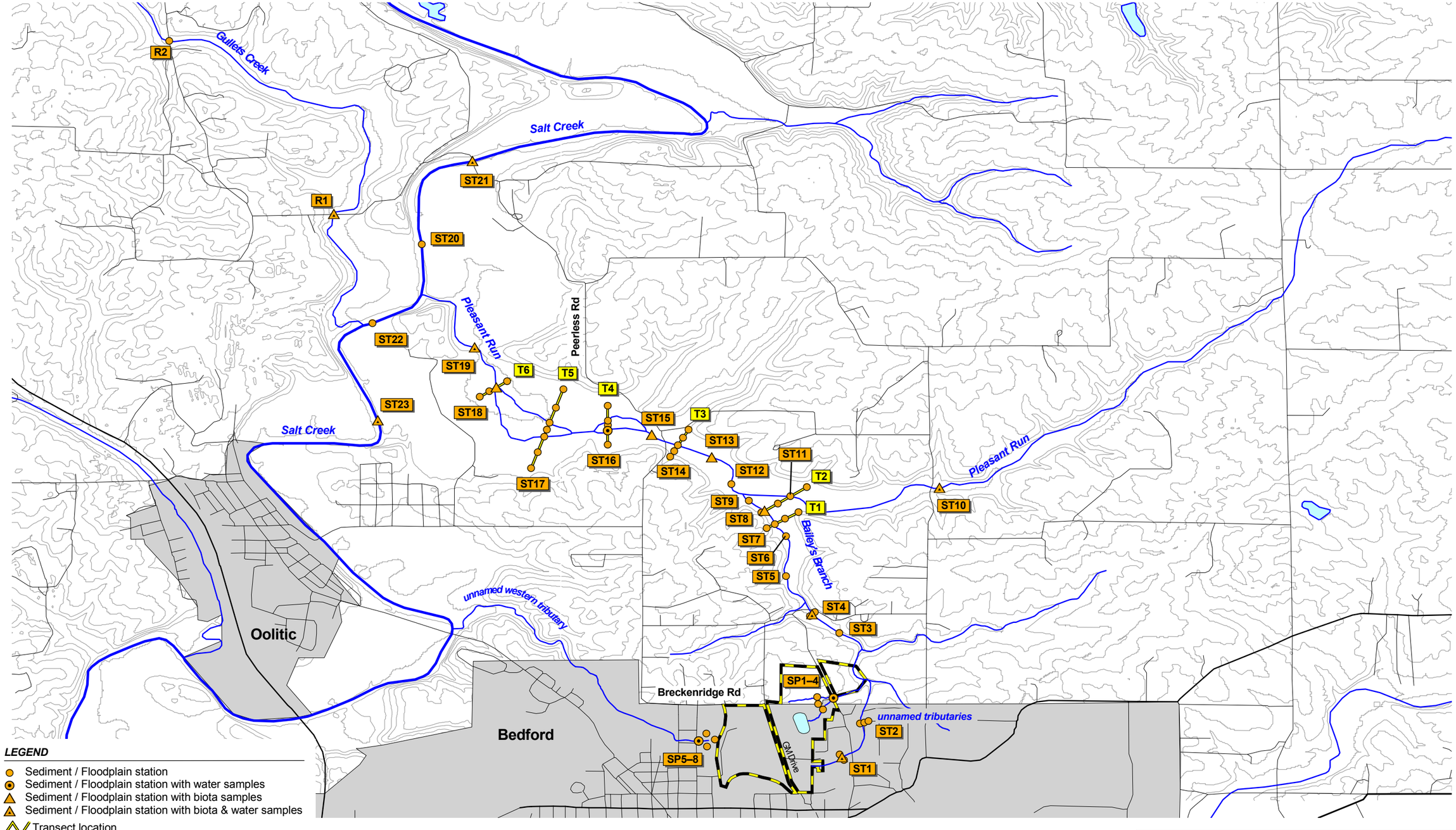


Figure 1. Stream investigation sampling stations

Table

Table 1. Stream investigation sample media by station

Station	Sediment	Surface Water	Biota	Bank Soils	Flood Plain Transect
ST-1	X	X	X	X	
ST-2	X			X	
ST-3	X				
ST-4	X	X	X	X	
ST-5	X				
ST-6	X				
ST-7	X				T-1
ST-8	X		X		T-2
ST-9	X				
ST-10	X	X	X		
ST-11	X				T-2
ST-12	X				
ST-13	X		X		
ST-14	X				T-3
ST-15	X		X		
ST-16	X	X			T-4
ST-17	X				T-5
ST-18	X		X		T-6
ST-19	X	X	X		
ST-20	X				
ST-21	X	X	X		
ST-22	X				
ST-23	X	X	X		
SP-1	X				
SP-2	X				
SP-3	X				
SP-4	X	X			
SP-5	X				
SP-6	X				
SP-7	X				
SP-8	X	X			
R-1	X	X	X		
R-2	X				

Appendix A

Field Notes from Ecological Reconnaissance of Bedford Stream Investigation Study Area—August 6–8, 2001

Exponent®
15375 SE 30th Place, Suite 250
Bellevue, WA 98007

Field Notes from Ecological Reconnaissance of Bedford Stream Investigation Study Area—August 6–8, 2001

Reconnaissance Participants

- Rick Bodishbaugh, Pieter Booth, Tony Dodd, Johanna Salatas—Exponent
- Jeff Nichols—CRA
- Will Enriquez—U.S. EPA Region 5
- John Gunter, Ann Kominowski (Monday, August 6 only).

The reconnaissance effort was initiated with a kick-off meeting at the site trailer on August 6. All participants confirmed review of the project Health and Safety Plan. Property boundaries, access agreements, and the reconnaissance strategy were reviewed. The study area is described in the stream investigation work plan (Exponent 2001). During the two-and-a-half-day visit, the entire study area drainage was viewed on foot and by car. Gullets Creek, a potential reference sampling location, was also observed at two road crossings. The following narrative presents habitat characterizations and observations organized according to stream reach. Observations made on different days have been consolidated. Trial fishing efforts using a backpack electroshocker and seine net were conducted at four locations. The findings of these efforts are also noted below.

Conditions during the reconnaissance were dry and very hot. All streams were in an extremely low-flow condition.

Seep Area East of Stormwater Retention Pond

Surface water originating from several seeps or bedrock springs collects in this low area. The largest of these seeps is approximately 4 ft in diameter with water depth to 0.5 in. Flow emerges in soft sediment substrates covered with detritus and a rust colored scum on the water surface. Several channels, including manmade ditches leading from Outfall 003 (normally zero flow), and the location of former Outfall 001 converge here. The combined water then flows east through a culvert under Bailey Scales Road, and eventually to Bailey's Branch. Average stream widths in the seep area are approximately 2 ft with water depths to 1 in. The soft fine-grained substrates are laden with twigs and detritus. The stream banks are well vegetated and shaded by a canopy of mature trees. No aquatic macroinvertebrates or fish were observed in this reach.

Outfall 002 to Bailey Scales Road Bridge

The entire flow of the unnamed tributary leading from the GM facility comes from the treated water discharge of Outfall 002 under the low-flow conditions observed. This stream segment varies in width from approximately 1 to 8 ft wide with depths ranging to nearly 1.5 ft in pools of the reach. Cobble, bedrock outcrop, gravel, and occasional patches of fine-grained deposits in pool habitats comprise the substrates throughout the reach. These microhabitats are augmented by limited bankside cover in the form of undercut ledges, patches of periphyton, and root wads. Water velocities range from trace velocities (<0.05 ft/s) in pools to nearly 1.5 ft/s in the cobble runs and riffles. Stream banks of the reach are well vegetated and well shaded by stands of mature trees. A single spot of floating sheen with faint chemical odors was observed in one location, though there was no sediment, depositional environment, or any evidence of submerged oil at this location.

A limited variety of aquatic and terrestrial fauna and/or animal signs were observed in this reach including: adult and nymph stage damsel flies (Odonata), aquatic snail (Gastropoda), crayfish (Decapoda) burrows, water striders (Veliidae), orangethroat darter (*Etheostoma spectabile*), blacknose dace (*Rhinichthys atratulus*), creek chub (*Semotilus atromaculatus*), Johnny darter

(*Etheostoma nigrum*), green sunfish (*Lepomis cyanellus*), and central stoneroller (*Campostoma anomalum*).

Signs of terrestrial fauna observed included tracks of white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), turkey vultures (*Cathartes aura*) flying overhead, and one dead short-tailed shrew (*Blarina brevicauda*). Evidence of mole activity was also observed.

Bailey Scales Road Bridge to Broomsage Road Bridge

In this reach, the unnamed tributary flows north into Bailey's Branch, which continues northwest towards Pleasant Run. Stream width ranges from approximately 7 to 9 ft with estimated maximum water depth to a few in. in the runs and to 12 in. in the pools. Substrate throughout the reach consists of bedrock outcrop, cobble, gravel, and occasional patches of fine-grained sediments in the pools. Dominant microhabitats are represented by shallow cobble runs and shallow pools. Unique habitats include a segment of channel approximately 500 ft long where stream flow subsides beneath the streambed, and a segment of very shallow water (to approximately 0.5 in. deep) flowing over smooth, fairly featureless, bedrock outcrop adjacent to a small, flooded rock quarry cut into the bedrock hillside. The quarry pond, of unknown depth, is located approximately 50 ft east of the stream channel. The surface is covered with algae and detritus. There are no visible outlets. According to local residents, the stream occasionally overflows its banks into the quarry pond during flood events. A sewage pipe runs the length of this reach to its terminus at a sewage lift station located along the main stem of Bailey's Branch. Stream banks of the reach are well vegetated and fully shaded by tree canopy. Several thousand feet downstream of the quarry pond area, other tributaries originating from the east join the Outfall 002 tributary to form Bailey's Branch. Under the conditions observed, these tributaries contribute little or no flow. Water velocities range from trace velocities in pools to approximately 1 ft/s across the bedrock slab.

Observations of aquatic fauna in this reach include aquatic pillbugs (Isopoda), leeches (Hirudinoidea), unidentified Cyprinid minnows and Centrarchid sunfishes, unidentified salamanders or newts (Caudata), water striders, crayfish, caddisfly nymphs (Glossosomatidae),

mayfly nymphs (Ephemeroptera), and water pennies (aquatic beetle or Psephenidae). Amphibians were abundant, including red-spotted newt (*Notophthalmus viridescens*), leopard frog (*Rana pipiens*), and green frog (*Rana clamitans melanota*).

Observations or signs of terrestrial or avian fauna included numerous sightings of passerine birds, red-headed woodpeckers, hawk feathers (*Buteo* sp.), tracks of deer and raccoon, and an Eastern box turtle (*Terrapenne carolina carolina*).

Electrofishing just upstream of the Broomsage Road bridge yielded 43 individual fish representing 5 species. A ranking of species by relative abundance is as follows: blacknose dace (55.8 percent), orangethroat darter (14 percent), creek cub (11.6 percent) central stoneroller (11.6 percent), Johnny darter (4.7 percent), and green sunfish (2.3 percent). Attachment 1 provides a list of species by relative abundance collected at this location plus three other locations sampled for fish during the reconnaissance.

Broomsage Road Bridge to Bailey's Branch—Pleasant Run Confluence

Typical habitat in the lower segment of Bailey's Branch is characterized by wetted channel width averaging approximately 8 ft and water depth to 1 ft in the pools. Substrate consists mostly of cobble, bedrock, gravel, and occasional patches of fine-grained sediments. The average stream gradient decreases below Broomsage Road, and areas of limited floodplain occur in the middle and lower reaches of this segment. Instream habitat consists mostly of interstices among the cobble, occasional undercut ledges, root wads, and accumulations of large woody debris. A few larger pools (to 30 ft long and 10 in. deep) and shallow, open runs over bedrock are present in the upper reach near a high voltage powerline right-of-way. Water velocities range from trace to approximately 0.75 ft/s. Isolated pools with apparently little or no flow occur near the most downstream portion of this reach near the confluence with Pleasant Run Creek. Stream banks of the reach are well vegetated and well shaded by stands of mature trees.

Observations of aquatic fauna included: unidentified minnows, crayfish, mayfly nymphs, and green frog. Observations or signs of non-aquatic animals were limited to small birds and deer tracks.

Bailey's Branch—Pleasant Run Confluence to Peerless Road Bridge

The stream gradient of Pleasant Run is considerably lower than that of Bailey's Branch. Relatively steep, heavily vegetated stream banks characterize this watercourse. Bank height averages approximately 6 ft throughout the reach. High water marks (to 9 ft) are evidence of seasonal high flow and over-bank flooding in this segment, and floodplain areas exist on both banks. Wetted channel width averaging approximately 10 ft and depths possibly ranging to 3 ft in pools. Substrate consists mostly of cobble interspersed among areas of gravel or soft sediments or cobble covered by soft sediments. Instream habitat consists mostly of root wads, accumulations of large woody debris, and shaded pools. Water velocities are sluggish with trace to 0.5 ft/s common. Stream banks exhibit a general trend of sloughing from high-flow events in addition to extensive segments of heavily worn and exposed banks due to cow activity. Instream habitat conditions for fish and aquatic invertebrates appear to be of marginal quality throughout this segment due to soft transient sediments and turbid conditions.

Observations of aquatic fauna included: creek chub, bluegill (*Lepomis macrochirus*), longear sunfish (*L. megalotis*), green sunfish, Johnny darter, blacknose dace, unidentified molluscs, numerous crayfish, and numerous frogs. Observations of non-aquatic mammals or their sign were limited to deer and raccoon tracks and scat. Several Eastern bluebird (*Sialia sialis*) boxes set in the stream banks on posts approximately 3 ft high were opened and found to be vacant and overrun by ants. Evidence of potential nesting materials from earlier in the breeding season was not found. One great-blue heron (*Ardea herodias*) was witnessed flying overhead, and one belted kingfisher (*Ceryle alcyon*) was noticed flying along the creek.

Trial fishing using a seine net was conducted just downstream of the Peerless Road bridge. The fish collection yielded 33 individual fish representing 6 species. Dominant species included

bluegill (42.4 percent of the catch), creek chub (24.2 percent), longear sunfish (15.2 percent), and blacknose dace (12.1 percent). Attachment 1 provides a list of other fish species collected at this location in ranked order of relative abundance.

Peerless Road Bridge to Salt Creek

Prominent riparian features of this segment include active and fallow agricultural fields and forested floodplain. Braided channel systems occur in floodplain areas and are influenced by beaverdam impoundments, occasional accumulation of large woody debris, and significant evidence of cow activity in the form of trodden and eroded stream banks and turbid waters. A herd of approximately 20 cows was present in the riparian area immediately west of the Peerless Road bridge.

High water stages from storm flows likely occur in this reach were indicated based on the presence of watermarks to 12 ft above streambed, water stains, and drift lines along steep embankments; although, stream banks are not as high (3 to 6 ft) in the upper-middle and upper reaches of this segment. Wetted channel width ranges from 6 to 12 ft with depths in pools possibly to 4 ft. Shallow runs with depths ranging from 0.2 to 1 ft deep are common, whereas cobble or gravel riffles occur at only one location, near the site of the former Murdock railroad bridge. Water velocities of 0.5 ft/s or less are common. Throughout the entire reach, the dominant substrate consists mostly of soft sediments over cobble or cobble patches interspersed with soft sediments. Floodplains are extensive on both banks upstream of the former railroad bridge. Stream banks exhibit sloughing slopes subject to storm flow events in addition to extensive segments of heavily worn and exposed banks due to cow activity, especially in the middle and upper reaches. Instream habitat conditions for fish and aquatic invertebrates appear to be of marginal to satisfactory quality throughout this segment due to occurrence of sluggish flows, soft sediments, and turbid conditions.

Pleasant Run flows into Salt Creek. Trial fish collections were not conducted in Salt Creek. Owing to its larger size and based on fish data from previous investigations of the area, Salt Creek is expected to provide an ample supply and diversity of target fishes for the purpose of

satisfying a fish tissue sampling event. This location may be a good candidate for collecting tissues from larger gamefish. Roadside observations were made at Salt Creek and Peerless Road bridge. At that location, the wetted perimeter of Salt Creek is approximately 55 ft wide. Depths are expected to commonly range to 6 ft or deeper throughout the vicinity. This area of Salt Creek is characterized by high, steep unvegetated banks that are mostly shaded by mature tree canopies throughout. Instream fish cover appears limited to occasional boulders, cobble patches, and large woody snags.

Observations of aquatic fauna included: juvenile pickerel (*Esox* sp., likely grass pickerel), unidentified shiners (*Notropis* sp.), bluegill, orangethroat darter, Johnny darter, common shiner, unidentified minnow (*Pimephales* sp.), silverjaw minnow (*Ericymba buccata*), central stoneroller, creek chub, striped shiner, northern hogsucker (*Hypentelium nigricans*), pugnose minnow (*Opsopoeodus emiliae*), white sucker (*Catostomus commersoni*), blacknose dace, longear sunfish, juvenile bullhead catfish (*Ameiurus* sp.), backswimmer beetles (Pleidae), unidentified minnow mayfly nymphs, caddisfly nymphs, aquatic snails, numerous crayfish, and frogs, including green frog and Southern leopard frog (*Rana utricularia*).

Observations of terrestrial wildlife or their signs included Northern cardinal (*Cardinalis cardinalis*), American goldfinch (*Carduelis tristis*), tracks and feathers of wild turkey (*Meleagris gallopavo*), feathers of a hawk (*Buteo* sp.), deer and raccoon tracks, and signs of beaver (*Castor canadensis*) activity.

Trial fishing using a seine net was conducted in the immediate vicinity of the former Murdock railroad bridge. The fish collection effort yielded 82 individual fish representing 18 species. Dominant species listed in ranked order of abundance included creek chub (23.2 percent), *Notropis* sp. shiners (22 percent), and striped shiner (11 percent). Attachment 1 provides a list of other fish species collected at this location in ranked order of relative abundance.

Pleasant Run at Mount Pleasant Road Bridge

Pleasant Run was observed in the vicinity of the Mount Pleasant Road bridge, approximately 1 mile upstream of the confluence with Bailey's Branch. Several large pools just upstream of the bridge were electrofished. Species observed and returned to the stream included orangethroat darter, bluegill, Johnny darter, green sunfish, common shiner (*Luxilus cornutus*), central stoneroller, creek chubsucker (*Erimyzon oblongus*), unidentified shiners (*Notropis* sp.), blacknose dace, striped shiner (*Luxilus chrysocephalus*), white sucker, unidentified minnow (*Pimephales* sp.), creek chub, and fantail darter (*Etheostoma flabellare*). The trial electrofishing effort yielded 151 individual fish representing 14 species. Dominant species listed in ranked order of abundance included central stoneroller (53.6 percent), blacknose dace (9.9 percent), and Johnny darter (9.3 percent). Attachment 1 provides a list of other fish species collected at this location in ranked order of relative abundance.

Pleasant Run at County Road 400 Bridge

Pleasant Run was observed in the vicinity of the County Road 400 culvert. The stream had no flow at this location. Several large isolated pools (approximately 15 ft wide by 20–50 ft long and up to 12 in. deep) are present downstream of the road crossing. These pools consisted of stagnant water with abundant algae growth. No fish were observed to be present in the pools. The pools were being used by cattle for wallowing and were heavily contaminated with manure at the time of the site reconnaissance. Little to no sediment was observed in the streambed at this location.

Gullett's Creek

Gullett's Creek was observed from two road crossings, one above and one below the town of Needmore. Based on the roadside observations, Gullett's Creek appears to support a relatively high quality aquatic habitat. Clear flowing waters and clean swept cobble, gravel, and bedrock substrates in wetted channels to 35 ft wide were apparent from the roadside views. A number of

schooling fishes were observed at these locations. Based on previous fish collections, Gullett's Creek is expected to provide an ample abundance and species diversity as a reference location.

Summary

Observations of aquatic fauna in the study area indicate that a limited diversity of aquatic macroinvertebrates and fish currently inhabit the area. The limited diversity is not unexpected based on the small size and relatively unproductive nature of headwater streams in the upper watershed (unnamed tributaries and Bailey's Branch) and the presence of degraded aquatic habitat due to cattle and agricultural activities in the middle and lower reaches of the study area (Pleasant Run). The reach of Pleasant Run between the confluence with Bailey's Branch and the Peerless Road bridge is most heavily impacted by sedimentation and turbid waters related to cattle movement along the stream banks and through the stream. The segment of Pleasant Run located farther downstream towards Salt Creek also exhibits marginal instream habitat quality. Sedimentation and turbidity in this reach is likely the combined result of downstream effects from the middle reaches, combined with short- and long-term runoff effects from tillage in the adjacent agricultural fields. Fish species diversity in the study area appears to reflect habitat-based constraints. Fish (and crayfish) of certain species appear to be relatively abundant in most reaches of the study area, excluding upper Bailey's Branch and its unnamed tributaries.

Reference

Exponent. 2001. Stream investigation work plan, GM Powertrain–Bedford plant, 105 GM Drive, Bedford, Indiana. EPA ID# IND 006036099. Prepared for General Motors Corporation. Exponent, Bellevue, WA.

Appendix B

Standard Operating Procedures

Note: SOPs 4 and 5 cited within.

Exponent™

SOP 2
SAMPLE PACKAGING AND SHIPPING

Specific requirements for sample packaging and shipping must be followed to ensure the proper transfer and documentation of environmental samples collected during field operations. Procedures for the careful and consistent transfer of samples from the field to the laboratory are outlined herein.

EQUIPMENT REQUIRED

Specific equipment or supplies necessary to properly pack and ship environmental samples include the following:

- Ice in sealed bags or Blue Ice®
- Sealable airtight bags
- Plastic garbage bags
- Coolers
- Bubble wrap
- Fiber reinforced packing tape
- Scissors
- Chain-of-custody seals
- Airbills for overnight shipment
- Chain-of-custody record/sample analysis request forms.

PROCEDURE

The following steps should be followed to ensure the proper transfer of samples from the field to the laboratories:

1. Appropriately document all samples using the proper logbooks (see SOP 4) and chain-of-custody record/sample analysis request forms (example provided in Attachment 2-1).

2. Make sure all applicable laboratory quality control sample designations have been made on the chain-of-custody record/sample analysis request forms. Samples that will be archived for future possible analysis should be clearly identified on the chain-of-custody record/sample analysis request form. Such samples should also be labeled on the chain-of-custody record/sample analysis request form as "Do Not Analyze: Hold and archive for possible future analysis" as some laboratories interpret "archive" to mean continue holding the residual sample after analysis.

3. Notify the laboratory contact and the project QA/QC coordinator that samples will be shipped and the estimated arrival time. Send copies of all chain-of-custody record/sample analysis request forms to the QA/QC coordinator.

4. Samples will be placed in secure onsite storage or remain in the possession of the sampling personnel before shipment. Any temporary sample storage areas will be locked and secured to maintain sample integrity and chain-of-custody requirements.

5. Clean the outside of all dirty sample containers to remove any residual material that may lead to cross-contamination.

6. Check sample containers against the chain-of-custody record/sample analysis request form to ensure all samples intended for shipment are accounted for.

7. Store each sample container in a sealable bag that allows the sample label (example provided in Attachment 2-1) to be read. Volatile organic analyte (VOA) vials for a single sample must be encased in bubble wrap before being sealed in bags.

8. Choose the appropriate size cooler (or coolers) and line with bubble wrap.

9. Fill the cooler with the samples, separating glass containers with bubble wrap and allowing room for ice to keep the samples cold. Add enough ice or Blue Ice® to keep the samples refrigerated overnight. Ice should be enclosed in sealable plastic bags to prevent leakage. Avoid separating the samples from the ice with excess bubble wrap because it will insulate the containers from the ice. After all samples and ice have been added to the cooler, use bubble wrap to fill any empty space to keep the samples from shifting during transport.

10. If possible, consolidate all VOA samples in a single cooler and ship them with (a) trip blank(s) if the quality assurance project plan calls for one.

11. After the cooler is sufficiently packed to prevent shifting of the containers, close the lid and seal it shut with fiber-reinforced packing tape. If the cooler has a drain at the bottom, it should be taped shut in the same manner.

12. Fill out the chain-of-custody/sample analysis request form as described in SOP 5, and retain the back copy of the form for the project records before sealing the cooler. Store the signed chain-of-custody record/sample analysis request forms in a sealable bag and tape them to the inside of the cooler lid. For a shipment containing multiple coolers, indicate on the outside of this cooler "Chain-of-Custody Inside."

13. As security against unauthorized handling of the samples, apply one or two chain-of-custody seals across the opening of the cooler lid (example provided in Attachment 2-1). Be sure the seals are properly affixed to the cooler so they are not removed during shipment.

14. Label the cooler with destination and return addresses, and add other appropriate stickers, such as "This End Up," "Fragile," and "Handle With Care."

15. If an overnight courier is used, fill out the airbill as required and fasten it to the top of the cooler. The identification number sticker should be taped to the lid, because tracking problems can occur if a sticker is removed during shipment.

ATTACHMENT 2-1

Example Chain-of-Custody Record/Sample Analysis Request Form, and Label and Custody Seal

DATE

SEAL BROKEN BY

SAMPLE NO.	SIGNATURE	PRINT NAME AND TITLE	DATE

OFFICIAL SAMPLE SEAL

Exponent

Exponent

Sample No.

Preservative

Sampler Date/Time

SITE NAME

1301

Tag No.

CHAIN OF CUSTODY RECORD/SAMPLE ANALYSIS REQUEST FORM

Page ____ of ____

Project:
(Name and Number)

Exponent Contact: _____ Office: ____
Ship to: _____
_____
_____
Lab Contact/Phone: _____

Samplers:

Sample No.	Tag No.	Date	Time	Matrix	Analyses Requested						Extra Container	Archive	Remarks

Matrix Code: GW - Groundwater SL - Soil SD - Sediment SW - Surface water
OTHER - Please identify codes _____

Priority: ☐ Normal ☐ Rush Rush time period _____

Shipped via: ☐ FedEx/UPS ☐ Courier Other _____

Condition of Samples Upon Receipt: _____

Custody Seal Intact: ☐ Yes ☐ No ☐ None

Relinquished by: _____ Date/Time: _____ Received by: _____ Date/Time: _____
(Signature) (Signature)

Relinquished by: _____ Date/Time: _____ Received by: _____ Date/Time: _____
(Signature) (Signature)

Distribution: White and Yellow Copies - Accompany Shipment; Pink Copy - Project File

Exponent
Environmental Group
Bellevue, WA (425) 643-9803
Boston, MA (781) 466-6681
Boulder, CO (303) 444-7270
Portland, OR (503) 636-4338
Washington, D.C. (301) 577-7830

Note: *SOP 5 cited within.*

Exponent™

SOP 4
FIELD DOCUMENTATION

The integrity of each sample from the time of collection to the point of data reporting must be maintained throughout the study. Proper record keeping will be implemented in the field to allow samples to be traced from collection to final disposition. All information relevant to field operations must be properly documented to ensure that activities are accounted for and can be reconstructed from written records. Several types of logbooks will be used for this purpose and should be consistently used by field crews (e.g., field logbooks, field data sheets).

FIELD LOGBOOKS

During field sampling events, field logbooks are used to record all daily field activities. The purpose of the field logbook is to document events that occur and record data measured in the field to the extent that someone not present at the site can reconstruct the activity without relying on the memory of the field crew.

A bound, waterproof field logbook with consecutively numbered pages will be completed using indelible ink for each sampling event; all entries will be signed and dated and no erasures will be made. All corrections should consist of a single line-out deletion, followed by the sampler's initials and the date. The sampler will sign and date the last page at the end of each day, and a line will be drawn through the remainder of the page.

The project name, site name and location (city and state), Exponent contract number, and the dates (i.e., duration) of sampling activity should be written on the cover of the field logbook. If more than one logbook is used during a single sampling event, then the upper right hand corner of the logbook will be annotated (e.g., 1 of 2, 2 of 2) to indicate the number of logbooks used during the field event.

Field logbooks will be stored in a secure manner when not in use in the field. At a minimum, the sampler will record the following information daily in the field logbook:

- Project name, project location, and project number
- Purpose and description of the field task
- Project start date and end date
- Date and time of entry (24-hour clock)
- Time and duration of daily sampling activities

- Weather conditions at the beginning of the field work and any changes that occur throughout the day, including the approximate time of the change
- Name of person making entries and other field personnel, including the times that they are present
- Onsite visitors, if any, including the times that they are present
- The name, agency, and telephone number of any field contacts
- The sample identifier and analysis code for each sample to be submitted for laboratory analysis
- All field measurements made (unless specific data sheets are available for this purpose), including the time that the measurement was collected
- The sampling location name, date, gear, water depth (if applicable), and sampling location co-ordinates
- The location and description of the work area, including sketches and map references, if appropriate
- Specific information on each type of sampling activity
- The sample type (i.e., groundwater, soil, surface sediment), sample number, and sample tag number
- Cross-references of numbers for duplicate samples
- A description of the sample (source and appearance, such as soil or sediment type, color, and odor)
- The number of photographs taken at the sampling location, if any
- Variations, if any, from specified sampling protocols and reasons for deviation
- References to other logbooks used to record information (e.g., field data sheets, health and safety log).
- The signature of the person making the entry.

Upon completion of the field sampling event, the field team leader will be responsible for submitting all field logbooks to be copied. A discussion of copy distribution is provided below.

FIELD DATA FORMS

Occasionally, additional field data forms are generated during a field sampling event (e.g., Station/Sample Log, Groundwater Monitoring Form, Sediment Core Profile Form) to record the relevant sample information collected during a sampling event. For instructions regarding proper use of sample identifiers, sampling personnel should consult the project-specific field sampling plan.

Upon completion of the field sampling event, the field team leader will be responsible for submitting all field data forms to be copied. A discussion of copy distribution is provided below.

SAMPLE LABELS

Exponent sample labels (tags) are designed to uniquely identify each container that is used for a sample. Field crews will be provided with preprinted sample labels, which must be affixed to each sample container used. The labels should be filled out at the time the samples are collected and should consist of the following information:

1. Sample number
2. Site name
3. Date and time sample is collected
4. Initials of the samplers
5. Preservatives used, if any
6. A unique tag number (preprinted on the tag, if possible) consisting of six digits, used to identify individual containers.

PHOTOGRAPHS

In certain instances, photographs of sampling stations will be taken using a camera-lens system with a perspective similar to the naked eye. Photographs should include a measured scale in the picture, when practical. Telephoto or wide-angle shots will not be used because they cannot be used in enforcement proceedings. The following items should be recorded in the field logbook for each photograph taken:

1. The photographer's name, the date, the time of the photograph, and the general direction faced
2. A brief description of the subject and the field work portrayed in the picture

3. The sequential number of the photograph and the roll number on which it is contained.

The slides, prints, or disks (as appropriate) and associated negatives will be placed in the project files after the film is developed. Any supporting documentation from the field logbooks will be photocopied and placed in the task files to accompany the slides, prints, or disks.

CHAIN-OF-CUSTODY/SAMPLE ANALYSIS REQUEST FORMS

Exponent uses a combined chain-of-custody/sample analysis request (COC/SAR) form. The COC/SAR form consists of three pages: a white sheet, which always remains with the samples; a yellow sheet, which remains with the samples when they are shipped to the laboratory; and a pink sheet, which is removed by field staff prior to shipping to the laboratory or prior to placing the samples into the sample archives. The pink sheet will be retained by the field staff for filing in Bellevue.

Exponent also uses computer-generated COC/SAR forms. If computer-generated forms are used, then the forms must be printed in triplicate and all three sheets signed so that two sheets can accompany the shipment to the laboratory and one sheet can be retained on file in Bellevue.

Upon completion of the field sampling event, the field team leader will be responsible for submitting all COC/SAR forms to be copied. A discussion of copy distribution is provided below.

SHIPPING AIRBILLS

When samples are shipped from the field to the testing laboratory via a commercial carrier (e.g., Federal Express, UPS), an airbill or receipt is provided by the shipper. Upon completion of the field sampling event, the field team leader will be responsible for submitting the sender's copy of all shipping airbills to be copied. A discussion of copy distribution is provided below.

ACKNOWLEDGMENT OF SAMPLE RECEIPT FORMS

In most cases, when samples are sent to a testing laboratory, an Acknowledgment of Sample Receipt form is faxed to the office the day the samples are received by the laboratory. It is the responsibility of the person receiving this form to review the form and make sure that all the samples that were sent to the laboratory were received by the laboratory and that the correct analyses were requested. If an error is found, the laboratory must be called immediately. Decisions made during the telephone conversation should be documented in writing on the Acknowledgment of Sample Receipt Form. In addition, corrections should be made to the COC/SAR forms and the corrected version of the COC/SAR form should be faxed to the laboratory.

The Acknowledgment of Sample Receipt form (and any modified COC/SAR forms) will then be submitted to be copied. A discussion of copy distribution is provided below.

ARCHIVE RECORD FORMS

On rare occasions, samples are archived at an Exponent office. If samples are to be archived at the Bellevue office, it is the responsibility of the project manager to complete an Archive Record form. This form is to be accompanied by a copy of the COC for the samples, and will be placed in a locked file cabinet.

DISTRIBUTION OF COPIES

Two copies of all field logbooks, additional field data forms, COC/SAR forms, and Acknowledgement of Sample Receipt forms will be made by the Bellevue copying center. The first copy will be stamped with a blue "COPY" stamp. This copy will be placed in the project file and will be available for general staff use. The second copy will be stamped with a red "COPY" stamp. This copy will be placed in the data management file with the laboratory data packages and will be used by the data management and quality assurance staff only. The original field logbooks and forms will be placed in a locked file cabinet.

One copy of the shipping airbill will be made by the Bellevue copying center. This copy will be stamped with a blue "COPY" stamp. The original airbill will be given to the Bellevue Receptionist for filing and the copy will be placed in the project file.

Setup of Locking File Cabinet

Each project will have its own file folder in the locking file cabinet. The folder label will include the project name and charge number. As many as five kinds of files will be included in this folder for each project:

- Field logbook(s)
- Additional field data forms
- COC/SAR forms
- Acknowledgment of Sample Receipt forms
- Archive Record form (to be completed only if samples are archived at the Bellevue office).

SOP 5
SAMPLE CUSTODY

A stringent, established program of sample chain-of-custody will be followed during sample storage and shipping activities to account for each sample. The procedure outlined herein will be used with SOP 4, which covers the use of sample logbooks, and SOP 2, which covers sample packaging and shipping. Chain-of-custody record/sample analysis request forms (Attachment 5-1) ensure that samples are traceable from the time of collection through processing and analysis until final disposition. A sample is considered to be in a person's custody if any of the following criteria are met:

1. The sample is in the person's possession
2. The sample is in the person's view after being in possession
3. The sample is in the person's possession and is being transferred to a designated secure area
4. The sample has been locked up to prevent tampering after it was in the person's possession.

PROCEDURE

The chain-of-custody record portion of the form is the most critical because it documents sample possession from the time of collection through the final disposition of the sample. The sample analysis request portion of the form provides information to the laboratory regarding what analyses are to be performed on the samples that are shipped.

The chain-of-custody record/sample analysis request form will be completed after each field collection activity and before the samples are shipped to the laboratory. Sampling personnel are responsible for the care and custody of the samples until they are shipped. When transferring possession of the samples, the individuals relinquishing and receiving the samples must sign the chain-of-custody record/sample analysis request form(s), indicating the time and date that the transfer occurs. Copies of the forms will be made and kept by Exponent, and the originals will be included with the samples in the transfer container. The following guidelines will be followed to ensure consistent shipping procedures and to maintain the integrity of the samples:

1. Each chain-of-custody record/sample analysis request form must be appropriately signed by the sampling personnel. The person who relinquishes custody of the samples must also sign this form.

2. The chain-of-custody record/sample analysis request form should not be signed until the information has been checked for inaccuracies by the lead sampler. All changes should be made by drawing a single line through the incorrect entry and initialing and dating it. Revised entries should be made in the space below the entries. On the handwritten chain-of-custody record/sample analysis request forms, spaces remaining at the bottom of the page after corrections are made should be marked out with single lines. This procedure will preclude any unauthorized additions.

3. At the bottom of each chain-of-custody record/sample analysis request form is a space for the signatures of the persons relinquishing and receiving the samples and the time and date that the transfer occurred. The time that the samples were relinquished should match exactly the time they were received by another party. Under no circumstances should there be any time when custody of the samples is undocumented.

4. If samples are sent by a commercial carrier not affiliated with the laboratory, such as Federal Express or UPS, the name of the carrier should be entered in the "received by" block. The time of transfer should be as close to the actual drop-off time as possible. After the chain-of-custody record/sample analysis request forms are signed and copied, they should be sealed inside the transfer container.

5. If errors are found after the shipment has left the custody of Exponent personnel, a corrected version of the forms must be made and sent to all relevant parties. Minor errors can be rectified by making the change on a copy of the original with a brief explanation and signature. Errors in the signature block may require a letter of explanation.

6. Samples that are archived internally at Exponent should be accompanied by a chain-of-custody record/sample analysis request form. While samples remain in Exponent's custody before being shipped, all containers will be kept in sight of Exponent personnel or in a secured area to preclude tampering with the samples.

ATTACHMENT 5-1

Example Chain-of-Custody Record/Sample Analysis Request Form

CHAIN OF CUSTODY RECORD/SAMPLE ANALYSIS REQUEST FORM

Project:
(Name and Number)

Exponent Contact: _____ Office: ____
Ship to: _____
_____
_____
Lab Contact/Phone: _____

Samplers:

Exponent
Environmental Group
Bellevue, WA (425) 643-9803
Boston, MA (781) 466-6681
Boulder, CO (303) 444-7270
Portland, OR (503) 636-4338
Washington, D.C. (301) 577-7830

Sample No.	Tag No.	Date	Time	Matrix	Analyses Requested						Extra Container	Archive	Remarks

Matrix Code: GW - Groundwater SL - Soil SD - Sediment SW - Surface water
OTHER - Please identify codes _____

Priority: ☐ Normal ☐ Rush Rush time period _____

Shipped via: ☐ FedEx/UPS ☐ Courier Other _____

Condition of Samples Upon Receipt: _____

Custody Seal Intact: ☐ Yes ☐ No ☐ None

Relinquished by: _____ (Signature) Date/Time: _____ Received by: _____ (Signature) Date/Time: _____

Relinquished by: _____ (Signature) Date/Time: _____ Received by: _____ (Signature) Date/Time: _____

Distribution: White and Yellow Copies - Accompany Shipment; Pink Copy - Project File

SOP 17
SURFACE WATER SAMPLING

Information regarding surface water sampling is presented below. Samples can be collected from storm drains, rivers, lakes, or ponds. These methods were developed based on Greenberg et al. (1985).

EQUIPMENT REQUIRED

- Sampling bucket or churn splitter
- Water sample containers (may include volatile organic analyte [VOA] vials)
- 1- or 2-L plastic bottle/depth-integrated sampler (DIS)
- Health and safety equipment and appropriate personal protective clothing (PPE) (see site safety plan).

PROCEDURE

1. Rinse a clean 1- or 2-L plastic bottle three times with stream water.
2. Rinse a decontaminated sampling bucket or churn splitter three times with stream water.
3. Rinse a set of clean sample bottles (for unfiltered samples) three times with stream water. VOA vials, if applicable, should not be rinsed.
4. On the basis of flow measurements, section channel into at least five equal discharge areas, as applicable. Samples will be collected at the center of each area to obtain a channel-integrated sample.
5. Submerse sample bottle or DIS in water, mouth pointing upstream and below the water surface. Samples should be collected by integrating the full depth of the water column. Take care not to collect any streambed solids disturbed by wading. Pour full bottle into bucket. Collect 4–5 L if no splits are required, and an additional 4–5 L if a split is required.
6. Stir or swirl the contents of the bucket or churn splitter gently. Using the sampling vessel, fill a set or sets of sample bottles (unfiltered samples).

7. If required for analysis, first collect samples for VOAs, making absolutely certain that no bubbles adhere to the sides or top of the VOA container and that no headspace is in the container. Be sure to check that these conditions are present in the VOA containers again before leaving each sampling site. If any air bubbles are present, the VOA sample must be retaken by using a fresh sample container.
8. Dipping from the bucket, filter 2 L of sample according to SOP 12.
9. Add preservatives to phosphate and metals bottles if necessary per the site-specific SAP or SOP 33. Fill out sample labels as specified in the project-specific work plan, SOP field sampling plan, or quality assurance plan.
10. Repeat Steps 3–7 for each required field replicate.
11. Perform field measurements according to the site-specific SAP.

REFERENCE

Greenberg, A.E., R.R. Trussell, and C.S. Clesceri (eds). 1985. Standard methods for the examination of water and wastewater. 16th Edition. American Public Health Association, Washington, DC. p. 37.

Note: SOP 51B cited within.

Exponent™

SOP 51A
STATION POSITIONING USING THE TRIMBLE PATHFINDER™ PRO XRS

This standard operating procedure (SOP) describes the use of Trimble's global positioning system (GPS) Pathfinder™ Pro XRS equipment used for positioning sampling vessels and locating sampling stations. The Pro XRS offers the sub-meter accuracy often required for documenting sampling station locations and for relocating previously sampled stations.

PRO XRS DESCRIPTION

The Pro XRS combines a high-performance GPS receiver and antenna, beacon differential receiver, and satellite differential receiver in one compact unit. With the Pro XRS, operators can gather GPS data of sub-meter accuracy using their choice of differential correction sources (i.e., free beacon differential signals [e.g., Coast Guard beacons] or real-time satellite differential signals from OmniSTAR) without establishing a reference station. Correction of data is required to gain sub-meter accuracy. Free beacon signals allow differential corrections to be performed after data collection by using a nearby beacon as the base station. For satellite-based signals, a built-in virtual base station allows for real-time data correction, eliminating the need for post-processing data.

The Pro XRS also includes Trimble's advanced Everest™ technology, which allows users to collect accurate positions data near walls, water, vehicles, or other surfaces that reflect satellite signals. Reflected signals, also called multipath signals, make it difficult for GPS receivers to accurately determine position. Everest uses a patented technique to remove multipath signals before measurements are used to calculate position.

EQUIPMENT REQUIRED

GPS Pathfinder™ Pro XRS consists of the following:

- GPS receiver in backpack casing (with system batteries and cables)
- Hand-held data logger (TDC1) and cable
- Pro XRS antenna, range poles, and cable
- Compass and tape measure

- Spare 12-volt camcorder and 9-volt batteries (2 each) (use only Kodak, Duracell or Energizer 9 volt batteries)
- Battery charger and power cord.

PRO XRS SETUP

Follow these procedures for the proper setup of the Pro XRS:

1. Ensure connections between batteries, receiver and data logger are correct and secure. The coaxial antenna cable connects from the GPS receiver port "ANT" to the base of the antenna. The TDC1 cable connects from the bottom of the TDC1 to the receiver port "B." The dual Y-clip cables should be connected from the batteries to the TDC1 cable via a "pig-tail"-type connector.
2. Screw the 3 long antenna poles together (the shorter pole may be added if necessary for taller users). Screw on the antenna and connect its cable.
3. Put backpack and shoulder strap on. The pouch for the data logger should be in place around the waist strap.
4. Place antenna in the side pouch of the back-pack. Wind cord around pole, and use Velcro on the shoulder strap to secure the antenna.

BASIC OPERATION OF THE PRO XRS

Recording a Feature

Before beginning field use, ensure that all GPS configurations and settings are set correctly for the particular use of the Pro XRS and that an appropriate data dictionary is loaded onto the TDC1 (See Attachment 51A-1 and 51A-2 for typical settings). These steps outline the basic use of the GPS to document a sample position or any other defined "feature." Note that the TDC1 has both hard-keys and soft-keys that allow for its operation. The hard keys are all the keys (e.g., letters and numbers) on its surface. The soft-keys are the F1 through F5 hard keys. The function of these changes depending upon the context. These keys will be referred to with arrows around them (<soft-key>).

1. Turn data logger on outside in an open area. Wait for antenna to receive satellite signals. The display will read "Recording Almanac," "Too few SVs," and "PDOP too high." Continue to wait until enough satellites (4) are acquired, and the PDOP is below 6.0.

2. Ensure that the OmniSTAR satellite in use is the correct one for your geographical location. There are 3 satellites which cover the United States – each covering approximately one-third of the width of the continental United States, with overlapping coverage on the periphery. This setting can be checked/changed by accessing the "Integrated DGPS" menu. (Press GPS, press <DGPS STATUS>, press <SETUP>.) The satellite setting in this menu should indicate the appropriate region: AMSC – Eastern USA, Central USA, or Western USA.

3. Select DATA CAPTURE, and open a new rover file. This file should be named according to the format: mmddxxxn; where "mm" is the month; "dd" is the date; "xxx" is the user's initials; and "n" is a number to indicate different files on the same date, if necessary (e.g., 0219cnc1). This naming convention allows future users and GIS staff to track the individual responsible for the file.

4. Pick the appropriate data dictionary to use with the rover file. Only one dictionary can be used with a rover file. The data dictionary entitled "General sampling," contains features with attributes common to many Exponent projects. Additionally, SOP 51B explains how to create a data dictionary using Pathfinder Office. It is very important to use a data dictionary and be familiar with its attributes before recording information in the field.

5. Move to the location of the first feature for which you want to record the GPS position. Select the appropriate feature. Log data points in accordance with the feature type. Point features should have at least 10 points collected at a single location. Line features should be collected while moving. If movement is stopped, press the <PAUSE> key. When movement starts again, press the <RESUME> key. Area features should be collected with enough points to define the outline of the area (e.g., a square building would have four single points collected on each corner and the <PAUSE> key would be used between each of the points).

6. Depending on the setup of the data dictionary, each feature may have one or more feature attributes. An attribute is used to record additional data associated with the feature. For example, the attributes assigned to a sediment sampling station could be sample number, station ID, sampling gear, sediment color, odor, etc. (The <PAUSE> key should be used while recording feature attributes to avoid too many data points being collected at one point feature. [Body movements while logging attributes for an extended time can decrease the accuracy of collection.] The <PAUSE> key must be used when recording attributes of a line or area feature because only one data point should be collected in a single location.) Once all attributes are entered, press OK to complete the feature and move on to a new feature.

7. When all features in a given area have been recorded, press CLEAR to exit data capture. When the Pro XRS is not in use, it should be turned off. If you need to come back to the same rover file later in the day, the rover file may be reopened at that time. (When starting a new day, a new rover file must be created to allow easier post-processing of position information.)

8. At the end of each day, the rover file should be downloaded to a PC by using Pathfinder Office software.

Feature Collection Options

Offsets—The Pro XRS can collect a point or line feature while standing at a set distance away from the feature. This option may be necessary because of obstructions such as tree cover, buildings, or car traffic. For a point feature, measure the distance between the object you want recorded and the Pro XRS antenna. Use the compass to determine the bearing (e.g., west is 270°). The bearing is the direction the point should be moved for it to be located in the correct place (e.g., if you are due north of the feature, the bearing is south or 180°; i.e., the position you want recorded is south of where you are standing). Estimate the inclination from the feature to the GPS antenna (if altitude determination is critical, a clinometer should be used). The inclination is the degree angle up from the feature to the antenna (e.g., if the feature is 5° below the antenna position, −5° would be entered). During data capture, from within the feature, press the <OFFSET> button, and enter the distance, bearing, and inclination. Press OK to complete the feature.

Note: This procedure describes an offset of a single feature. A constant offset may be applied to all features collected as well.

Nesting—While recording a line feature or an area feature, a point feature may be collected to avoid backtracking. While recording the line or area feature, press <PAUSE> and then <NEST>. The Pro XRS will prompt for collection of a new feature. Move to the feature, and collect data as for any other point feature. When the feature is complete, press OK. The Pro XRS is ready to resume collecting data as part of the line/area feature: press <RESUME>. (Remember to continue moving before pressing resume to avoid having multiple positions recorded in the same place in the line or area feature.)

Segmenting—While moving along a line feature, changing the attributes of that line may be necessary (e.g., because of a change in surface type from paved to dirt road). This change may be done without having to begin a new feature by pressing <PAUSE> and then . Change the appropriate attributes and then press <RESUME> to continue recording.

Repeat—The function allows the collection of a new feature with the same feature attributes as the previous feature. If features are not exactly the same, it also allows editing of the attributes.

Quickmark—Allows collection of point features while moving (e.g., from a car or a boat) by estimating the exact location. The use of this feature will not result in positionally accurate locations.

REVIEWING/EDITING FEATURES

It is possible to review or edit features collected in the field while still in the data capture mode. For example, it may be necessary to document the GPS location in the field logbook or to edit one of the feature's attributes.

Without exiting data capture, press <VIEW>. (If data capture is already complete, just press VIEW and then select the appropriate rover file.) This step will display a list of data points including each feature collected. Scroll to the appropriate feature, and follow the steps below depending on the required action:

- To view the GPS location (e.g., lat/lon), press <POS>
- To edit the attributes, press ENTER. Make any necessary edits to the attributes by scrolling through.
- To change or add an offset, press <POS>, then press <OFFSET>. Make any necessary changes.
- To create a waypoint (see section on Navigation), press <POS>, then press <WAYPT>. Name the waypoint appropriately.
- To delete a feature collected in error, press <DEL>.

NAVIGATING TO AN EXISTING LOCATION

Waypoints

To use the Pro XRS to navigate to a previously established position, this position must be loaded into the data logger as a waypoint. Waypoints may be entered into the TDC1 by:

- Manually entering coordinates
- Choosing previously recorded locations and importing them into the TDC1 by using Pathfinder Office

- Defining a location stored in a rover file saved to the TDC1 as a waypoint (see Reviewing/Editing Features, above).

Navigating

There are three modes of navigation with the Pro XRS:

- <NAV1>: for navigating with a compass across an open area
- <NAV2>: for navigating in areas where obstacles restrict movement
- <NAV3>: for traveling along the shortest path without a compass.

Navigation allows you to navigate from one waypoint to another. In this situation, both the starting and the ending locations must be entered into the TDC1 as waypoints. More likely, you will be navigating from your current position (an undefined position) to a known location, which is entered as a waypoint. To do this:

1. Choose Navigation from the main menu.
2. Press <START> to choose the starting waypoint "?". If the start position is a waypoint, select it from the list.
3. Press <END> and then select the desired waypoint to navigate to.
4. Allow the fields described below to guide you to the end waypoint.

Depending upon the NAV mode, some of the following fields will be displayed. Use them to guide your movement, keeping in mind the delay inherent in constantly recalculating the current position with respect to the end position.

- Dist to go: distance remaining between current position and waypoint
- Brng to go: directional path to follow
- Heading: angle at which you are traveling from north
- Time: ground speed and estimate of time to reach waypoint
- Change course: modification needed to your current bearing
- Go (North/South): distance from current position to end waypoint as 2 Cartesian distances
- Go (East/West): distance from current position to end waypoint as 2 Cartesian distances

- X-track Go: direction and distance to the shortest line between the start and end waypoints.

DOWNLOADING ROVER FILES

Upon returning to the office, all rover files should be downloaded from the TDC1 to a PC for post-processing. After downloading, all rover files and waypoints should be removed from the TDC1 to conserve memory. See SOP 51B for downloading instructions. Rover files may be deleted from the Data Capture menu.

1. From the main menu, select data capture, then delete file(s).
2. Select the rover file to be deleted, and press <ENTER>.
3. Confirm the deletion of this file by pressing <YES>.

Data dictionaries can be deleted in the same manner by selecting Data dictionaries from the Data Capture menu. Waypoints may be deleted by selecting Waypoints from the Utilities menu.

ATTACHMENT 51A-1

Pro XRS Settings

Exponent™

ATTACHMENT 51A-1
PRO XRS SETTINGS

The following are lists of menus that can be accessed through the TDC1 keypad. Please ensure that settings are correct before proceeding. Please do not make changes to the settings unless necessary. Each menu will list the all available subheading, the correct setting, and the available <soft-keys> to access additional menus. Comments are included only where necessary.

GPS OPERATIONS

Access this menu by pressing the GPS key.

	Comment
Position	indicates current position or last available position
Receiver status	
Satellite info	
DGPS status	
Navigation	alternative path to access navigation functions
Waypoints	lists all waypoints available, or entry of additional waypoints
2D Altitude	
Disconnect	

<SETUP>

ROVER OPTIONS

Access this menu by pressing <SETUP> from the GPS Operations menu. Then select Rover options.

	Setting	**Comment**
Logging intervals		
Point feature	1s	
Line/area feature	2s–5s	depending upon speed of movement
Not in feature	None	
Velocity	None	
Minimum pos	10	
Carrier phase min time	10mins	
Pos Mode	Manual 3D	
Elev Mask	15°	

SNR Mask	6.0	
PDOP Mask	6.0	
PDOP Switch	6.0	
Audible click	Yes	
Log DOP data	Yes	
Dynamics code	Land	may be changed to sea or air, as appropriate

<RTCM> <ANTEN> <OUTPUT>

RTCM INPUT OPTIONS

This menu can be accessed from the Rover options menu by pressing <RTCM>.

	Setting	**Comment**
RTCM input mode	Auto	
RTCM version	Auto	
RTCM station	Any	
Warning time	20s	
Log PP data	Yes	"yes" to be enable post-processing of real-time corrected data
Baud rate	9600	
Data bits	8	
Stop bits	1	
Parity	None	

<DGPS>

INTEGRATED DGPS

This menu can be accessed from the RTCM input option menu by pressing <DGPS>.

	Setting	**Comment**
Source	Satellite	
Provider	Omnistar	
Satellite	AMSC – Eastern USA	should be changed to as appropriate: Eastern, Central, Western
Frequency	(automatically updated by selection in satellite field)	
Data rate	(automatically updated by selection in satellite field)	

ANTENNA OPTIONS

This menu can be accessed from the Rover options menu by pressing <ANTEN>.

	Setting	Comment
Height	6 ft	adjust accordingly to antenna height
Measure	Vertical	
Type	MS	
Confirm	Per file	can be changed to “Per feature” if antenna height varies and elevation is critical

OUTPUT OPTIONS

This menu can be accessed from the Rover options menu by pressing <OUTPUT>.

	Setting	Comment
Output	None	
Baud rate	9600	

ATTACHMENT 51A-2

Additional Settings for the Pro XRS

Exponent™

ATTACHMENT 51A-2
ADDITIONAL SETTINGS FOR THE PRO XRS

Additional Pro XRS settings can be found in the configuration menu. Items of particular importance are indicated in italics.

CONFIGURATION

This menu can be accessed by pressing FUNC followed by GPS.

	Description
GPS	Alternate path to access the ***Rover options*** menu
Coordinate system	Changes coordinate system among latitude/longitude, UTM, and other coordinate systems. System can be converted, if necessary, after data capture by using Pathfinder Office software.
Units and display	Changes various units, for example: length (e.g., feet, meters), altitude reference (e.g., MSL), ***North reference*** (i.e., true or magnetic). Units can be converted, if necessary, after data capture by using Pathfinder Office software.
Time and date	Changes to ***local time***, 24 hour clock, date format, etc.
Quickmarks	Set-up parameters for use with quickmarks.
Constant offset	Set-up parameters for use with a constant offset.
External sensors	Connections with external sensors.
Hardware (TDC1)	TDC1 settings such as beep volume, contrast, ***internal and external battery status***, software version.

CONTRAST AND BACKLIGHTING

The TDC1 display can be viewed in various light settings. Pressing FUNC, then L turns on the display backlight for viewing in dim lighting. In addition, the contrast can be adjusted by pressing FUNC, then → or ←.

Exponent™

SOP 51B
POST-COLLECTION PROCESSING AND CORRECTIONS USING PATHFINDER SOFTWARE

Pathfinder Office is PC software used to create data dictionaries, to download and upload files to/from the Pro XRS, and to post-process GPS rover files. To use the software, the Pathfinder activation "key" must be in place in the LPT1 port of the computer. Without the key, Pathfinder Office will run only in "demo" mode.

DOWNLOADING ROVER FILES AND UPLOADING DATA DICTIONARIES

The most basic use of the Pathfinder Office is to transfer field-collected GPS data as a rover file on the TDC1 to a personal computer. This same process is used to transfer PC-generated data dictionaries to the TDC1.

1. Connect one end of the yellow download cable to the TDC1 and the other end to the COM port of the computer.
2. Turn on the TDC1 and select **File transfer**. In Pathfinder Office, select **Data Transfer** from the **Utilities** pull-down menu.
3. Under the **Data Type** menu, select **Data Dictionary** to download a dictionary to the TDC1; or select **Data** to upload rover files from the TDC1 to the PC. The direction also needs to be selected: **Send** or **Receive**.
4. When downloading rover files, ensure that the files are transferred to a file specific directory. If a new directory needs to be created, click on the change directory button, and create a new folder.
5. All rover files stored on the TDC1 will be listed in the dialog box. Select the appropriate files, click **Add**. When all necessary files are selected, click **Transfer**. The name of the rover file will be appended with a ".ssf" file extension and will be located within the project-specific folder.
6. After the rover files have been downloaded, please remember to delete them from the TDC1.

Waypoints

Waypoints from existing files can be exported from Pathfinder Office to the TDC1. (Waypoints from other file types can first be imported into Pathfinder Office.)

1. Choose **Waypoints** from the **File** menu and name the waypoint file appropriately.
2. Click **Create** from the **Waypoint Properties** window. Name the individual point, and check off "pick from map." From the map view, select the point to be exported as a waypoint. The coordinates will be entered into the dialog box.
3. Continue to enter new waypoints until complete. Waypoints can be edited or deleted as well. Save the waypoint file.
4. Setup the TDC1 as indicated above for rover file transfer. From the data transfer menu, select waypoint as the data type, and send as the direction.
5. Choose the correct waypoint file, and transfer it to the TDC1 by clicking **Transfer**.

REVIEWING THE ROVER FILE IN PATHFINDER OFFICE

Choose **Open** from the **File** menu, and select the appropriate file. Review the file to ensure that all information contained is correct. For example, confirm that all features collected are named correctly, and that no inadvertent features were collected. After opening the file, select **Map and Time Line** from the **View** menu. This will display both the spatial and temporal collection of features. Choose a feature, and review its features. They can be edited from the **Feature Properties** window. If changes are made, please save the file as new name so it can be restored to the original if necessary. Whole features may be deleted. If a feature is deleted, all of its individual data points remain. These points may be reviewed to look for evidence of multi-pathing. Individual data points can be deleted from the Position properties window. The feature may then be restored without the deleted points. This action may improve the accuracy of the feature's location.

POST-PROCESSING ROVER FILES

[Note: this information needs to be repeated in the other SOP. Perhaps as an addition to the second item under RECORDING A DATA FEATURE PAGE 51a-3]The positional accuracy of the features depends upon whether the features were collected with real-time differential correction data provided by the OmniSTAR satellite. You can determine whether you are collecting with real-time correction by the "R" indicator on the bottom of TDC1 display. Without real-time correctional data, a "#" is displayed. This information can also be reviewed in Pathfinder Office. The feature must first be deleted (it can be undeleted later), and then individual points can be reviewed in the Position property window. The window will indicate whether the point is "Uncorrected" or "3D Real-time Differential."

Uncorrected positions need to be post-processed, and post-processing real-time corrected positions will improve the accuracy of this data. The steps below outline the procedure for post-processing rover files (.ssf).

1. If you have multiple .ssf files for the same site (e.g., data collected over multiple days), these files should be combined into one. (This step may be performed before or after processing.) From the **Utilities** menu, select **Combine**. Select the files that should be combined. By default, the file will be called combined.ssf. This name an be changed if needed by clicking the output file button. Combining the files will lessen the base station downloading time.

2. Check the differential correction settings. The figures below contain "typical" settings.

3. The file(s) to be corrected should be listed under rover files. Click on **Internet search** to download files from nearby community base stations (CBS). In the **Internet search** dialog box, select the appropriate base station if it is listed, or click on **New**.

4. If you have recently downloaded the Trimble's list of CBSs, click on "select from list," or click on "download the latest…" if you have not.

5. A list of base providers listed in increasing distance from your site of collection will be listed. Select one of the closer ones. Details regarding the ownership of the station will be provided in the **Provider Properties** window. Click OK. The base station must be within 300 km. A closer base station provides for more accurate correction.

6. Click OK to select the base station, and proceed to download appropriate files from the internet. These base files will be downloaded into the project base file directory (usually, c:\pfdata\projectname\base). When downloading from the internet is complete, a "confirm selected base files" window will appear. Check to see that the appropriate base files have been copied and that full time coverage for your rover file exists, and click OK. (e.g., a base file named R90201917 is from 02/19/99 for the 17th hour, GMT). Base files may also be downloaded into this folder from a variety of sites on the Internet.

7. Confirm the reference station location by clicking OK, and click OK in the differential correction window. Correction will commence and may take a while depending upon the size of the rover file.

8. The new file will have the same name as the original file, but with a .cor extension replacing the .ssf extension. A differential correction completed window will appear indicating how many position were corrected. The log will explain the details.

9. From the file menu, open the new file with the .cor extension to view its map and time line.

10. Before transferring the files to GIS, please check with GIS staff for the appropriate export settings. These setting can be changed from the **Utilities** menu.

Creating Data Dictionaries

Pathfinder Office software is also used to generate data dictionaries. A data dictionary can be quite general or very specific depending upon the needs of the user. A brief description of writing a data dictionary follows:

1. From the **Utilities** menu, select data dictionary editor. Name the new dictionary appropriately. (Or you can choose to edit a previously created dictionary by selecting **File**, then **Open**.)

2. Click new feature at the bottom of the window. Name the feature (e.g., sample type), and select the feature type: either point, line, or area (e.g., tree, path, and building).

3. Define one or more attributes of the feature by clicking new attribute. Attributes can be defined in several ways. The following table provides some explanatory examples:

Attribute Type	Description	Example
Menu	List of attributes to choose from	Sample type: Sediment, soil, surface water, and groundwater
Numeric	A numeral value to describe the attribute	Penetration depth in centimeters
Text	Free text to describe the attribute	Physical description of sediment
Date	Date of data collection	Automatically logs date as an attribute
Time	Time of data collection	Automatically logs time as an attribute

4. Each attribute can be a required entry (data collection will not proceed without entry) or an optional entry. The list (e.g., sediment, soil, or water) can be arranged in any way or can have a default value. Numeric entries can also have a default value.

5. All data dictionaries contain all the features entered plus generic point, line and area features. This feature allows entry of features not anticipated in the data dictionary design.

6. Once all the features and attributes have been entered, the dictionary should be saved and is then ready to uploaded to the TDC1 by following the instructions above.

Other Features of Pathfinder Office

Pathfinder Office has other useful features that are more fully described in the user's manuals. A few of the highlights are listed below:

- **Quick plan utility—**This feature allows the user to determine the optimum times for data collection. More than 20 satellites are available, but only a limited number of these have line of site to the project area at given time of day. Because at least four satellites are required for differential accuracy, it is good idea to get an idea of what time of day may have limited satellite availability and to avoid data collection during those times.
- **Measure—**From the map view, distance between points can be measured by using the ruler tool button.
- **Graphics—**Pathfinder Office can also be used as a presentation tool, and feature symbols may be edited. Maps may be printed with legends showing feature types.

Exponent™

SOP 99
SURFACE SEDIMENT SAMPLING USING AN EKMAN GRAB SAMPLER

This standard operating procedure (SOP) describes the procedures used to collect surface sediment with an Ekman grab sampler. Surface sediment is typically analyzed for various physical and chemical variables. For the purposes of this SOP, surface sediment is defined as the upper 10 cm of the sediment column but may vary given the sampling interval specified in the study design.

A stainless-steel Ekman grab sampler is capable of collecting acceptable samples from a variety of soft substrates, such as silt, silt mixed with clay, and silt mixed with some sand. The Ekman grab sampler has two doors on top to allow easy access to the sediment for visual characterization and sampling of surface sediments. The procedures for collecting surface sediment samples using the Ekman grab sampler are described below.

EQUIPMENT AND SUPPLIES REQUIRED

Equipment required for sediment sampling using the Ekman grab sampler includes the following:

- Stainless-steel Ekman grab sampler (typically 0.25 ft^2) with handle and rope
- Trigger weight (i.e., messenger)
- Teflon® or polyethylene siphon
- Flat-bottomed container (e.g., dish pan)
- Stainless-steel ruler
- Stainless-steel spoons
- Stainless-steel mixing bowl or pot
- Scrub brush
- Squirt bottles (for solvents)
- Alconox® (laboratory detergent)
- Acetone and hexane (if applicable for a specific project).

DECONTAMINATION

Before each station is sampled, decontaminate the inner surfaces of the grab sampler and all stainless-steel sample compositing equipment. Sediment sampling and compositing equipment will be decontaminated using the following general sequence: site water rinse, Alconox scrub and rinse, site water rinse, solvent rinse (if applicable for a specific project) with acetone and hexane (respectively), and a final site water rinse. Equipment used for compositing the sediment samples will follow the same basic decontamination sequence except that the final rinse will be with laboratory-grade distilled/deionized water. If there is a significant lapse of time between decontamination of the sediment sampling and compositing equipment and collection of the sample, then the decontaminated sediment sampling and compositing equipment will be protected from additional contamination by wrapping it in foil (with the dull side of the foil touching the equipment) and placing it in clean bags for transport, if necessary.

All solvent rinsates will be collected into a bucket or tub and allowed to evaporate over the course of the day. Any rinsate that has not evaporated by the end of the sampling event will be containerized and disposed of in accordance with federal regulations.

GRAB SAMPLER DEPLOYMENT

1. If the water depth is less than 9 ft, attach the grab sampler to the metal handles. If the water depth is greater than 9 ft, use the rope to deploy the grab sampler.
2. Place the grab sampler on a decontaminated surface and open it.
3. Ensure that the two release wires are securely placed around the release pins.
4. Lower the sampler through the water column at a slow and steady speed.
5. Allow the grab sampler to contact the bottom gently, with only its weight being used to force it into the sediments. The sampler should never be allowed to "free fall" to the bottom because this may result in premature triggering, an excessive wake, or improper orientation upon contact with the bottom.
6. Deploy trigger weight (i.e., messenger) to release the doors on the bottom of the grab sampler.

GRAB RETRIEVAL

1. After the grab sampler has rested on the bottom for approximately 5 seconds, begin retrieving it at a slow and steady rate.
2. After the grab sampler breaks the water surface, gently lower it into a clean, flat-bottomed container, while maintaining the grab sampler in an upright position.
3. Open the doors on the top of the grab sampler, and inspect the sample for acceptability. The following acceptability criteria should be satisfied:
   - The sampler is not overfilled with sample to the point that the sediment surface presses against the top of the sampler or is extruded through the top of the sampler.
   - Overlying water is present (indicating minimal leakage).
   - The overlying water is not excessively turbid (indicating minimal disturbance or winnowing).
   - The sediment surface is relatively undisturbed.
   - The desired penetration depth is achieved.

If a sample fails to meet the above criteria, it will be rejected and discarded away from the station.

Penetration depth should be determined by placing a decontaminated stainless-steel ruler against the center of the inside edge of the opening on the top of one side of the grab sampler and extending it into the grab sampler until it is almost in contact with the top of the sample. The penetration depth is determined by the difference between that measurement and the total depth of the grab sampler.

SAMPLE REMOVAL AND PROCESSING

1. For acceptable samples, remove the overlying water by slowly siphoning it off near one or more sides of the grab sampler. Ensure that the siphon does not contact the sediments or that fine-grained suspended sediment is not siphoned off. If sediment is suspended in the overlying water, do not proceed with siphoning until the sediment is allowed sufficient time to settle.
2. After the overlying water is removed, characterize the sample as specified in the study design. Characteristics that are often recorded include:

- Sediment type (e.g., silt, sand)
- Texture (e.g., fine-grain, coarse, poorly sorted sand)
- Color
- Approximate percentage of moisture
- Biological structures (e.g., chironomids, tubes, macrophytes)
- Approximate percentage of biological structures
- Presence of debris (e.g., twigs, leaves)
- Approximate percentage of organic debris
- Presence of shells
- Approximate percentage of shells
- Stratification, if any
- Presence of a sheen
- Odor (e.g., hydrogen sulfide, oil, creosote).

3. After the sample is characterized, remove the top 10 cm using a stainless-steel spoon (see site-specific study design for project-specific sampling interval). Unrepresentative material (e.g., large shells, stones, leaves, twigs) should be carefully removed without touching the sediment sample under the supervision of the chief scientist and noted on the field logbook.
4. Remove subsamples for analysis of unstable constituents (e.g., volatile organic compounds, acid-volatile sulfides), and place them directly into sample containers without homogenization.
5. Transfer the remaining surface sediment to a stainless-steel mixing bowl or pot for homogenization. Additional grab samples may be required to collect the volume of sediment specified in the study design. The mixing bowl should be covered with aluminum foil (dull side down) while additional grab samples are being collected to prevent sample contamination (e.g., from precipitation, splashing water, falling leaves).
6. After a sufficient volume of surface sediment from a grab is collected (i.e., 0–10 cm), move away from the station, open the jaws of the grab sampler, and allow the remainder of the sediment sample to fall out of the grab sampler. Discard this material away from the station, and rinse away any sediment adhering to the inside of the grab sampler. The grab sampler is now ready for additional sampling at the same station or decontamination before sampling at a new station.

7. After a sufficient volume of sediment is transferred to the mixing bowl, homogenize the contents of the bowl using stainless-steel spoons until the texture and color of the sediment appears to be uniform.

8. After the sample is homogenized, distribute subsamples to the various containers specified in the study design and preserve the samples as specified in the study design.

Note: *SOP 115 cited within.*

Exponent™

SOP 111
FISH COLLECTION PROCEDURES FOR USING A SEINE NET

This SOP discusses the sampling of fishes by use of a seine net. The procedures for processing the individuals captured with a seine are described in SOP 115, *Fish Processing Procedures*.

SAMPLE COLLECTION USING A SEINE NET

A seine net is used as an active sampling device to capture fish along a segment of shallow shoreline by encircling them. Each encircling effort or sweep of shoreline with the net is referred to as a "haul." The number of hauls and number of fish collected in each haul can be documented to yield quantitative (i.e., catch-per-unit-effort) information as a standard method of reporting fisheries seine data. Sampling by seine net is generally most effective in areas with smooth substrate and few underwater obstructions. A seine net consists of a length of mesh fabric, usually made of nylon or polyester, vertically suspended between a float line on top and a weighted lead line at the bottom. Seine nets can be obtained from commercial net vendors in a variety of dimensions and mesh sizes. Seine nets commonly used for fisheries work have mesh sizes that range from 1/16 in. to 4 in. Specific seine dimensions are selectively used by stream investigators depending on the needs of the fish survey, fish sizes, or life stages of the fish sought.

Each end of the net is fastened to a metal or wooden pole referred to as a braille. Seine nets can be constructed with an extended bag at the center that aids in the entrapment of fish during the seine haul.

Equipment Required

Equipment required for collecting samples with a seine net consists of the following:

- Seine net
- Brailles
- Hip boots or chest waders
- Life jackets
- Collection buckets or sample containers

- Boat (for difficult access)
- Tape measure or hip chain.

Sampling Procedures

Collection of fishes by using the seine net will proceed as follows:

1. Mark off the segment of shoreline to be sampled.
2. Hold the inner end of the seine at the beginning of the shoreline sampling segment.
3. Carry the other end of the seine into the water perpendicular to the shore (a second person is needed to complete this task). When sampling areas are difficult or dangerous to wade in, or when a very long seine (e.g., for seining an ocean beach) is deployed, a boat can be used to manipulate the outer end of the seine. When using a boat, one person should hold the seine pole while a second person rows the boat. Alternatively, the shoreward end of the seine can be tethered to a fixed object on the shore while the boat maneuvers the outer end of the seine.
4. Extend the seine away from shore until it is fully extended or until the water becomes too deep to maneuver the outer end of the net. Ideally, the water depth to be sampled is no deeper than the mesh wall on the seine net. If an extra bag is sewn into the seine net, make sure the bag is extended out behind the seine.
5. With the first person pulling the inner seine pole from shore and the second person pulling the outer pole in the water, drag the seine parallel to the shoreline for the length of the sampling segment. Make sure the lead line drags along the substrate so that fish cannot escape under the net.
6. If necessary, a third person can follow behind the seine as it is being pulled to free the net from any snags that are encountered.
7. When the end of the sampling segment is reached, swing the outer end of the seine shoreward and continue moving (sweeping) the seine toward shore until both ends meet at the shoreline.
8. Pull the remainder of the seine toward shore, making sure that the lead line drags along the substrate.
9. Check the net for fish after the entire seine is brought onto the shore.
10. Transfer the captured individuals to collection buckets.

11. Process the fish in accordance with study design specifications and SOP 115, *Fish Processing Procedures*.

12. If replicate shoreline segments are to be sampled, repeat Steps 1–10 for each replicate segment.

13. If a quantitative analysis of the fish community is being conducted (i.e., catch-per-unit-effort, total enumeration, or mark-recapture), it is recommended that the upper and lower boundaries of the stream segment be blocked by nets of the same mesh as the seine net. These nets should be strung across the channel, ensuring that the bottom of the net contacts the sediments so fish cannot move out of the stream segment being sampled.

REFERENCES AND OTHER SOURCES

Hayes, M.L. 1983. Active fish capture methods. pp. 123–145. In: Fisheries Techniques. L.A. Nielsen and D.L. Johnson (eds). Publication of the American Fisheries Society, Bethesda, MD.

Note: *SOP 115 cited within.*

Exponent™

SOP 112
FISH COLLECTION PROCEDURES WHILE USING AN ELECTROSHOCKER

This SOP discusses the sampling of fishes by use of an electrofishing device referred to as an "electroshocker." The procedures for processing fish captured by an electroshocker are described in SOP 115, *Fish Processing Procedures*.

SAMPLE COLLECTION WHILE USING AN ELECTROSHOCKER

An electroshocker is an active fish collection device that sends an electric current through the water, temporarily stunning or directing the movements of fish. Stunned fish are collected by using a dip net. Because an electric current is generated during sampling, several precautions must be taken when using an electroshocker to avoid being electrocuted. Electroshocking should not be conducted without knowledge of the safety procedures described below. All equipment should be maintained and operated according to the manufacturer's instructions.

Basic procedures for using electroshockers are described below. One of four general electroshocker configurations can be used for fish collections. A backpack-mounted electroshocker is used in shallow streams where wading is safe. A pram shocker is used when wading in small and medium-sized shallow streams. The pram is a small barge-mounted electrofishing unit that allows one or more fish collectors to work simultaneously without the encumbrance of backpack-mounted units. A bankside shocker offers alternative sampling flexibility in that it can be stationed along an embankment and deployed throughout small or medium-size streams by the use of handheld electrodes with extended conductor cables. Pram and bankside shockers offer more power output than backpack shockers and, as such, potentially pose higher risks. A boat electroshocker is used along shorelines of deeper or open waters where wading is not possible or safe.

Safety Precautions

Electrofishing is hazardous work. The following safety precautions must be taken when using an electroshocker:

1. Never electrofish alone. The buddy system must always be enforced.
2. Ensure that all persons in the sampling crew wear proper sampling attire.
3. Ensure that all members of an electrofishing crew understand the system they are using and the risks involved. Before a field operation begins, new crew

members should receive orientation on equipment and procedures. At least one member of the electrofishing crew must have CPR and first aid training.

4. Ensure that people, livestock, or pets are not in the water either upstream or downstream from the sampling site.
5. Do not use the electroshocker during an electrical storm or periods of heavy rainfall.
6. Limit the number of sampling crew to maximize safety through increased freedom of movement on deck or in the stream and to reduce confusion.
7. Make sure that the person-in-charge has ultimate control of the power source.
8. Never reach into the water with hands or feet for any reason while the electrosystem is operating..
9. Turn off the electroshocker immediately if a person falls into the water. All sampling crew must know how to turn off the electroshocker.
10. When electroshocking in streams, proceed upstream at a slow pace. Do not chase the fish.
11. With the exception of standard shoreline fish community surveys, do not shock constantly; it is preferable to shock for a few seconds, stop shocking while continuing to move, and then begin shocking again.

Equipment Required

Equipment required for collecting samples with an electroshocker consists of the following:

- Electroshocker unit (backpack, pram, bankside, boat)
- Hip boots or chest waders (if wading)
- Rubber gloves
- Personal floatation device
- Dip nets
- Buckets.

Operating the Electroshocker

The electroshocker will be used to collect fish samples as follows:

1. Mark off the stream segment to be sampled, if applicable to the needs of the study.
2. Set up the electroshocking equipment according to the manufacturer's instructions. Each electroshocker configuration has unique set-up procedures.
3. Have all members of the sampling crew put on appropriate attire (e.g., gloves, chest waders, etc.).
4. Designate one person as the operator of the electroshocker (i.e., the "shocker").
5. Adjust the voltage and ampere settings to the appropriate levels for the conductivity and velocity of the water that will be sampled and the size range of the target fish. This decision is deferred to the experienced operator.
6. If so equipped, adjust the setting for the electroshocker timer to zero before each electroshocking effort to document "on-time" electrofishing effort.
7. Have the crew members that will collect the shocked fish (i.e., the "dip-netters") stand by with dip nets.
8. If sampling a small stream, have all sampling crew members enter the water at the downstream end of the survey stream segment.
9. In small streams, have the crew face upstream while the "shocker" begins moving the anode through the water by extending it in an upstream direction and then pulling it away from fish cover or back in a downstream direction. At the same time, have the "dip-netters" position themselves slightly downstream on either side of the "shocker" to capture the shocked fish and transfer them to collection buckets.
10. Have the sampling crew proceed in an upstream direction while electrofishing available fish micro-habitats until the end of the sampling segment is reached or until a pre-determined sampling time is expended. If electroshocking from a boat, the dip netters will position themselves at the handrail on the bow, from which point they can safely net the stunned fish.
11. Where quantitative fish data is not required, sample distances and times may be limited only by the needs of the survey.
12. When the end of the sampling segment is reached, record the number of electroshocker seconds elapsed during sampling plus the number of fish collected during that period.

13. Process the fish according to study design specifications and the procedures described in SOP 115, *Fish Processing Procedures*.

14. If replicate stream segments will be sampled, repeat Steps 1–13 for each replicate.

REFERENCES AND OTHER SOURCES

Coffelt Electronics. 1976. Instruction manual for the variable voltage pulsator backpack electroshocker. Coffelt Electronics Company, Inc., Englewood, CO.

Reynolds, J.B. 1983. Electrofishing. pp. 147–163. In: Fisheries Techniques. L.A. Nielsen and D.L. Johnson (eds). Publication of the American Fisheries Society, Bethesda, MD.

Smith-Root, Inc. 1995. Electrofishing Safety. Smith-Root Incorporated. Vancouver, WA.

Note: *SOP 115 cited within.*

Exponent™

SOP 114
FISH COLLECTION PROCEDURES USING FISH TRAPS

This SOP discusses the sampling of fishes by use of traps including trap nets, hoop nets, and minnow traps. The procedures for processing fish captured by traps are described in SOP 115, *Fish Processing Procedures*.

SAMPLE COLLECTION USING A TRAP NET OR HOOP NET

Trap nets and hoop nets are used as passive sampling devices to capture fish as they swim along the shoreline. Although the nets can be set in different configurations to sample deeper open waters as well. Trap nets are particularly effective in capturing several migratory species. A trap net consists of a leader (wall of mesh fabric) and a series of hoops or compartments that entrap fish after they pass through a series of funnels or openings. Panels of mesh referred to as "wings" can be added to either side of the openings on these traps and serve to guide otherwise passing fishes into the net funnels. The net is commonly set perpendicular to the shore with its mouth facing the shoreline. When fish encounter the leader or wings, they are directed into the mouth of the net. As fish move through the series of hoops or compartments, escape becomes increasingly difficult. Fish may be attracted to the net by other fish that are already captured in it. Bait may be added to trap nets and hoop nets to attract species such as catfish.

Equipment Required

Equipment required for collecting samples with a trap net or hoop net consists of the following:

- Trap net or hoop net
- Buoys
- Anchors (traditional, bricks, or concrete blocks, etc.)
- Line
- Boat hook
- Collection buckets
- Boat.

Setting the Net

The net will be set as follows:

1. Bait the inside of the last compartment of the net if catfish or other bottom feeders are desired.
2. Anchor the shoreward end of the leader near the shoreline, or attach it to the shoreline by tying it to a fixed object onshore (e.g., a tree, a root, etc.).
3. Extend the leader line out into the water and perpendicular to shore until it is taut.
4. Extend each wing at a 45–90° angle to the leader line. This step can be done either by boat or by wading, depending on water depth and substrate characteristics.
5. Anchor the lower ends of both wings with anchors, and attach buoys to the upper ends of the wings. Adjust the buoy lines so that the buoys are floating and the lines are relatively taut.
6. Extend the hoops of the trap away from shore in line with the leader line, and pull on the end of the net until all of the hoops are upright.
7. Close the back end (cod end) of the net with a piece of line.
8. Attach an anchor to the end of the net to keep it submerged, and attach a buoy to the anchor to mark the location of the end of the net.
9. Allow the net to soak for the prescribed sampling period (e.g., 24–48 hours).

Retrieving the Net

The net will be retrieved and the fishes collected as follows:

1. Arrive at the buoy at the end of the net, snag the buoy line with a boat hook, and pull the buoy and its anchor into the boat.
2. Retrieve the hoops in sequence while moving toward shore.
3. Starting at the mouth of the net, shake the captured fish into the closed end of the net.
4. Once all captured fish are in the back end of the net, empty them into the collection buckets.
5. Process the fish according to study design specifications and SOP 115*, Fish Processing Procedures*.

6. If sampling will continue at the collection site, reset the net according to Steps 5–8 of the above procedures for setting a net.

SAMPLE COLLECTION BY USING A MINNOW TRAP

A minnow trap is used as a passive sampling device to capture juvenile fish as well as the adult individuals of small fish species. Minnow traps can also be effective in capturing crayfish and tadpoles. Fish are captured when they swim into the trap through a funnel-shaped opening that makes escape difficult. The trap is generally set in shallow nearshore areas and should have a buoy attached to facilitate retrieval. Multiple traps can also be strung together with line to facilitate retrieval. The trap can be deployed with bait inside to attract fish or without bait. Fish may be attracted to the trap by other fish that are already captured in it.

Equipment Required

Equipment required for collecting samples with a minnow trap consists of the following:

- Minnow trap(s)
- Buoy(s) or surveyor flagging
- Line
- Boat hook
- Boat.

Setting the Minnow Trap

The minnow trap will be set as follows:

1. Attach a buoy to the trap with enough line to ensure that the line will remain slack at the highest water level expected for the period of deployment. If sufficient line is not used, the buoy can reduce the negative buoyancy of the trap, allowing the trap to be moved by waves or currents. The use of an excessive length of line should also be avoided because it will increase the probability of the line becoming snagged as it is moved around by waves or currents.
2. Assemble the trap. If bait will be used, the trap can be baited at this time.
3. Deploy the trap at the sampling station by lowering it over the side of the boat, making sure that it does not get tangled in the buoy line. If a string of

traps will be deployed, attach the trap to the next one in the sequence before deploying it. Buoys do not need to be attached to any of the additional traps.

4. After the trap is placed on the bottom, adjust the length of the buoy line on the basis of the considerations discussed in Step 1. If a string of traps is used, move the boat to the prescribed location of each additional trap in sequence, and deploy each of those traps.
5. Allow the trap to soak for the prescribed sampling period (e.g., 24–48 hours).
6. If the minnow traps are being set from the shoreline, tie a long piece of rope onto the trap, and lower the minnow trap out into the stream channel, or place it at the edge of habitat along the shoreline or adjacent to habitat structure (e.g., a downed tree limb).
7. Secure the end of the line to a structure on the shoreline, and use surveyor flagging to mark where the line is tied.
8. If motorized boats are expected to traverse the channel, fasten a buoy to the trap with a length of line sufficient to allow the buoy to float above the trap. Ensure a sufficient amount of line is attached to keep the buoy afloat during high water conditions.

Retrieving the Minnow Trap

The minnow trap will be retrieved and the fishes collected as follows:

1. Arrive at the buoy attached to the trap, and snag the buoy line by using a boat hook or similar device.
2. Pull the trap to the water surface by using the buoy line, and bring the trap onboard the boat.
3. Open the trap, and transfer the captured fish to the collection buckets. If a string of traps is used, proceed to the next trap in sequence, and follow Steps 2 and 3.
4. Process the fish according to study design specifications and SOP 115, *Fish Processing Procedures*.
5. If sampling will continue at the collection site, reset the trap according to Steps 3–5 of the above procedures for setting a minnow trap.
6. In habitats influenced by tidal flux, check minnow traps before low tide is reached because the trap may become exposed during low tides, leading to mortality of the organisms in the trap or serving as an attractant to other wildlife.

REFERENCES AND OTHER SOURCES

Hubert, W.A. 1983. Passive capture techniques. pp. 95–111. In: Fisheries Techniques. L.A. Nielsen and D.L. Johnson (eds). Publication of the American Fisheries Society, Bethesda, MD.

Exponent™

SOP 115
FISH PROCESSING PROCEDURES

This SOP discusses the procedures for making biological measurements of individual fish and for resecting fillets from individual fish for analysis of chemical concentrations in edible muscle tissue.

BIOLOGICAL MEASUREMENTS/OBSERVATIONS

The biological measurements and observations commonly made of individual fish include length, weight, gender, reproductive condition, presence or absence of physical anomalies, parasites, or disease, and age using scales or hard body parts.

Equipment Required

Equipment required for making biological measurements and resecting fish fillets consists of the following:

- Measuring board
- Analytical balance
- Stainless-steel filleting knife
- Skinning pliers (if needed for removing catfish skins)
- Blunt-point forceps
- Fish scale-remover ("scaler")
- Fillet board
- Microprojector
- Coin envelopes
- Aluminum foil
- Ziploc® bags
- Disposable nitrile gloves
- Alconox®

- Hexane
- Methanol
- Collection buckets.

Length and Weight Measurements and Other Observations

Length and weight measurements should be made on unpreserved fish as soon as possible after collection. Preservation techniques such as freezing and fixation with formalin and ethanol can alter length and weight measurements relative to the values that would be found for unpreserved individuals immediately after capture. The procedure described below for measuring length addresses total length (i.e., the distance from the most anterior part of the fish to the tip of the longest caudal fin ray):

1. Examine each fish for signs of physical anomalies, disease, or external parasites. Examples of physical anomalies include eroded fins, missing eyes, scoliosis or other body or mouth deformities, and skin lesions. Examples of disease symptoms include hemorrhagic sores, skin fungi, or grossly undernourished body condition. Examples of external parasites include attached leeches or worms, or cysts embedded in the skin or fin membranes. Detailed observations should be noted on appropriate data sheets for each fish examined. Note the location of the anomalies (i.e., caudal fin, left mandible).
2. Place each fish on the measuring board, with its head touching the wall of the board and its side resting along the ruler of the board. Do not squeeze the head of the fish against the wall of the board.
3. Push the caudal fin together, and record the measurement for the longest part of the fin to the specified accuracy (e.g., the nearest 1.0 mm).
4. Place the balance tray on the analytical balance, and press TARE. Wait for a reading of 0.0 g.
5. Place the fish in the balance tray.
6. Allow the weight reading to stabilize, and record the weight to the specified accuracy (e.g., 1.0 g).

Fish Filleting Procedures

Fish are commonly filleted to resect edible muscle tissue for analysis of chemical concentrations. The filleting process is the same one used by fishermen to remove edible muscle tissue from fish. The results of the chemical analyses are therefore directly related to the

tissue that is frequently consumed by humans. Filleting should occur after length and weight measurements and other observations have been recorded for each fish, as follows:

1. Decontaminate all filleting equipment (filleting knife, scaler, fillet board) with Alconox®, methanol, and hexane, in sequence. After the hexane rinse, allow the equipment to air dry.
2. Cover the cutting board with a piece of aluminum foil, dull side facing up.
3. Place each fish on its side on the fillet board.
4. Remove all scales from the caudal fin to the head. Do not remove the skin from fish that are commonly eaten with the skin attached to the fillet. For species that are commonly skinned before eating (e.g., catfish), remove the skin from the entire fish by cutting the skin around the head and peeling it off with pliers.
5. Make a cut along the ventral midline of the fish from the vent to the base of the jaw.
6. Make a diagonal cut from the base of the cranium, following just behind the gill to the ventral side just behind the pectoral fin.
7. Remove the flesh and rib cage from each side of the fish by cutting from the cranium along the spine and dorsal fin to the caudal fin. Leave the ribs attached to the main fillet. When removing the fillet, it is common to leave the fatty "belly" meat on the fish carcass. Consult specific project study plans regarding inclusion of belly meat or rib bones with the fillet portions because this procedural requirement may vary among agencies.
8. Wrap the fillets in aluminum foil with the dull side facing the tissue.
9. Label the wrapped sample according to job-specific study plan instructions.
10. Place the labeled, wrapped sample in a labeled Ziploc® bag, and preserve as indicated in the project-specific study plan.

Determination of Gender and Reproductive State

Gender and reproductive state will be determined as follows:

1. After filleting each fish, examine the gonads, and determine whether they are ovaries or testes. Record the gender of the fish.

2. Identify the reproductive state of the gonads according to the following scale:

   - **Stage I—**Ovaries are wine-colored and shaped like torpedoes, and no eggs are visible; testes are small, flat, whitish in color, and cling closely to the spine.

   - **Stage II—**Ovaries resemble those in Stage I, except that small black (but color may vary) eggs are visible to the naked eye; testes are swollen and milky in appearance.

   - **Stage III—**Ovaries are somewhat swollen and yellowish in color; testes are large, lobed, and freely emit a milky liquid.

   - **Stage IV—**Ovaries are greatly swollen, their texture resembles tapioca, and the largest eggs are transparent and more than 1 mm in diameter; testes are slack and contain an abundance of connective tissue.

   - **Stage V—**Ovaries are slack and contain only a matrix and a few residual eggs.

Age Determination

The age of fish is commonly determined by counting the number of annual check marks (i.e., annuli) on hard structures such as scales, spines, otoliths, vertebrae, and opercular bones. The procedures described below are based on the use of scales for age determination. If otoliths, opercular bones, or vertebrae are required for age analysis, follow procedures specified in Nielsen et al. (1983) or as otherwise indicated in the project-specific work plan.

1. Only personnel experienced in the process of fish-scale age determinations should be assigned to this task. At least one experienced peer should validate age determinations.

2. Before collecting scales for age determinations, remove mucous, dirt, and epidermis from the area by gently wiping the side of the fish in the direction of the tail with a blunt-edged knife.

3. Remove about 20 scales from the left side of each fish from areas suitable for the particular species being aged. Consult standardized methods manuals or experienced fisheries workers to obtain this information. Removal must be done carefully. Blunt forceps or a knife tip may be very useful for this task. Be careful not to break the margins of the scales or scratch the surfaces. Scales that are broken or irregularly shaped should be discarded.

4. Transfer fish scales to a labeled coin envelope for later age determination. For bullheads and catfishes, remove the dorsal spine for age determination instead of the scales. If otoliths, opercular bones, or vertebrae are required

for age analysis, follow procedures specified in Nielson et al. (1983) or as otherwise indicated in the project-specific work plan.

5. A scale sample number should be included on the coin envelope for each fish sampled. The sample number should cross reference vital data for each fish including information such as species, length, weight, sex, date, location, and project number.

6. Scales should be inspected and cleaned before mounting them for microscopic viewing. If mucus, skin pigments, or dirt is present on the scale, soak them in water for about two hours, and scrub off any remaining deposits with a small brush or piece of cloth after the soaking period. Retain the best 5 to 10 scales for mounting and viewing.

7. Mount the viewing scales between two microscope slides, making sure that the scales do not overlap.

8. Project the mounted scales with a microprojector (microfiche reader) and identify the scale(s) that have a complete set of rings emanating outward from their center. The microprojector should provide an enlarged image to about 50 times the natural size of the scale.

9. The number of annual rings (annuli) on each scale are counted. Each "true" annulus represents one year of growth. Care must be taken not to misinterpret "false" annuli, "split" annuli, checks, crowded annuli, or accessory rings. An important consideration for aging fish via scale marks is to understand the time of annulus formation which can vary with latitude, spawning, migration, and feeding habits of the sampled fish population as well as with environmental data and water temperature range.

10. Scale and age data are recorded on a Scale Analysis Summary Sheet (Attachment 115-1). The scale analyst must sign and date the sample control sheet.

REFERENCES AND OTHER SOURCES

Nielson, L.A., D.L. Johnson, and S.S Lampton. 1983. Fisheries techniques. American Fisheries Society, Bethesda, MD.

NYSDEC. Fish preparation procedures for contaminant analysis. New York State Department of Environmental Conservation, Albany, NY.

ATTACHMENT 115-1

Scale Analysis Summary Sheet

Exponent™

Scale Analysis Summary Sheet

Project Name:_____

Project Number:_____

Water Body:_____

Sample No.	Date Collected	Location	Species	Length (mm)	Weight (g)	Sex	Age	Remark

Analyst:_____ Date:_____

Witness:_____ Date:_____

Exponent™

SOP 116
CRAYFISH COLLECTION PROCEDURES

This SOP discusses collection of crayfish by use of kick-nets and crayfish traps and the procedures for processing captured crayfish. Sampling can be conducted at day or night. Crayfish can be caught by passive or active means. A passive technique entails the baiting of crayfish traps which are placed in the water during the day and left to fish overnight. If more intensive (active) methods are required, kick-nets can be deployed in shallow streams to seek out crayfish. When working in small streams, if electrofishing gear is available, crayfish may be incidentally collected along with fish. Night sampling in shallow water is often the most productive approach because a number of species venture out of their burrows or out from other cover at night. Captured crayfish should be handled with care because of their pinchers.

COLLECTION OF CRAYFISH WITH A KICK-NET

Kick-net sampling is an active method of sampling benthic organisms by vigorously kicking and disturbing bottom sediments and catching the dislodged organisms with an aquatic net. Kick-net sampling is most effective in shallow streams (<1 m deep) with substrates of rock, rubble, or gravel in the riffle/run areas with light to moderate currents.

Equipment Required for Kick-Net Sampling

Equipment required for kick-net sampling includes the following:

- Hip boots or chest waders
- Kick-net with a mesh opening size less than 2 mm^2
- Sample collection pan or bucket
- Measuring board
- 8-oz glass jars or aluminum foil
- Cooler with ice
- Adhesive labels
- Space pen and field collection logs.

Kick-Net Sampling Procedures

Collection of crayfish by using a kick-net shall proceed as follows:

1. The kick-net is positioned in the stream about 0.5 m downstream.
2. The stream bottom including stones and debris is vigorously disturbed by foot so that the dislodged organisms are carried by the current into the net.
3. Sampling can be continued for a specified time and for a specified distance in the stream if standard effort is required.
4. The preferred line of sampling is a diagonal transect of the stream.
5. The net contents are emptied into a pan of stream water.
6. Crayfish are removed from the net and washed with water from the stream being sampled then placed in collection bucket. Other benthic macroinvertebrates are removed from the net and discarded into the stream.
7. The net is vigorously rinsed in the stream between sample efforts.

COLLECTION WITH CRAYFISH TRAPS

Crayfish traps provide a passive means of collecting crayfish. The use of bait (usually some type of meat) attracts scavenging crayfish into the traps. Traps can be deployed in shallow or deep water. An experienced biologist should determine how to most efficiently bait and deploy the traps for the habitats being investigated. Crayfish traps are commonly identical to minnow traps used to catch small fish. The funnel shaped entrance of a minnow trap should be widened beyond the factory dimension to accommodate the capture of larger crayfish. Traps can be set individually with a line and a float or in a series with several traps attached to a single line and float.

Equipment Required for Crayfish Trapping

Required equipment includes:

- Minnow/crayfish traps
- Bait (cheese whey, beef or pork, chicken parts, fish, peanut butter, or other suitable baits)
- Chest waders or rubber boots (if deployed in wading conditions)
- Sample collection pan or bucket
- Measuring board

- Small floats or surveyor flagging
- Boat hook
- Twine
- 8-oz glass jars or aluminum foil
- Cooler with ice
- Adhesive labels
- Space pen and field collection logs.

Deployment of Crayfish Traps

1. Determine the number of sample locations to be sampled.
2. Bait and assemble each two-piece trap by using the hinges provided around the rim of each trap.
3. Attach a buoy (small visible float) to the trap to aid in retrieval of the trap at a later time.
4. Deploy the trap at the sampling station by lowering it into the water (or over the side of the boat), making sure that it does not get tangled in the buoy line. If a series of traps will be deployed, attach the trap to the next one in the sequence before deploying it. Floats do not need to be attached to any of the additional traps.
5. Allow the trap to soak for the prescribed sampling period (e.g., 24 hours).
6. If the traps are being set from the shoreline, tie a long piece of rope onto the trap and lower the trap at the edge of the habitat along the shoreline.
7. Secure the end of the line to a structure on the shoreline, and use surveyor flagging to mark where the line is tied.

Retrieving the Crayfish Trap

The trap will be retrieved and the crayfish collected as follows:

1. Arrive at the buoy attached to the trap, and snag the buoy line with a boat hook if using a boat to retrieve the traps.
2. Pull the trap to the water surface by using the buoy line, and bring the trap onboard the boat or onto shore if wading.

3. Open the trap and transfer the captured crayfish into the collection buckets. If a string of traps is used, proceed to the next trap in sequence, and follow Steps 2 and 3.
4. Process the crayfish for length, weight, and enumeration according to study design specifications.
5. If sampling will continue at the collection site, reset the trap according to Steps 3–5 of the above procedures for setting a crayfish trap.

CRAYFISH LENGTH AND WEIGHT MEASUREMENTS

The following measurements and preparations for shipping shall be made:

1. Place each crayfish on a measuring board, and record its total length to the nearest millimeter from the tip of its rostrum to the end of the telsun (central tail section or uropod).
2. Place a balance tray on an analytical scale, and press TARE. Wait for a reading of 0.0 g.
3. Place the crayfish in the balance tray.
4. Allow the weight reading to stabilize, and record the weight to the specified accuracy (e.g., 1.0 g).
5. Record measurements on a field collection log.
6. Place crayfish in decontaminated 8-oz glass jars or into aluminum foil with the dull side facing the sample.
7. Label jars or foil packets with an adhesive label.
8. Labeled sample containers should be placed in a clean plastic outer bag and stored on dry ice or wet ice pending shipment to the laboratory for tissue analysis. Frozen crayfish in glass jars may be transferred to double polyethylene bags to avoid breakage during shipment and storage.
9. If required sample sizes are greater than the mass of individual organisms, the composition of any composite samples should be noted in the field notebook (number of organisms, species, if possible).
10. Sample preparation and analysis, problems encountered, and corrective action taken during sample collection, preparation, and delivery shall be recorded in the field notebook.

QUALITY CONTROL

At no time should organisms that are found dead in traps or that are known to have been caught more than 24 hours before collection be retained for analysis. Checking traps on a daily basis is required.

REFERENCES AND OTHER SOURCES

Hobbs, H.H., Jr. 1976. Crayfishes (Astacidae) of North and Middle America. Water Pollution Control Research Series 18050 ELDO5/72. U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, OH.

Hubert, W.A. 1983. Passive capture techniques for minnow/crayfish traps. pp. 95–111. In: Fisheries Techniques. L.A. Nielsen and D.L. Johnson (eds). Publication of the American Fisheries Society, Bethesda, MD.

Plakfin, J.L, M.T. Barbour, K.D. Porter, S.K Gross, and R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: benthic macroinvertebrates and fish. Publication EPA/444/4-89-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

Exponent™

SOP 116A
AQUATIC INVERTEBRATE PROCESSING PROCEDURES

This SOP discusses handing and sampling processing of aquatic invertebrates.

EQUIPMENT REQUIRED FOR SAMPLE HANDLING AND PROCESSING

Equipment required for aquatic invertebrate sample handling and processing includes the following:

- Measuring board
- 8-oz glass jars or aluminum foil
- Cooler with ice
- Adhesive labels
- Camera and film
- Space pen and field collection logs.

AQUATIC INVERTEBRATE LENGTH AND WEIGHT MEASUREMENTS

The following measurements and preparations for shipping shall be made:

1. Place each aquatic invertebrate on a measuring board, and record its total length to the nearest millimeter (e.g., from the tip of its rostrum to the end of the telsun [central tail section or uropod]).
2. Place a balance tray on an analytical scale, and press TARE. Wait for a reading of 0.0 g.
3. Place the aquatic invertebrate in the balance tray.
4. Allow the weight reading to stabilize, and record the weight to the specified accuracy (e.g., 1.0 g).
5. Record measurements on a field collection log.

SAMPLE SIZE, COLLECTION, PRESERVATION, AND HANDLING

1. Place individuals on ice immediately after capture to kill them.
2. Place aquatic invertebrate in decontaminated 8-oz glass jars or into aluminum foil with the dull side facing the sample.
3. Label jars or foil packets with an adhesive label.
4. Place labeled sample containers in a clean plastic outer bag and store on dry ice or wet ice pending shipment to the laboratory for tissue analysis. Frozen aquatic invertebrate in glass jars may be transferred to double polyethylene bags to avoid breakage during shipment and storage.
5. If required sample sizes are greater than the mass of individual organisms, note the composition of any composite samples (number of organisms, species, if possible) in the field notebook.
6. Preserve samples on dry ice for shipment. Samples will be placed in a freezer on receipt at the laboratory.
7. In the field notebook, record sample preparation and analysis, problems encountered, and corrective action taken during sample collection, preparation, and delivery.

DOCUMENTATION

Sample preparation and analysis, sex and reproductive state (if possible), presence of grossly visible abnormalities, problems encountered, and corrective action taken during the process of sample collection, preparation, and delivery shall be recorded in the field notebook.

Appendix C

Example Field Forms

Exponent®

OFFICIAL SAMPLE SEAL

SAMPLE NO.	DATE
SIGNATURE	
PRINT NAME AND TITLE	

Exponent®

SAMPLE NO.

SITE NAME

DATE TIME

SAMPLER PRESERVATIVE

TAG NO. 25101

Example label and chain-of-custody seal

CHAIN OF CUSTODY RECORD/SAMPLE ANALYSIS REQUEST FORM

Page ____ of ____

Project:
(Name and Number)

Exponent

Exponent Contact: _____ Office: _____

Ship to: _____

_____

_____

Lab Contact/Phone: _____

Samplers:

Environmental Group

Bellevue, WA
(425) 643-9803
Boulder, CO
(303) 444-7270
Lake Oswego, OR
(503) 636-4338
Los Angeles, CA
(310) 823-2035
Natick, MA
(508) 652-8500

Sample No.	Tag No.	Date	Time	Matrix	Analyses Requested						Extra Container	Archive	Remarks

Matrix Code: GW - Groundwater SL - Soil SD - Sediment SW - Surface water

OTHER - Please identify codes _____

Priority:

❑ Normal ❑ Rush Rush time period _____

Shipped via: ❑ FedEx/UPS ❑ Courier Other _____

Condition of Samples Upon Receipt: _____

Custody Seal Intact: ❑ Yes ❑ No ❑ None

Relinquished by: _____ Date/Time: _____ Received by: _____ Date/Time: _____
(Signature) *(Signature)*

Relinquished by: _____ Date/Time: _____ Received by: _____ Date/Time: _____
(Signature) *(Signature)*

Distribution: White and Yellow Copies - Accompany Shipment; Pink Copy - Project File

Example chain-of-custody/sample analysis request form

Appendix D

Health and Safety Plan

Exponent™

HEALTH AND SAFETY PLAN

Site Name GM Powertrain – Bedford Plant Contract No. 8601913.001 0501

Proposed Activity Surface water, surface sediment, floodplain soil, and fish sampling

Prepared by Sheryl Law Date 5/01/01

Reviewed by Larry Peterson Date 9/13/01

1. INTRODUCTION

This site-specific health and safety plan, in conjunction with the Corporate Health and Safety Program, establishes procedures and practices to protect employees of Exponent and its subcontractors from potential hazards posed by field activities at Bedford, Indiana. In this health and safety plan, measures are provided to minimize potential exposures, accidents, and physical injuries that may occur during daily onsite activities and adverse conditions. Contingency arrangements are also provided for emergency situations.

2. DISCLAIMER

Exponent cannot guarantee the health or safety of any person entering this site. Because of the potentially hazardous nature of this site and the activity occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible hazards that may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury and illness at this site. The health and safety guidelines in this plan were prepared specifically for this site and should not be used on any other site without prior evaluation by trained health and safety personnel.

3. SITE DESCRIPTION

Site name: GM Powertrain – Bedford Plant

Site location or address: 105 GM Drive/ Bedford, Indiana

Owners/tenants: General Motors (GM) and multiple private owners of land surrounding the plant

Current site use: GM manufactures powertrain assemblies at the Bedford plant. However, this investigation will not occur at the GM plant, but in the surface drainages that are downstream of the plant. The surface drainages cut through residential areas and farm land.

Past site use (if different):

Designated hazardous waste site: No (federal, state, other)

Industrial facility X Spill Other

Active X Inactive

Topography: Hills, valleys, riparian habitats, and floodplains

Name of and distance to nearest surface water body: Sampling will occur on and along Bailey's Branch, Salt Creek, Pleasant Run, and Gullets Creek

Surrounding land use/nearest population: Farm land and residential areas of Bedford, Indiana

Site access: Multiple access points will be used to reach the sampling stations as required. Access agreements have been obtained from all private landowners.

Nearest drinking water/sanitary facilities: Sanitary facilities and drinking water are available at the GM/CRA project trailer at the GM site. Each field team will carry a daily supply of drinking water with them into the field.

Nearest telephone (list number if possible): Field Team Leader's cellular phone: 425-922-7449
GM/CRA project trailer: 812-227-8960.

All buried utilities must be located prior to drilling or excavating at the site. List procedures to be used to locate utilities or indicate that no subsurface excavation or sampling will occur:

Subsurface sampling will not occur.

Site map attached: Yes

4. PROJECT PERSONNEL

	Name/Affiliation	Work Telephone	Home Telephone
Project manager	Rick Bodishbaugh	425-519-8707	425-922-5423
Field team leader	Steve Klein		
Site safety officer	Steve Klein		
Exponent field personnel	Sheryl Law	425-519-8718	425-373-9916
	Jo Salatas	720-406-8126	303-786-1274
Facility contact	GM/CRA Project Trailer	812-277-8960	NA
Client contact (if different)	Cheryl Hiatt	(248) 680-5219	NA

5. WORK PROPOSED

Description of proposed work: Surface water, surface sediment, floodplain soil, fish will be sampled during the field event. Except for Salt Creek, all of the water depths in the surface drainages are wadeable. All samples in Salt Creek will be collected by one team (GeoSyntec) from the electroshocking boat. Surface water will be collected using either individual bottle grabs or a depth integrated sampler. Surface sediment samples will be collected with either an Ekman or modified-Ponar grab sampler. Floodplain soil will be collected using either spoons or scoops. Biota samples will be collected using either an electroshocking boat (Salt Creek only), seine nets, or traps.

Proposed work dates: September 21–October 3, 2001. Timing will depend on study plan approval by Client and EPA.

Subcontractors	Name	Task	Contact	Telephone
	Geosyntec	Brian Estes	Fish sampling	(404) 705-9500
	Geosyntec	Cristin Corless	Fish sampling	(404) 705-9500

6. HAZARD EVALUATION

Potentially hazardous chemicals known or suspected to be onsite (include preservatives and decontamination chemicals):

Chemical of Concern	Concentration (observed or expected)	Medium	OSHA/ WA PEL	WA STEL	OSHA IDLH	Odor Threshold	IP(eV)	Carcinogen or Other Hazard
PCBs (as Aroclor® 1248)	<0.055 mg/L	Water (Pleasant Run)	0.5 mg/m^3 (skin)[a]	1.5 mg/m^3 (skin)[a]	5 mg/m^3	NA	--	carcinogen
PCBs (as Aroclor® 1248)	<1,840 mg/kg	Sediment (Pleasant Run)	0.5 mg/m^3 (skin)[a]	1.5 mg/m^3 (skin)[a]	5 mg/m^3	NA	--	carcinogen
PCBs (as Aroclor® 1248)	<1,840 mg/kg	Floodplain soil (Pleasant Run)	0.5 mg/m^3 (skin)[a]	1.5 mg/m^3 (skin)[a]	5 mg/m^3	NA	--	carcinogen
PCBs (as Aroclor® 1242)	<5.6 µg/L	Water (Salt Creek)	1.0 mg/m^3 (skin)	3.0 mg/m^3 (skin)	5 mg/m^3	NA	--	carcinogen
PCBs (as Aroclor® 1242)	<184mg/kg	Fish (Pleasant Run and Salt Creek)	1.0 mg/m^3 (skin)	3.0 mg/m^3 (skin)	5 mg/m^3	NA	--	carcinogen
Acetone	concentrated	decon	1,000 ppm	--	2,500 ppm (10% LEL)	13–100 ppm	9.69	flammable, reactive
Hexane	concentrated	decon	50 ppm	--	1,100 ppm (10% LEL)	130 ppm	10.18	flammable

Note: -- - none established; C - carcinogen; GW - groundwater; IDLH - immediately dangerous to life and health; IP(eV) - ionization potential; N/A - not applicable; NA - not available; P - poison; PCB - polychlorinated biphenyl; PEL - permissible exposure level; SC - suspected carcinogen; STEL - short-term exposure level

[a] for Aroclor® 1254

	Known	Possible	Unlikely
Potential chemical exposure routes at the site:			
Inhalation	X (decon chemicals)		X (sediment/water/soil)
Ingestion		X	
Skin absorption		X	
Skin contact		X	
Eye contact		X	
Chemical characteristics:			
Corrosive			X
Ignitable	X (decon chemicals)		X (sediment/water/soil)
Reactive	X (acetone)		X (sediment/water/soil)
Volatile	X (decon chemicals)		X (sediment/water/soil)
Radioactive			X
Explosive			X
Biological agent			X
Particulates or fibers			X

If known or likely, describe: Acetone and hexane are volatile, and field personnel will stand upwind when using chemicals. These chemicals will not be used unless area is well ventilated.

Possible physical hazards present during site activities:

	Yes	No	Proposed Safety Procedure
Uneven terrain/tripping	X		Use caution, wear properly fitting shoes or boots, keep work area orderly
Heat stress	X		Follow heat stress SOP, attached
Cold/hypothermia		X	
Drowning	X		Wear personal flotation device when working over water that is greater than waist high
Falling objects		X	
Noise		X	
Excavations		X	
Heights		X	
Heavy equipment		X	

	Yes	No	Proposed Safety Procedure
Material handling	X		Lift properly, seek assistance if necessary; do not overfill coolers or boxes
Compressed air equipment		X	
Confined spaces		X	
Adverse weather	X		Seek shelter during electrical storms; work in adverse weather conditions only with proper training and equipment
Work in remote areas	X		Use buddy system, carry radio and/or cellular phone; bring sufficient equipment in case of accident or injury (first aid kit, shelter if appropriate)
Biohazard		X	
Plant/animal hazards	X		Know local hazards (e.g., snakes) and take appropriate precautions; avoid contact with potential biological materials (e.g., poison ivy or oak); wear gloves, boots, and coveralls, as appropriate; wash hands as soon as possible after contact and before eating or drinking
Other: Eletroshocking activities	X		Use caution and follow proper electroshocking procedures; review health and safety procedures in electroshocking SOP. Only trained staff will operate the electroshocking equipment.
Vessel operations	X		Review marine safety SOP

Note: If confined space entry is required, personnel must first obtain a confined space entry permit.

Potential physical hazards posed by proposed site activities:

Activity	Potential Hazard
Study area access	Uneven terrain, trips, falls, heat
Sample collection activities	Drowning, shock, exposure to adverse weather, work in remote area, plant/animal hazards, heat stress
Sampling handling/mobilization	Material handling

7. PERSONAL PROTECTIVE EQUIPMENT

Based on the hazards identified above, the following personal protective equipment will be required for the following site activities (specify both an initial level of protection and a more protective level of protection in the event conditions should change):

	Level of Protection	
	Initial	**Contingency**
Site inspection	D	MD
Surface water sampling	MD	leave site
Sediment sampling	MD	leave site
Floodplain soil sampling	MD	leave site
Fish sampling	D	MD
Sample handling	D	MD
Other activities (list)		

Each level of protection will incorporate the following equipment (specify type of coveralls, boots, gloves, respiratory cartridges or other protection, safety glasses, hard hat, and hearing protection):

Level D: [X] Long pants and shirt or work coveralls; nitrile gloves. Hard hat, eye, and hearing protection (if required for GM plant access). If the weather is hot, shorts may be worn under coveralls or during fish collection activities on the boat.

Modified D: [X] Same as Level D with addition of rain gear or Tyvek® and chemical resistant steel-toe boots or waders. Silver shield gloves will be used when handling decon solvents. Nitrile gloves will be used for all other activities.

Level C: [ ]

Level B: [ ]

Respirator/Respirator Cartridge Information

Is there potential for a respirator to be donned during fieldwork? No

If no, proceed to Section 8. If yes, the following section must be completed for each respirator/respirator cartridge combination that will be or potentially will be used during the course of the fieldwork. The Exponent Environmental Group health and safety manager can be contacted for resources to complete this section.

Respirator Manufacturer #1 NA

Respirator Cartridge Selected for Use NA

Respirator Cartridge Change Schedule NA

Justify the cartridge change schedule and present all data used to establish this schedule.

Respirator Manufacturer #2 NA

Respirator Cartridge Selected for Use NA

Respirator Cartridge Change Schedule NA

Justify the cartridge change schedule and present all data used to establish this schedule.

Note: Project personnel are not permitted to deviate from the specified levels of protection without the prior approval of the site safety officer or Exponent Environmental Group health and safety manager.

8. SAFETY EQUIPMENT

The following safety equipment will be onsite during the proposed field activities:

Air Monitoring (check the items required for this project)

- [ ] PID
- [ ] CG/O_2 meter
- [ ] H_2S meter
- [ ] Detector pump and tubes
- [ ] Air sampling pumps
- [ ] Miniram
- [ ] Radiation meter
- [ ] Other: _____

First Aid Kit (mandatory, including adhesive band-aids, gauze, tape, gloves, CPR shield, triangle bandage)
(check additional items required for the site)

- [X] Emergency blanket
- [X] Insect repellent
- [X] Sunscreen
- [X] Other: Snake bite kit

Other (check the items required for this project)

- [ ] Eyewash
- [X] Drinking water
- [X] Stopwatch for monitoring heart rate
- [X] Thermoscan thermometer for heat stress monitoring
- [ ] Survival kit
- [X] Personal flotation device
- [ ] Cool vests
- [ ] Fit test supplies
- [X] Fire extinguisher (boat)
- [ ] Windsock
- [X] Cellular phone
- [ ] Radio
- [X] Global positioning system
- [ ] Other: _____

9. SITE CONTROL

Describe location and designation of each zone:

Exclusion zone: The working area (i.e., the shore) and the land immediately surrounding the working area (e.g., within 5m) are the exclusion zone.

Contamination/reduction zone: This zone will be a designated area on or near the stream bank.

Support zone: Any other upland or upwind areas, as appropriate, outside of the specified exclusion zone or contamination reduction zone will be the support zone.

Describe controls to be used to prevent entry by unauthorized persons:

Public access to the study area will be limited to the individual property owners. However, if unauthorized personnel are encountered during the sampling event, they will be asked to take care not to impede the sampling activities.

10. AIR MONITORING

Air monitoring will be conducted when entering previously uncharacterized sites, when working in the vicinity of uncontaminated chemicals or spills, when opening containers and well casings, and prior to opening and entering confined spaces. Air monitoring must be conducted to identify potentially hazardous environments and determine reference or background concentrations. Air monitoring will be used to define exclusion zones. Air monitoring may also be conducted to evaluate the concentration of chemicals in samples.

The following equipment will be used to monitor air quality in the breathing zone during work activities:

Monitoring Instrument	Calibration Frequency	Parameters of Interest	Sampling Frequency
NA			

The following action levels have been established to determine the appropriate level of personal protection to be used during site investigation activities:

Instrument	Reading	Action[a]	Comments
NA			

[a] Examples: "upgrade to Level C" or "leave site."

11. DECONTAMINATION

To prevent the distribution of contaminants outside the exclusion zone or cross-contamination of samples, the following procedures will be used to decontaminate sampling equipment:

Sediment and floodplain soil must be brushed or washed off all equipment at the sample location using study area water. Equipment that cannot be thoroughly decontaminated and that comes into contact with potentially contaminated sediments will be washed and disposed of in accordance with proper waste handling procedures.

Sediment sampling equipment will be decontaminated using the following general sequence: site water or tap water rinse, Alconox® scrub using site or tap water, site water or tap water rinse, solvent rinse with acetone and hexane (respectively), and a final site water rinse. Equipment used for compositing the soil samples (i.e., stainless-steel bowls and spoons) for chemical analysis and toxicity testing will follow the same basic decontamination sequence except that the final rinse will be with distilled/deionized water.

To prevent the distribution of contaminants outside the exclusion zone and personal exposure to chemicals, vehicles will not be allowed inside the exclusion zone. If vehicles are required in the exclusion zone (e.g., drill rigs), the following procedures will be used to prevent contamination or decontaminate the vehicles:

No vehicles will be required in an exclusion zone. Chemicals and samples will be packaged in secure containers before placement in the field vehicle. All sampling equipment and personal protective equipment (e.g., rain gear, boots) will be decontaminated before placement in the field vehicle.

To minimize or prevent personal exposure to hazardous materials, all personnel working in the exclusion zone and contamination reduction zones will comply with the following decontamination procedures:

Sediment and floodplain soil will be brushed or washed off boots and personal protective clothing (e.g., rain gear, boots) at the sample location. Waders and work boots will not be worn in the hotel. At the end of the day, field personnel will shower promptly upon return to the hotel.

Decontamination equipment required on site will include the following:

Brushes, Alconox® buckets, garbage bags, foil, hexane, acetone, paper towels, plastic tubs, and distilled/deionized water. After gross cleaning, disposable protective clothing, if used, will be bagged up for disposal as solid waste.

Decontamination wastewater and contaminated materials will be disposed of in the following manner:

It is not anticipated that any wastewater will be created during these sample collection activities. Site water at each respective station will be used to rinse the equipment.

Any contaminated clothing and equipment that cannot be properly decontaminated will be contained in bags and disposed of as solid waste.

Excess solvent rinsates will be collected in a plastic tub and allowed to evaporate during the course of the decontamination activity. Any rinsates that have not evaporated by the end of the decontamination activity will be containerized and disposed of appropriately.

The following personal hygiene practices will be used:

- Long hair will be secured away from the face so it does not interfere with any activities.
- All personnel leaving potentially contaminated areas will wash their hands and faces prior to entering any clean areas or eating areas.
- Personnel leaving potentially contaminated areas will shower (including washing hair) and change to clean clothing as soon as possible after leaving the site.
- No person will eat, drink, or chew gum or tobacco in potentially contaminated areas. Drink containers and drinking of replacement fluids for heat stress control will be permitted only in areas that are free from contamination. Smoking is prohibited in all areas of the site because of the potential for contaminating samples and for health and safety reasons.

12. VEHICLE SAFETY

Exponent's vehicle safety program requires the following:

- All vehicles are to be operated in a safe manner and in compliance with statutory traffic regulations and ordinances
- Operators are to practice defensive driving and drive in a courteous manner
- Operators are required to have a valid driver's license and liability insurance (per local state laws)
- Seat belts are to be worn by the driver and all passengers
- No persons are allowed to ride in the back of any trucks or vans
- Vehicles are to be driven in conformance with local speed limits
- Personnel who are impaired by fatigue, illness, alcohol, illegal or prescription drugs, or who are otherwise physically unfit, are not allowed to drive
- Personnel are to avoid using cellular phones or engaging in other distractions while driving
- All Exponent-owned field vehicles are to be maintained in a safe and clean condition
- All Exponent-owned field vehicles are to be equipped with the following:
  - First-aid kit
  - Fire extinguisher
  - Flares
  - Spare tire and jack
  - Other equipment as required for the project (e.g., tire chains, towing cable, tools, cellular phone or radio)
- Motor vehicle accidents are to be reported to the responsible law enforcement agency, the Exponent Environmental Group risk manager, and the Exponent Environmental Group health and safety manager
- Employees who have experienced work-related vehicle accidents or citations may be required to complete a defensive driving program.

13. SPILL CONTAINMENT

Provisions must be made for spill containment at any site where bulk liquids will be handled.

Will the proposed fieldwork include the handling of bulk liquids, oil, or chemicals (other than water)? Yes _____ No X

If yes, describe spill containment provisions for the site: _____

14. SHIPMENT OF RESTRICTED ARTICLES

Federal laws and international guidelines place restrictions on what materials may be shipped by passenger and cargo aircraft. In the course of this field investigation, the following items will be shipped to and from the site in the following manner:

Item	Hazardous Constituent	Quantity	Packaging	How Shipped
Samples	Possibly low concentrations of PCBs		Samples will be in correct sample container (e.g., sample bottle or Ziploc™ bags); each sample will be placed in an individual Ziploc™ bag; and glass jars will be wrapped in bubble wrap. All samples will be secured in cooler to prevent breakage.	Overnight courier service (e.g., Federal Express) on ice at 4°C.
Solvents (name)	Acetone and hexane	1 gal each	Glass bottles protected against breakage in manufacturers' shipping containers or plastic bottle jackets	Solvents are shipped directly from the chemical manufacturer to the site. Any unused solvents will be stored under appropriate conditions and left at the site.
Calibration gas (name)	None			
Preservatives (name)	None			
Other:	None			

Exponent has arranged with CHEM-TEL to provide a 24-hour emergency contact number for all chemical shipments. CHEM-TEL can also provide advisory services (i.e., information on how to label, ship, and package chemicals). EXPONENT PERSONNEL MUST PROVIDE THE 24-HOUR EMERGENCY NUMBER TO THE SHIPPER.

For ANY shipment (air, rail, sea, or ground) within the United States, Canada, Puerto Rico, and the U.S. Virgin Islands that requires a 24-hour emergency response number (on ANY documents, such as Uniform Hazardous Waste Manifests, Shipper's Declaration of Dangerous Goods, etc.), the telephone number to use is 1-800-255-3924. ANY shipment outside the North American continent should reference "813-979-0626 (use the AT&T collect call operator)" on the document. Having international users call collect will ensure a bilingual operator is available to identify the call as an emergency. After accepting the call, if needed, CHEM-TEL will network with a translation service to prevent communication difficulties if the caller speaks a language other than English. On the shipping documents, please remember to indicate that the phone number specified is an emergency response contact number.

Before shipping chemicals (and listing the CHEM-TEL emergency number), Exponent personnel must fax the shipping document (manifest, declaration of dangerous goods, etc.) to CHEM-TEL informing them of the shipment. The fax number is 813-979-4620.

Regulatory advisory services are available from CHEM-TEL during business hours: 9 a.m. to 5:30 p.m. at 813-979-0626 (EST). This assistance can include determining the proper packaging, labeling, and shipping requirements for shipping hazardous substances.

15. MEDICAL MONITORING

OSHA requires medical monitoring for personnel potentially exposed to chemical hazards in concentrations in excess of the PEL for more than 30 days per year and for personnel who must use respiratory protection for more than 30 days per year. Exponent requires medical monitoring for all employees potentially exposed to chemical hazards.

Will personnel working at this site be enrolled in a medical monitoring program? Yes X No _____

16. HEALTH AND SAFETY TRAINING

State and federal laws establish training requirements for workers at uncontrolled hazardous waste sites (including areas where accumulations of hazardous waste create a threat to the health and safety of an individual, the environment, or both).

Exponent and subcontractor personnel will be required to complete the following training requirements:

Duties	No Special Training[a]	24-hour	40-hour	Supervisor	First Aid/CPR	Other
Exponent Personnel						
Steve Klein			X	X	X	
Sheryl Law			X			
Jo Salatas			X			
Subcontractors						
Brian Estes			X			
Cristin Corless			X			

[a] Provide explanation or justification: _____

17. SITE SAFETY MEETINGS

Site safety meetings must be held before beginning new tasks or when new staff enter a site. Site safety meetings should be held at a minimum of once a week and should be held daily on large projects. Attendance and topics covered must be documented.

18. FACILITY SAFETY PROCEDURES

The client or facility operators require that the following procedures be followed for all personnel at the site:

_____

19. EMERGENCY PLANNING

In case of fire, spill, or other emergency affecting the site, all affected personnel must immediately evacuate the work area and report to the site safety officer at a predetermined location. Field personnel must also immediately notify facility or community emergency response providers unless facility personnel have already initiated this notification.

Designated assembly point: Will be determined onsite, prior to initiation of field activities and will be communicated to personnel in the site-safety meeting.

In case of injury, field personnel should take precautions to protect the victim from further harm and notify local or facility emergency services. In remote areas, it will be necessary to have first aid-trained personnel on the field team. The victim may require decontamination prior to treatment—requirements will vary based on site conditions.

Emergency medical care will be provided by:

- [X] Local emergency medical provider (i.e., fire department)
- [ ] Facility emergency medical provider
- [ ] First aid-trained field staff (for remote areas only)

Local Resources	Name	Telephone	Notified Prior to Work (Yes/No)?
Fire	Bedford Fire Department	911	No
Police	Bedford Police Department	911	No
Ambulance	Bedford	911	No
Hospital	Dunn Memorial Hospital	(812) 275-3331	No
Site phone	GM/CRA project trailer	(812) 277-8960	Yes

Directions to hospital: Start SW on IN-58 (or 5th Street), then turn left onto Lincoln Avenue. Turn right on 12th Street, left on M Street, right on US-50, then right on 24th Street.

Corporate Resources	Name	Work Telephone	Home Telephone
Exponent Environmental Group health and safety manager	Larry Peterson	(303) 809-7887 (cell) (303) 444-7270	(303) 255-1787
Regional health and safety officer	Jane Sexton	(425) 643-9803	(206) 782-1754
Medical consultant	Dr. Jones/ Virginia Mason Clinic	(206) 242-3651	NA
CHEM-TEL	Emergency No. 1-800-979-0626		

In case of serious injuries, death, or other emergency, the Exponent Environmental Group health and safety manager must be notified immediately. To contact the Exponent Environmental Group health and safety manager (or delegate), try calling Larry Peterson at the work and home numbers listed above. If

no response, call the **emergency pager (888) 488-7204**. If no response, call Larry Marx at (425) 643-9803 or (425) 643-6019 or (360) 378-3778.

In case of accident or emergency the client or facility operators require that the following person be notified immediately: Cheryl Hiatt (248) 680-5219

Other Resources	Agency Name/Location	Telephone
Local OSHA office	Not applicable; contact state OSHA office	NA
State OSHA equivalent	Indiana Department of Labor/Indianapolis	(317) 232-2378

20. DOCUMENTATION

	Attached	In File	Not Applicable
Exponent site safety acknowledgment forms	X		
OSHA or equivalent state poster	X		
Site safety meeting minutes	X		
Exponent accident/incident report form	X		
Exponent heat stress monitoring form	X		
Exponent confined space entry permit			X
Exponent confined space entry checklist			X
Exponent air monitoring record			X
Exponent air sampling record			X
Exponent diving plan			X
Site map	X		
Work plan		X	
Material safety data sheets	X		
Hospital route	X		
Health and safety training records		X	
Heat stress standard operating procedure	X		
Confined space entry information			X
Equipment standard operating procedures:	X		
SOP 423 Safety during Marine Operations			
SOP 112 Fish Collection Procedures Using an Electroshocker			
Other:			

21. LIST OF ATTACHMENTS

Attachment 1. Site Map(s) and Hospital Route
Site Location and Route to Dunn Memorial Hospital

Attachment 2. Regulatory Notices and Health and Safety Training Records
OSHA Poster

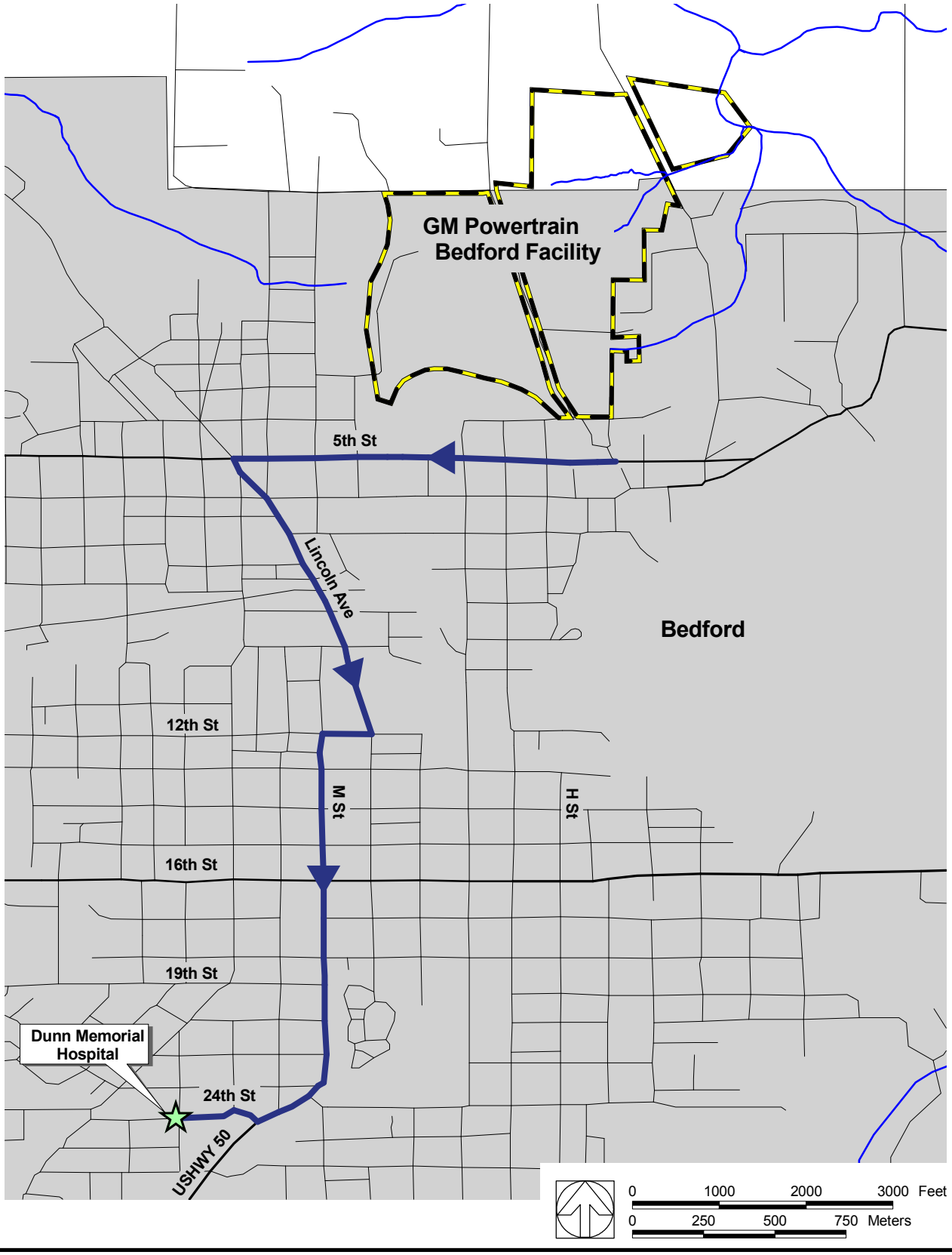
Attachment 3. Forms
Health and Safety Plan Consent Agreement
Site Safety Meeting Minutes
OSHA Onsite Training Documentation Form
Employee Accident, Injury, Incident, and/or Exposure Report

Attachment 4. Standard Operating Procedures
SOP 112. Fish Collection Procedures Using an Electroshocker
SOP 115. Fish Processing Procedures
SOP 420. Heat Stress Prevention and Monitoring
SOP 423. Safety During Marine Operations

Attachment 5. Material Safety Data Sheets
Acetone
Hexane

Attachment 1

Site Map(s) and Hospital Route



Site location and route to Dunn Memorial Hospital

Exponent®

Attachment 2

Regulatory Notices and Health and Safety Training Records

You Have a Right to a Safe and Healthful Workplace.

IT'S THE LAW!

- You have the right to notify your employer or OSHA about workplace hazards. You may ask OSHA to keep your name confidential.
- You have the right to request an OSHA inspection if you believe that there are unsafe and unhealthful conditions in your workplace. You or your representative may participate in the inspection.
- You can file a complaint with OSHA within 30 days of discrimination by your employer for making safety and health complaints or for exercising your rights under the *OSH Act*.
- You have a right to see OSHA citations issued to your employer. Your employer must post the citations at or near the place of the alleged violation.
- Your employer must correct workplace hazards by the date indicated on the citation and must certify that these hazards have been reduced or eliminated.
- You have the right to copies of your medical records or records of your exposure to toxic and harmful substances or conditions.
- Your employer must post this notice in your workplace.

The *Occupational Safety and Health Act of 1970 (OSH Act)*, P.L. 91-596, assures safe and healthful working conditions for working men and women throughout the Nation. The Occupational Safety and Health Administration, in the U.S. Department of Labor, has the primary responsibility for administering the *OSH Act*. The rights listed here may vary depending on the particular circumstances. To file a complaint, report an emergency, or seek OSHA advice, assistance, or products, call 1-800-321-OSHA or your nearest OSHA office: • Atlanta (404) 562-2300 • Boston (617) 565-9860 • Chicago (312) 353-2220 • Dallas (214) 767-4731 • Denver (303) 844-1600 • Kansas City (816) 426-5861 • New York (212) 337-2378 • Philadelphia (215) 861-4900 • San Francisco (415) 975-4310 • Seattle (206) 553-5930. Teletypewriter (TTY) number is 1-877-889-5627. To file a complaint online or obtain more information on OSHA federal and state programs, visit OSHA's website at **www.osha.gov**. If your workplace is in a state operating under an OSHA-approved plan, your employer must post the required state equivalent of this poster.

1-800-321-OSHA
www.osha.gov

U.S. Department of Labor • Occupational Safety and Health Administration • OSHA 3165

Attachment 3

Forms

Exponent™

HEALTH AND SAFETY PLAN CONSENT AGREEMENT

I have reviewed the health and safety plan prepared by _____, dated _____, for the _____ _____ site fieldwork. I understand the purpose of the plan, and I consent to adhere to its policies, procedures, and guidelines while an employee of Exponent or its subcontractors.

Employee signature	Firm	Date
Employee signature	Firm	Date
Employee signature	Firm	Date
Employee signature	Firm	Date
Employee signature	Firm	Date
Employee signature	Firm	Date
Employee signature	Firm	Date
Employee signature	Firm	Date

Exponent™

SITE SAFETY MEETING MINUTES

Site Name _____ Contract No. _____

Meeting Location _____

Meeting Date _____ Time _____ Conducted By _____

Pre-fieldwork Orientation ____ Weekly Site Meeting ____ Other _____

Subjects Discussed _____

Safety Officer Comments _____

Name and Signature of Participating Personnel (list company name if subcontractor)

Note: Attach additional pages if necessary. Send this form to the Exponent Environmental Group health and safety manager. Copies will be placed in the appropriate project files.

Exponent™

OSHA ONSITE TRAINING DOCUMENTATION FORM

After completion of the OSHA 40-hour training class, 29 CFR 1910.120 states that 3 days of onsite experience under the direct supervision of a trained, experienced supervisor are required to complete the OSHA HAZWOPER training requirements. This form is to be used to document this requirement, and shall be completed by a qualified supervisor (i.e., someone who has completed the 8-hour supervisory training class). Upon completion of this form, please submit it to the Exponent Environmental Group health and safety manager.

EMPLOYEE INFORMATION

Name _____

Signature _____

40-Hour Training Completion Date _____

Dates of Onsite Training _____

Name of Site _____

Type of Site _____

SUPERVISOR CERTIFICATION

Supervisor _____

Signature _____

Exponent™

Employee Accident, Injury, Incident and/or Exposure Report

Main portion of form to be completed by affected employee. Investigation and Follow-up Section to be completed by the regional or corporate H&S manager.

Affected employee:

Exponent office:

Date and time of injury, illness, or exposure:

Date reported to Exponent:

Person to whom incident was reported:

Date incident report completed:

Location where incident occurred:

Employee's supervisor:

Field team leader or supervisor at the time of the incident:

Was employee hospitalized:

How much time away from work (if any):

Date returned to work:

Work limitations or restrictions:

Worker's compensation claim filed:

OSHA or other regulatory action resulting:

Nature of incident (Check one and complete corresponding section):

- ❑ Incident (no injury)
- ❑ Accident or injury
- ❑ Potential exposure to chemicals
- ❑ Potential exposure to bloodborne pathogens
- ❑ Ergonomic injury
- ❑ Work related illness

Incident

Description of incident:

Injury

Description of accident:

Nature of injuries:

Medical treatment received:

Medical treatment provided by (doctor, EMS):

First Aid treatment received (describe):

First Aid treatment provided by (doctor, co-worker, EMS):

Weather (wind, precipitation, temp., other contributing factors):

Activities being performed:

Other injured parties (if any):

Witnesses

Precautions being taken or safety equipment in use at the time of the accident:

Property damage:

Potential Chemical Exposure

Description of exposure:

Source and concentration of exposure:

Signs or symptoms:

Duration of exposure:

Medical treatment received:

Activities being performed:

Precautions being taken at the time of exposure:

Witnesses:

Other people potentially exposed:

Potential Bloodborne Pathogen Exposure

Description of exposure:

Source of potential exposure (i.e., providing first aid, contact with discarded syringes or medical waste):

Duration of exposure:

Activities being performed:

Medical treatment received:

Had employee previously received Hepatitis B vaccine:

Precautions being taken at time of exposure:

Witnesses:

Other people potentially exposed:

Ergonomic Injury

Description of injury:

Signs or symptoms:

Description of work area:

Activities being performed:

Medical treatment received:

Ergonomic precautions that were being taken:

Work Related Illness

Name of illness:

Signs or symptoms:

Activities being performed:

Medical treatment received:

Other people affected:

Investigation and Recommended Follow Up

To be completed by the regional or corporate safety manager, then routed for approvals as listed.

Identified cause of injuries or exposure:

Safety procedures violated:

Regulatory agencies notified:

Disciplinary action required:

Recommendations to prevent recurrence:

Does unsafe condition remain:

What changes have been implemented:

Approvals/acknowledgments (signatures):

- Employee_____
- Supervisor_____
- Regional H&S officer_____
- Corporate H&S manager_____

Attachments (check all that apply):

- ❑ Medical report
- ❑ Health and safety plan
- ❑ OSHA citation or other regulatory report
- ❑ Other information, as appropriate (list)

Attachment 4

Standard Operating Procedures

Note: *SOP 115 cited within.*

Exponent™

SOP 112
FISH COLLECTION PROCEDURES WHILE USING AN ELECTROSHOCKER

This SOP discusses the sampling of fishes by use of an electrofishing device referred to as an "electroshocker." The procedures for processing fish captured by an electroshocker are described in SOP 115, *Fish Processing Procedures*.

SAMPLE COLLECTION WHILE USING AN ELECTROSHOCKER

An electroshocker is an active fish collection device that sends an electric current through the water, temporarily stunning or directing the movements of fish. Stunned fish are collected by using a dip net. Because an electric current is generated during sampling, several precautions must be taken when using an electroshocker to avoid being electrocuted. Electroshocking should not be conducted without knowledge of the safety procedures described below. All equipment should be maintained and operated according to the manufacturer's instructions.

Basic procedures for using electroshockers are described below. One of four general electroshocker configurations can be used for fish collections. A backpack-mounted electroshocker is used in shallow streams where wading is safe. A pram shocker is used when wading in small and medium-sized shallow streams. The pram is a small barge-mounted electrofishing unit that allows one or more fish collectors to work simultaneously without the encumbrance of backpack-mounted units. A bankside shocker offers alternative sampling flexibility in that it can be stationed along an embankment and deployed throughout small or medium-size streams by the use of handheld electrodes with extended conductor cables. Pram and bankside shockers offer more power output than backpack shockers and, as such, potentially pose higher risks. A boat electroshocker is used along shorelines of deeper or open waters where wading is not possible or safe.

Safety Precautions

Electrofishing is hazardous work. The following safety precautions must be taken when using an electroshocker:

1. Never electrofish alone. The buddy system must always be enforced.
2. Ensure that all persons in the sampling crew wear proper sampling attire.
3. Ensure that all members of an electrofishing crew understand the system they are using and the risks involved. Before a field operation begins, new crew

members should receive orientation on equipment and procedures. At least one member of the electrofishing crew must have CPR and first aid training.

4. Ensure that people, livestock, or pets are not in the water either upstream or downstream from the sampling site.
5. Do not use the electroshocker during an electrical storm or periods of heavy rainfall.
6. Limit the number of sampling crew to maximize safety through increased freedom of movement on deck or in the stream and to reduce confusion.
7. Make sure that the person-in-charge has ultimate control of the power source.
8. Never reach into the water with hands or feet for any reason while the electrosystem is operating..
9. Turn off the electroshocker immediately if a person falls into the water. All sampling crew must know how to turn off the electroshocker.
10. When electroshocking in streams, proceed upstream at a slow pace. Do not chase the fish.
11. With the exception of standard shoreline fish community surveys, do not shock constantly; it is preferable to shock for a few seconds, stop shocking while continuing to move, and then begin shocking again.

Equipment Required

Equipment required for collecting samples with an electroshocker consists of the following:

- Electroshocker unit (backpack, pram, bankside, boat)
- Hip boots or chest waders (if wading)
- Rubber gloves
- Personal floatation device
- Dip nets
- Buckets.

Operating the Electroshocker

The electroshocker will be used to collect fish samples as follows:

1. Mark off the stream segment to be sampled, if applicable to the needs of the study.
2. Set up the electroshocking equipment according to the manufacturer's instructions. Each electroshocker configuration has unique set-up procedures.
3. Have all members of the sampling crew put on appropriate attire (e.g., gloves, chest waders, etc.).
4. Designate one person as the operator of the electroshocker (i.e., the "shocker").
5. Adjust the voltage and ampere settings to the appropriate levels for the conductivity and velocity of the water that will be sampled and the size range of the target fish. This decision is deferred to the experienced operator.
6. If so equipped, adjust the setting for the electroshocker timer to zero before each electroshocking effort to document "on-time" electrofishing effort.
7. Have the crew members that will collect the shocked fish (i.e., the "dip-netters") stand by with dip nets.
8. If sampling a small stream, have all sampling crew members enter the water at the downstream end of the survey stream segment.
9. In small streams, have the crew face upstream while the "shocker" begins moving the anode through the water by extending it in an upstream direction and then pulling it away from fish cover or back in a downstream direction. At the same time, have the "dip-netters" position themselves slightly downstream on either side of the "shocker" to capture the shocked fish and transfer them to collection buckets.
10. Have the sampling crew proceed in an upstream direction while electrofishing available fish micro-habitats until the end of the sampling segment is reached or until a pre-determined sampling time is expended. If electroshocking from a boat, the dip netters will position themselves at the handrail on the bow, from which point they can safely net the stunned fish.
11. Where quantitative fish data is not required, sample distances and times may be limited only by the needs of the survey.
12. When the end of the sampling segment is reached, record the number of electroshocker seconds elapsed during sampling plus the number of fish collected during that period.

13. Process the fish according to study design specifications and the procedures described in SOP 115, *Fish Processing Procedures*.

14. If replicate stream segments will be sampled, repeat Steps 1–13 for each replicate.

REFERENCES AND OTHER SOURCES

Coffelt Electronics. 1976. Instruction manual for the variable voltage pulsator backpack electroshocker. Coffelt Electronics Company, Inc., Englewood, CO.

Reynolds, J.B. 1983. Electrofishing. pp. 147–163. In: Fisheries Techniques. L.A. Nielsen and D.L. Johnson (eds). Publication of the American Fisheries Society, Bethesda, MD.

Smith-Root, Inc. 1995. Electrofishing Safety. Smith-Root Incorporated. Vancouver, WA.

Exponent™

SOP 115
FISH PROCESSING PROCEDURES

This SOP discusses the procedures for making biological measurements of individual fish and for resecting fillets from individual fish for analysis of chemical concentrations in edible muscle tissue.

BIOLOGICAL MEASUREMENTS/OBSERVATIONS

The biological measurements and observations commonly made of individual fish include length, weight, gender, reproductive condition, presence or absence of physical anomalies, parasites, or disease, and age using scales or hard body parts.

Equipment Required

Equipment required for making biological measurements and resecting fish fillets consists of the following:

- Measuring board
- Analytical balance
- Stainless-steel filleting knife
- Skinning pliers (if needed for removing catfish skins)
- Blunt-point forceps
- Fish scale-remover ("scaler")
- Fillet board
- Microprojector
- Coin envelopes
- Aluminum foil
- Ziploc® bags
- Disposable nitrile gloves
- Alconox®

- Hexane
- Methanol
- Collection buckets.

Length and Weight Measurements and Other Observations

Length and weight measurements should be made on unpreserved fish as soon as possible after collection. Preservation techniques such as freezing and fixation with formalin and ethanol can alter length and weight measurements relative to the values that would be found for unpreserved individuals immediately after capture. The procedure described below for measuring length addresses total length (i.e., the distance from the most anterior part of the fish to the tip of the longest caudal fin ray):

1. Examine each fish for signs of physical anomalies, disease, or external parasites. Examples of physical anomalies include eroded fins, missing eyes, scoliosis or other body or mouth deformities, and skin lesions. Examples of disease symptoms include hemorrhagic sores, skin fungi, or grossly undernourished body condition. Examples of external parasites include attached leeches or worms, or cysts embedded in the skin or fin membranes. Detailed observations should be noted on appropriate data sheets for each fish examined. Note the location of the anomalies (i.e., caudal fin, left mandible).
2. Place each fish on the measuring board, with its head touching the wall of the board and its side resting along the ruler of the board. Do not squeeze the head of the fish against the wall of the board.
3. Push the caudal fin together, and record the measurement for the longest part of the fin to the specified accuracy (e.g., the nearest 1.0 mm).
4. Place the balance tray on the analytical balance, and press TARE. Wait for a reading of 0.0 g.
5. Place the fish in the balance tray.
6. Allow the weight reading to stabilize, and record the weight to the specified accuracy (e.g., 1.0 g).

Fish Filleting Procedures

Fish are commonly filleted to resect edible muscle tissue for analysis of chemical concentrations. The filleting process is the same one used by fishermen to remove edible muscle tissue from fish. The results of the chemical analyses are therefore directly related to the

tissue that is frequently consumed by humans. Filleting should occur after length and weight measurements and other observations have been recorded for each fish, as follows:

1. Decontaminate all filleting equipment (filleting knife, scaler, fillet board) with Alconox®, methanol, and hexane, in sequence. After the hexane rinse, allow the equipment to air dry.
2. Cover the cutting board with a piece of aluminum foil, dull side facing up.
3. Place each fish on its side on the fillet board.
4. Remove all scales from the caudal fin to the head. Do not remove the skin from fish that are commonly eaten with the skin attached to the fillet. For species that are commonly skinned before eating (e.g., catfish), remove the skin from the entire fish by cutting the skin around the head and peeling it off with pliers.
5. Make a cut along the ventral midline of the fish from the vent to the base of the jaw.
6. Make a diagonal cut from the base of the cranium, following just behind the gill to the ventral side just behind the pectoral fin.
7. Remove the flesh and rib cage from each side of the fish by cutting from the cranium along the spine and dorsal fin to the caudal fin. Leave the ribs attached to the main fillet. When removing the fillet, it is common to leave the fatty "belly" meat on the fish carcass. Consult specific project study plans regarding inclusion of belly meat or rib bones with the fillet portions because this procedural requirement may vary among agencies.
8. Wrap the fillets in aluminum foil with the dull side facing the tissue.
9. Label the wrapped sample according to job-specific study plan instructions.
10. Place the labeled, wrapped sample in a labeled Ziploc® bag, and preserve as indicated in the project-specific study plan.

Determination of Gender and Reproductive State

Gender and reproductive state will be determined as follows:

1. After filleting each fish, examine the gonads, and determine whether they are ovaries or testes. Record the gender of the fish.

2. Identify the reproductive state of the gonads according to the following scale:

   - **Stage I—**Ovaries are wine-colored and shaped like torpedoes, and no eggs are visible; testes are small, flat, whitish in color, and cling closely to the spine.

   - **Stage II—**Ovaries resemble those in Stage I, except that small black (but color may vary) eggs are visible to the naked eye; testes are swollen and milky in appearance.

   - **Stage III—**Ovaries are somewhat swollen and yellowish in color; testes are large, lobed, and freely emit a milky liquid.

   - **Stage IV—**Ovaries are greatly swollen, their texture resembles tapioca, and the largest eggs are transparent and more than 1 mm in diameter; testes are slack and contain an abundance of connective tissue.

   - **Stage V—**Ovaries are slack and contain only a matrix and a few residual eggs.

Age Determination

The age of fish is commonly determined by counting the number of annual check marks (i.e., annuli) on hard structures such as scales, spines, otoliths, vertebrae, and opercular bones. The procedures described below are based on the use of scales for age determination. If otoliths, opercular bones, or vertebrae are required for age analysis, follow procedures specified in Nielsen et al. (1983) or as otherwise indicated in the project-specific work plan.

1. Only personnel experienced in the process of fish-scale age determinations should be assigned to this task. At least one experienced peer should validate age determinations.

2. Before collecting scales for age determinations, remove mucous, dirt, and epidermis from the area by gently wiping the side of the fish in the direction of the tail with a blunt-edged knife.

3. Remove about 20 scales from the left side of each fish from areas suitable for the particular species being aged. Consult standardized methods manuals or experienced fisheries workers to obtain this information. Removal must be done carefully. Blunt forceps or a knife tip may be very useful for this task. Be careful not to break the margins of the scales or scratch the surfaces. Scales that are broken or irregularly shaped should be discarded.

4. Transfer fish scales to a labeled coin envelope for later age determination. For bullheads and catfishes, remove the dorsal spine for age determination instead of the scales. If otoliths, opercular bones, or vertebrae are required

for age analysis, follow procedures specified in Nielson et al. (1983) or as otherwise indicated in the project-specific work plan.

5. A scale sample number should be included on the coin envelope for each fish sampled. The sample number should cross reference vital data for each fish including information such as species, length, weight, sex, date, location, and project number.

6. Scales should be inspected and cleaned before mounting them for microscopic viewing. If mucus, skin pigments, or dirt is present on the scale, soak them in water for about two hours, and scrub off any remaining deposits with a small brush or piece of cloth after the soaking period. Retain the best 5 to 10 scales for mounting and viewing.

7. Mount the viewing scales between two microscope slides, making sure that the scales do not overlap.

8. Project the mounted scales with a microprojector (microfiche reader) and identify the scale(s) that have a complete set of rings emanating outward from their center. The microprojector should provide an enlarged image to about 50 times the natural size of the scale.

9. The number of annual rings (annuli) on each scale are counted. Each "true" annulus represents one year of growth. Care must be taken not to misinterpret "false" annuli, "split" annuli, checks, crowded annuli, or accessory rings. An important consideration for aging fish via scale marks is to understand the time of annulus formation which can vary with latitude, spawning, migration, and feeding habits of the sampled fish population as well as with environmental data and water temperature range.

10. Scale and age data are recorded on a Scale Analysis Summary Sheet (Attachment 115-1). The scale analyst must sign and date the sample control sheet.

REFERENCES AND OTHER SOURCES

Nielson, L.A., D.L. Johnson, and S.S Lampton. 1983. Fisheries techniques. American Fisheries Society, Bethesda, MD.

NYSDEC. Fish preparation procedures for contaminant analysis. New York State Department of Environmental Conservation, Albany, NY.

ATTACHMENT 115-1

Scale Analysis Summary Sheet

Exponent™

Scale Analysis Summary Sheet

Project Name:_____

Project Number:_____

Water Body:_____

Sample No.	Date Collected	Location	Species	Length (mm)	Weight (g)	Sex	Age	Remark

Analyst:_____ Date:_____

Witness:_____ Date:_____

STANDARD OPERATING PROCEDURE

HEAT STRESS PREVENTION AND MONITORING
SOP 420

INTRODUCTION

Heat stress poses a serious threat to the health of workers conducting hazardous material or chemical investigations at industrial and other facilities. This threat is increased for workers wearing chemical protective clothing or personal protective equipment (PPE) because the impermeable clothing does not allow sweat to evaporate and cool the body. Depending on ambient conditions, the work being performed, and other factors, heat stress may affect workers at temperatures as low as 70°F (adjusted for humidity and sunlight; see *Monitoring for Heat Stress*, below) and can occur rapidly, with workers suffering acute symptoms in less than 15 minutes. Even relatively minor symptoms of heat stress can result in impaired functional ability, threatening the safety of the worker and his or her companions. Thus, heat stress can present as great a health risk to workers as chemical hazards or traditional physical hazards such as falling objects and confined spaces. This SOP presents information on heat-related illnesses, factors that influence heat stress, monitoring for heat stress, and heat stress prevention.

HEAT-RELATED ILLNESSES

A common factor in heat-related illnesses is the failure of the worker to recognize the symptoms of heat stress. All personnel should become familiar with the symptoms of heat stress and appropriate first aid precautionary measures.

Table 420-1 provides information on the types of heat-related disorders and procedures for treating them. Heat stress can result in minor symptoms such as heat rash, heat cramps, discomfort, and drowsiness. Prolonged heat stress can result in more severe effects, such as heat exhaustion and heat stroke. Heat rash is a relatively minor form of early heat stress that results from prolonged contact with wet clothing. Heat rash can be prevented by allowing the skin to dry completely during rest periods and by showering as soon as possible at the end of the work day. Although heat cramps and drowsiness are generally of minor concern, these symptoms may also result in impaired functional ability, which in turn may threaten the safety of the individual and coworkers.

Heat cramps, heat syncope, heat exhaustion, and heat stroke all result from excessive loss of body fluids and electrolytes. The symptom of heat cramps is spasms in the abdomen or

TABLE 420-1. HEAT DISORDERS

Disorder	Cause	Signs	Treatment
Heat rash	Heavy sweating, drinking large volumes of water without replacing salt loss	Profuse tiny raised vesicles, prickly skin	Remove from source of heat; allow skin to dry completely during rest periods; shower as soon as possible after work day
Heat syncope	Lack of acclimatization, pooling of blood in the legs	Fainting while standing, immobile in heat	Remove to cooler area
Heat cramps	Heavy sweating, drinking large volumes of water without replacing salt loss	Painful spasms of muscles used during work; cool, moist skin	Provide fluids that replace salts and protein; allow 1–3 days of rest, depending on the severity of the attack
Heat exhaustion	Sustained exertion in heat, lack of acclimatization, failure to replace water and/or salt	Fatigue, nausea, headache, moist and clammy skin, pale complexion, delirium, diarrhea, cramps	Remove to cooler area; provide cool water and salted fruit or protein drinks
Heat stroke	Sustained exertion in heat, excessive exposure to heat, lack of physical fitness, alcoholism and drug abuse, dehydration, cardiovascular disease	Headache; rapid pulse; dizziness; nausea; confusion; convulsions; flushed, dry skin; high body temperature; loss of consciousness; coma	Call emergency medical services (often 911) immediately; place the worker in a cool, shady area; remove their clothing, then sprinkle their entire body with cool water; also cool by fanning; treat for shock

limbs. Heat syncope is a pooling of blood in the lower extremities, which may result in fainting when the worker stands up suddenly or has been immobile. Heat exhaustion, caused by more severe dehydration, has the following symptoms: pale, clammy skin; profuse sweating; weakness; headache; and nausea. Heat stroke (sometimes called sunstroke) is a life-threatening condition that occurs when the body's temperature-regulating system no longer functions properly. Heat stroke requires immediate medical attention. Symptoms of heat stroke include hot, dry skin; a high fever (often 106°F or more); dizziness; nausea; rapid pulse; and unconsciousness. Brain damage and death may follow if the body temperature is not reduced.

Workers must learn to recognize that dizziness, nausea, headaches, skin rashes, muscle cramps, and pale or clammy skin are symptoms of heat stress and act promptly when suffering these symptoms. Workers may not realize the risk they face by ignoring these symptoms and staying in the work area until overcome by heat stress or suffer other injuries of heat stress-related impairment. Critical factors in the prevention of heat stress include a proper work regimen and the intake of adequate replacement fluids and electrolytes.

FACTORS INFLUENCING HEAT STRESS

Many factors determine an individual's susceptibility to heat stress. Environmental factors include the ambient temperature, humidity, and presence or absence of cooling breezes or shade. The nature of the work being performed, including the level of physical activity, the degree of permeability and the number of layers of protective clothing, and the time of day that the work is being performed affects the level of heat stress.

Some workers are predisposed towards suffering heat stress. Factors that could increase a worker's susceptibility to heat stress include degree of physical fitness, lack of acclimatization, age, dehydration, obesity, alcohol and drug use, infection, sunburn, diarrhea, and chronic disease.

Workers who have acclimated to working in hot climates or in PPE will be less likely to suffer heat stress. Acclimated individuals typically have lower heart rates and body temperatures than nonacclimated workers. Acclimated workers also sweat sooner and more profusely than those not acclimated to high temperatures or the use of PPE (acclimated individuals may sweat more profusely when wearing PPE than nonacclimated workers, thus increasing their risk of dehydration). The National Institute of Occupational Safety and Health (NIOSH) recommends a progressive 6-day regimen to allow a worker to acclimate to work in a hot environment, especially when wearing PPE (this program begins with 50-percent exposure, then lengthens the staying time by 10 percent each subsequent day). A individual's capacity to work in hot environments generally decreases with age. According to NIOSH, however, an older person in peak physical condition may have a greater work capacity than a less fit, younger worker. Thus, physical fitness is a more significant factor than age when determining an individual's work capacity.

Weight is usually a significant factor when determining the ability of an individual to work in a heated environment because overweight people have a lower surface area to mass ratio and, thus, can not dissipate heat as well as slimmer people. Weight is not as significant a factor when wearing PPE, as the impermeable garments impede the dissipation of body heat regardless of the individual's weight.

MONITORING FOR HEAT STRESS

To ensure the safety of workers wearing impermeable or semipermeable encapsulating PPE, NIOSH recommends that heat stress monitoring be implemented at temperatures above 70°F, using an "adjusted temperature." The adjusted temperature is calculated by determining the ambient temperature (using a standard thermometer, shielded from heat) and adding the total of 13 × the percentage of sunshine (complete overcast = 0 percent sunshine and no cloud cover = 100 percent sunshine). For example, for an ambient temperature of 80°F and 80 percent sunshine, the adjusted temperature would be 90.4°F (80+[13×0.80]=90.4). The effect of heat stress on the body may be monitored using the techniques described below. Recommended intervals for physiological monitoring when wearing permeable or impermeable work clothes are shown in Table 420-2.

Heart Rate

To monitor the effect of heat stress on the worker using the heart rate method, the worker must measure his or her heart rate over a 30-second period as soon as possible at the beginning of each rest break. The pulse should be taken at the radial (wrist) artery, not the carotid (neck) artery. When monitoring heart rate, the following guidelines apply:

- If the worker's heart rate does not exceed 110 beats/minute, proceed as before
- If the worker's heart rate exceeds 110 beats/minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same
- If the worker's heart rate exceeds 110 beats/minute at the beginning of the next rest period, shorten the next work cycle by another one-third.

Exponent recommends the use of heart rate monitoring as the minimum heat stress monitoring technique.

TABLE 420-2. SUGGESTED FREQUENCY OF PHYSIOLOGICAL MONITORING FOR FIT AND ACCLIMATIZED WORKERS[a]

Adjusted Air Temperature[b]	Normal Work Ensemble[c]	Impermeable Ensemble
90°F or above (32.2°C)	After each 45 minutes of work	After each 15 minutes of work
87.5°–90°F (30.8°–32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5°–87.5°F (28.1°–30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5°–82.5°F (25.3°–28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5°–77.5°F (22.5°–25.3°C)	After each 150 minutes of work	After each 120 minutes of work

Source: NIOSH (1985).

[a] For work level of 250 kilocalories/hour (moderate work activity).

[b] Calculate the adjusted air temperature (ta adj) by using this equation: ta adj °F = ta °F + (13 × percent sunshine). Measure air temperature (ta) with a standard, mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent of time the sun is not covered by clouds that are thick enough to produce a shadow (100 percent sunshine = no cloud cover and sharp, distinct shadows; 0 percent sunshine = no shadows).

[c] A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

Oral Temperature

To monitor the effect of heat stress on the worker using the oral temperature method, the worker should use a clinical thermometer (3 minutes under the tongue) at the end of each work period, but before taking a drink. When monitoring oral temperature, the following guidelines apply:

- If the oral temperature does not exceed 99.6°F, no action is needed
- If the oral temperature exceeds 99.6°F at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same
- If the oral temperature exceeds 99.6°F at the beginning of the next rest period, shorten the following work period by one-third
- If the oral temperature exceeds 100.6°F at the beginning of any rest period, the worker should not be permitted to wear impermeable clothing.

Body Water Loss

To monitor the effect of heat stress on workers by measuring body water loss, the workers must weigh themselves with a scale accurate to within 0.25 lb at the beginning and end of each work day. Their weight for the beginning and the end of the work shift should be taken while wearing similar clothing or, for greatest accuracy, when nude. Fluctuations in weight (between the beginning of the shift and end of the shift) indicate the gain or loss of body fluids, thus revealing if fluid replenishment has been effective. Body weight loss in a work day should not exceed 1.5 percent of total body weight. Where such weight losses occur, more attention should be given to fluid replacement during subsequent work shifts.

Electronic Monitors

Electronic monitors that constantly monitor a worker's heart rate and core temperature have recently been developed. These devices utilize sensors that are held in place on the worker's chest with an elastic band and are programmed to account for the worker's age and type of protective clothing. The worker's heart rate and core temperature are monitored, and lights illuminate on a small pad (worn on the outside of the PPE) to indicate one of the following conditions: the worker may continue as before, the worker has only a limited amount of work time left, or the worker should exit the work area immediately. These devices also include audible alarms and can be set to download heat stress data to a printer at the end of a shift.

Other electronic monitors are designed to measure adjusted (ambient) temperatures and can be programmed to account for the level of worker activity and type of protective clothing. These devices can calculate stay times (the amount of time the workers in the area may remain in that area at the current activity levels) and can also log conditions encountered. These devices do not actually monitor the effects of heat stress on the workers, but may be used to implement heat stress prevention measures.

HEAT STRESS PREVENTION

Several means are available to decrease or prevent the effects of heat stress.

An effective means of preventing heat stress is to schedule work in the cool parts of day—early mornings, evenings, or at night. If the heat source is mechanical (e.g., caused by a power plant or production equipment), it may be possible to schedule the work during hours when the facility is inoperative.

Engineering methods may be used to cool workers regardless of the time of day. These methods frequently involve the use of cool vests (ice packs worn under PPE in a special vest), circulating air (often associated with powered air-purifying respirators that utilize hoods rather than sealed facepieces), or in extreme cases, circulating liquids through specially designed suits. Other engineering controls to prevent heat stress include erecting a shelter to protect workers from direct sunlight or the circulation of air through the workplace. In some instances, deluge showers can be constructed within the exclusion zone or in the decontamination area that allow workers wearing fully encapsulating PPE to stand under a shower of cold water. The deluge shower is an efficient means of providing relief to the worker without requiring the worker to proceed through decontamination and exit from the work area.

A critical element in an effective heat stress prevention program is to ensure that workers maintain a normal level of fluids within their bodies. To prevent heat-related illness, the worker's intake of fluids must approximate the amount of fluid lost (e.g., the worker must drink 8 oz of water for every 8 oz decrease in body weight). The sensation of thirst is not a reliable indicator of fluid loss. When heavy sweating occurs, it is essential that workers increase their fluid intake. The following guidelines may be useful:

- Provide fluid replenishment beverages at the work site, cooled to 50–60°F (appropriate beverages include water and diluted fruit juices or Gatorade®)
- Have workers drink 16 oz of fluid prior to working in a hot environment
- Encourage workers to drink 8–16 oz of liquids every 15–20 minutes, or at each rest break. NIOSH recommends that workers consume a total of 1–1.5 gal of fluids/day, although a greater quantity may be required.

Scheduling rest periods to break up work periods is essential to prevent heat-related illnesses. It is difficult to establish a rigid schedule that spells out the staying time and rest breaks based on temperature alone because other factors, such as the level of physical activity and the type of protective equipment, play a significant role in determining an individual's susceptibility to heat stress. The recommended course of action is to use the guidelines for physiological monitoring provided in Table 420-2 to schedule the initial work period, then vary the length of the break and the next work period based on the physiological responses of individual workers to the work load. If the workers are engaged in strenuous activities, are not acclimated to the work environment, or are not in peak physical condition, the work interval should be shortened significantly, and monitoring continued.

INDIVIDUAL RESPONSIBILITIES

In preventing heat stress, it is essential that the individual monitor his or her own symptoms and promptly take steps to remedy any signs of heat stress. Such steps include notifying coworkers of his or her condition and taking whatever measures may be necessary to alleviate the symptoms by taking a break, increasing the intake of fluids, instituting environmental controls (such as the use of cool vests or circulating air), assuming less strenuous duties, or implementing appropriate first-aid procedures as indicated in Table 420-1. No field monitoring program can substitute for the individual's sense of their own health and physical limits.

REFERENCES

NIOSH. 1985. Occupational safety and health guidance manual for hazardous waste site activities. Prepared by the National Institute for Occupational Safety and Health, Occupational Safety and Health Administration, U.S. Coast Guard, and U.S. Environmental Protection Agency. U.S. Department of Human and Health Services, Public Health Service, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Washington, DC.

STANDARD OPERATING PROCEDURE
SAFETY DURING MARINE OPERATIONS
SOP 423

INTRODUCTION

Contractor field projects often require the collection of biological, sediment, and water samples from vessels. In addition to the physical and chemical hazards associated with all field sampling, there are special hazards associated with vessels. This SOP provides guidance for ensuring the safety of contractor and subcontractor personnel when working on the water. These procedures address inland or protected waters only. Additional procedures are required for working on vessels offshore.

TRAINING

Appropriate training is essential for preventing accidents and ensuring the proper completion of all field duties. The following training requirements apply to all field work conducted on the water:

All contractor and subcontractor personnel must participate in an initial safety briefing prior to beginning the field work, whenever new personnel come aboard, and when conditions or tasks change.

- If the field project is conducted at a designated hazardous materials site or there is any potential for chemical exposure, then all contractor and subcontractor personnel must have the appropriate 40-hour hazardous waste operations training and current 8-hour annual refresher training. Supervisors must have completed the 8-hour supervisors training course.
- The field team leader, or site safety officer must have current first aid and cardiopulmonary resuscitation (CPR) training.
- The vessel operator must demonstrate proficiency in the operation of that type of vessel and knowledge of marine safety and navigation rules. Personnel without prior experience will be required to complete training in these subjects.

REQUIRED SAFETY EQUIPMENT

To prevent accidents and ensure adequate preparation for any emergencies that may arise, it is the responsibility of the project manager to secure appropriate safety equipment for the duration of the project. This equipment must include the following:

- **Personal Flotation Devices (PFDs)—**There must be one PFD for every person onboard the vessel, plus an additional throwable flotation device for vessels over 16 ft in length.
- **Fire Extinguisher—**Requirements for fire extinguishers vary based on the vessel length and whether the vessel has inboard engines or closed compartments. Fire extinguishers are recommended for all motorized vessels. Additional information regarding requirements for fire extinguishers can be obtained from the U.S. Coast Guard.
- **First-Aid Kit—**A first-aid kit must be provided during all field projects. The contents of the first-aid kit will vary based on the number of persons present, but at a minimum should include a variety of bandages and compresses, disinfectant, gloves, a CPR shield, eyewash, and an emergency blanket. Additional information regarding requirements for first-aid kits can be obtained from the applicable federal or state department responsible for occupational safety and health.
- **Marine Radio with Weather Channel—**A VHF radio is required by law on commercial vessels and is recommended for all work on open waters. The frequency and call sign of local emergency services must be posted on the vessel and be included in the site health and safety plan.
- **Cellular Telephone—**If a two-way VHF marine radio is not available then a cellular telephone must be onboard.
- **Horn or Bell—**U.S. Coast Guard regulations require a signaling device be onboard all vessels longer than 36 ft and require that all vessels, regardless of length, be capable of making audible signals during certain events (i.e., approaching or overtaking other vessels).
- **Navigation Lights—**The requirements for navigation lights vary based on the length and type of vessel. All vessels operated at night must have the appropriate navigation lights.
- **Oars or Paddles—**Small power boats should be equipped with alternate means of propulsion.

- **Anchor and Suitable Line—**In most cases, vessels should be equipped with one (or two) anchors and sufficient anchor line for expected water depths and bottom conditions.
- **Flares—**A flare kit should be onboard all field vessels.
- **Reach Pole or Shepherd's Hook—**On larger vessels, a reach pole or shepherd's hook must be available to facilitate rescue of any persons who fall overboard.
- **Other Rescue Gear—**On larger vessels, a block and tackle or other means must be available to pull a person from the water.

HAZARDS AND PREVENTION

There are many physical hazards associated with working onboard a vessel. Potential hazards and appropriate precautions are listed below:

- **Slips/Trips/Falls—**The combination of a moving vessel and wet or slippery decks increases the potential for slips, trips, or falls. These can be prevented by increasing your awareness of the surroundings, keeping one hand free for handholds and support, keeping the deck and working areas clear of unnecessary obstacles or hazards, and wearing nonskid boots or shoes.
- **Drowning—**Even the best swimmer can drown if caught unprepared, tired, or weighted down with bulky clothing and boots. Drowning can be prevented by taking precautions against falling overboard (avoid reaching over the side, beware of slips/trips/falls, avoid ondeck work in heavy seas) and by wearing a PFD. PFDs should be worn underneath chemical protective clothing such as Tyvek® coveralls (thus allowing the wearer to remove the coveralls without first removing the PFD) and should be properly secured or buckled.
- **Crushing/Falling Objects—**The use of hoists to lift coring tools and other equipment could result in crushing or other injuries to field workers. These injuries can be avoided by using properly adjusted and maintained hoists, allowing only experienced personnel to operate the hoist, keeping all personnel out of the way during lifting and hoisting, and wearing hardhats to protect against head injuries or bumps.
- **Gear Deployment and Retrieval—**The deployment and retrieval of sampling gear presents a hazard because of the weight of the gear, its suspension over the deck, and the risk of entanglement or accidental and premature release or closure. Setting the triggering mechanism must always be performed when the equipment is resting on a stable

surface. During sample retrieval, at least one crew member is required to watch for the appearance of the sampling gear and alert the winch operator. Failure to observe the sampling gear and stop the winch could lead to breakage of the cable, loss of the sampling gear, and possible injury from either the falling gear or the end of the broken cable. All nonessential personnel should stay clear of the work area during the retrieval and deployment of sampling gear. All personnel should be knowledgeable in the proper hand signals for guiding the winch operator.

- **Cables—**After repeated use, stainless steel cables may fray or break. Sampling personnel must never take ahold of the moving cable unless they are wearing work gloves. Periodically during the sampling event, the site safety officer should inspect the cable for wear, especially where the wire or cable is attached to the sampling equipment.

- **Climate—**Depending on the climate, field personnel may suffer from hypothermia, dehydration, or heat stress. Climate-related illnesses and injuries can be prevented by dressing appropriately for the expected climate and by having additional clothing onboard should personnel get wet or the weather change suddenly. When working in cold, wet weather, appropriate clothing may include raingear, wool, and modern synthetics. Cotton clothing should only be worn during warm, dry weather. In addition, fluid replenishment beverages (to protect against heat stress and dehydration) or warm beverages (to protect against hypothermia) should be available during field work.

- **Unsecured Gear—**Wherever possible, all ondeck sampling and safety gear should be secured to a deck, rail, or bulkhead to prevent loss from unexpected movement caused by wind or waves.

- **Hatches—**All personnel should be alerted to the presence of an open hatch and hatches should not be left open unnecessarily.

- **Chemical and Sample Storage—**To prevent fire, health hazards, or sample contamination, all field chemicals such as solvents and formalin should be stored on deck, not in the cabin, hold, or near samples.

EMERGENCY PROCEDURES

In case of a boating-related injury or fatality, field personnel must:

- Notify emergency medical or rescue personnel immediately (as appropriate). The U.S. Coast Guard emergency frequency is VHF Channel 16.

- Notify the site safety officer, the appropriate project manager, and the corporate health and safety officer immediately. The project manager and corporate health and safety officer will coordinate notifications to the Occupational Safety and Health Administration and the U.S. Coast Guard.

In case of boating-related property damage exceeding $200, field personnel must:

- Notify police or other legal jurisdiction (as appropriate).
- Notify the site safety officer, the appropriate project manager, and the corporate health and safety officer within 48 hours of the incident. The project manager and corporate health and safety officer will coordinate notification of the U.S. Coast Guard.
- Notify the business operations manager to initiate insurance claims.

Attachment 5

Material Safety Data Sheets

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS | J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

ACETONE

MSDS Number: A0446 --- *Effective Date: 04/10/01*

1. Product Identification

Synonyms: Dimethylketone; 2-propanone; dimethylketal
CAS No.: 67-64-1
Molecular Weight: 58.08
Chemical Formula: (CH3)2CO
Product Codes:
J.T. Baker: 5356, 5580, 5805, 9001, 9002, 9003, 9004, 9005, 9006, 9007, 9008, 9009, 9010, 9015, 9036, 9125, 9254, 9271, A134, V655
Mallinckrodt: 0018, 2432, 2435, 2437, 2438, 2440, 2443, 2445, 2850, H451, H580, H981

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Acetone	67-64-1	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 4 - Extreme (Flammable)
Reactivity Rating: 2 - Moderate
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache. Higher concentrations can produce central nervous system depression, narcosis, and unconsciousness.
Ingestion:
Swallowing small amounts is not likely to produce harmful effects. Ingestion of larger amounts may produce abdominal pain, nausea and vomiting. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms are expected to parallel inhalation.
Skin Contact:
Irritating due to defatting action on skin. Causes redness, pain, drying and cracking of the skin.
Eye Contact:
Vapors are irritating to the eyes. Splashes may cause severe irritation, with stinging, tearing, redness and pain.
Chronic Exposure:
Prolonged or repeated skin contact may produce severe irritation or dermatitis.
Aggravation of Pre-existing Conditions:

Use of alcoholic beverages enhances toxic effects. Exposure may increase the toxic potential of chlorinated hydrocarbons, such as chloroform, trichloroethane.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention.

---

5. Fire Fighting Measures

Fire:
Flash point: -20C (-4F) CC
Autoignition temperature: 465C (869F)
Flammable limits in air % by volume:
lel: 2.5; uel: 12.8
Extremely Flammable Liquid and Vapor! Vapor may cause flash fire.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Vapors can flow along surfaces to distant ignition source and flash back. Contact with strong oxidizers may cause fire. Sealed containers may rupture when heated. This material may produce a floating fire hazard. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, alcohol foam or carbon dioxide. Water may be ineffective. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB(R) solvent adsorbent is recommended for spills of this product.

---

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Acetone:
-OSHA Permissible Exposure Limit (PEL):
1000 ppm (TWA)

-ACGIH Threshold Limit Value (TLV):
500 ppm (TWA), 750 ppm (STEL) A4 - not classifiable as a human carcinogen

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a half-face organic vapor respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Clear, colorless, volatile liquid.

Odor:
Fragrant, mint-like

Solubility:
Miscible in all proportions in water.

Specific Gravity:
0.79 @ 20C/4C

pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
56.5C (133F) @ 760 mm Hg
Melting Point:
-95C (-139F)
Vapor Density (Air=1):
2.0
Vapor Pressure (mm Hg):
400 @ 39.5C (104F)
Evaporation Rate (BuAc=1):
ca. 7.7

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Concentrated nitric and sulfuric acid mixtures, oxidizing materials, chloroform, alkalis, chlorine compounds, acids, potassium t-butoxide.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

---

11. Toxicological Information

Oral rat LD50: 5800 mg/kg; Inhalation rat LC50: 50,100mg/m3; Irritation eye rabbit, Standard Draize, 20 mg severe; investigated as a tumorigen, mutagen, reproductive effector.

```
  --------\Cancer Lists\----------------------------------------------
-------
                                          ---NTP Carcinogen---
  Ingredient                              Known    Anticipated    IARC
Category
```

Acetone (67-64-1)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material is expected to readily biodegrade. When released to water, this material is expected to quickly evaporate. This material has a log octanol-water partition coefficient of less than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material may be moderately degraded by photolysis. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition.
Environmental Toxicity:
This material is not expected to be toxic to aquatic life. The LC50/96-hour values for fish are over 100 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: ACETONE
Hazard Class: 3
UN/NA: UN1090

Packing Group: II
Information reported for product/size: 350LB

International (Water, I.M.O.)

Proper Shipping Name: ACETONE
Hazard Class: 3.1
UN/NA: UN1090
Packing Group: II
Information reported for product/size: 350LB

---

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Acetone (67-64-1)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Acetone (67-64-1)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Acetone (67-64-1)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	TSCA- 8(d)
Acetone (67-64-1)	5000	U002	No

```
Chemical Weapons Convention:  No     TSCA 12(b):  Yes    CDTA:  Yes
SARA 311/312:  Acute: Yes      Chronic: No   Fire: Yes Pressure: No
Reactivity: No          (Pure / Liquid)
```

Australian Hazchem Code: 2[Y]E
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.
Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.
Label First Aid:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
No changes.
Disclaimer:
****

****

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

****
****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

HEXANE

MSDS Number: H2381 --- *Effective Date: 04/15/99*

1. Product Identification

Synonyms: Hexanes,Normal Hexane; Hexyl Hydride; Hexane 95%
CAS No.: 110-54-3 (n-hexane)
Molecular Weight: 86.18
Chemical Formula: CH3(CH2)4CH3 n-hexane
Product Codes: 9262, 9304, 9308, N168

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hexane	110-54-3	85 - 100%	Yes
Methylcyclopentane	96-37-7	1 - 2%	Yes
Trace amount of Benzene (10 ppm)	071-43-2	*	No

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 0 - None
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

The health hazards addressed are for the major component: n-hexane.

Inhalation:
Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Greater exposure may cause muscle weakness, numbness of the extremities, unconsciousness and death.
Ingestion:
May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.
Skin Contact:
May cause redness, irritation, with dryness, cracking.
Eye Contact:
Vapors may cause irritation. Splashes may cause redness and pain.
Chronic Exposure:
Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Chronic inhalation may cause peripheral nerve disorders and central nervous system effects.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired

respiratory function may be more susceptible to the effects of the substance. May affect the developing fetus.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Remove any contaminated clothing. Wipe off excess from skin. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
BEI=2,5-hexadione in urine, sample at end of shift at workweeks end, 5 mg/g creatine. Also, measure n-hexane in expired air. Analgesics may be necessary for pain management, there is no specific antidote. Monitor arterial blood gases in cases of severe aspiration.

---

5. Fire Fighting Measures

Fire:
Flash point: -23C (-9F) CC
Autoignition temperature: 224C (435F)
Flammable limits in air % by volume:
lel: 1.2; uel: 7.7
Extremely Flammable Liquid and Vapor! Vapor may cause flash fire. Dangerous fire hazard when exposed to heat or flame.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with oxidizing materials may cause extremely violent combustion.Explodes when mixed @ 28C with dinitrogen tetraoxide. Sensitive to static discharge.
Fire Extinguishing Media:

Dry chemical, foam or carbon dioxide. Water may be ineffective.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water spray may be used to keep fire exposed containers cool. Vapors can flow along surfaces to distant ignition source and flash back. Vapor explosion hazard exists indoors, outdoors, or in sewers.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB(R) solvent adsorbent is recommended for spills of this product.

---

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from direct sunlight and any area where the fire hazard may be acute. Store in tightly closed containers (preferably under nitrogen atmosphere). Outside or detached storage is preferred. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
N-Hexane [110-54-3]:
-OSHA Permissible Exposure Limit (PEL): 500 ppm (TWA)
-ACGIH Threshold Limit Value (TLV): 50 ppm (TWA), Skin
other isomers of hexane
-ACGIH Threshold Limit Value (TLV): 500 ppm (TWA),1000ppm (STEL)

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. This substance has poor warning properties.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.

Odor:
Light odor.

Solubility:
Insoluble in water.

Specific Gravity:
0.66

pH:
No information found.

% Volatiles by volume @ 21C (70F):

100
Boiling Point:
ca. 68C (ca. 154F)
Melting Point:
ca. -95C (ca. -139F)
Vapor Density (Air=1):
3.0
Vapor Pressure (mm Hg):
130 @ 20C (68F)
Evaporation Rate (BuAc=1):
9

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Heat will contribute to instability.
Hazardous Decomposition Products:
May produce acrid smoke and irritating fumes when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizers.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

---

11. Toxicological Information

N-Hexane: Oral rat LD50: 28710 mg/kg. Irritation eye rabbit: 10 mg mild. Investigated as a tumorigen, mutagen and reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Hexane (110-54-3)	No	No	None

Methylcyclopentane (96-37-7)	No	No	None	
Trace amount of Benzene (071-43-2)	10 ppm	Yes	No	1

12. Ecological Information

Environmental Fate:
When released into the soil, this material may biodegrade to a moderate extent. When released into the soil, this material is not expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. This material has an estimated bioconcentration factor (BCF) of less than 100. This material has a log octanol-water partition coefficient of greater than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208

Packing Group: II
Information reported for product/size: 215L

International (Water, I.M.O.)

Proper Shipping Name: HEXANES
Hazard Class: 3.1
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 215L

---

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Hexane (110-54-3)	Yes	Yes	Yes	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
Trace amount of Benzene (10 ppm) (071-43-2)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

		--Canada--		
Ingredient	Korea	DSL	NDSL	Phil.
Hexane (110-54-3)	Yes	Yes	No	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
Trace amount of Benzene (10 ppm) (071-43-2)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

	-SARA 302-		------SARA 313------	
Ingredient	RQ	TPQ	List	Chemical Catg.
Hexane (110-54-3)	No	No	Yes	No

```
  Methylcyclopentane (96-37-7)               No    No      No
No
  Trace amount of Benzene  (10 ppm)          No    No      Yes
No
  (071-43-2)

  --------\Federal, State & International Regulations - Part 2\--------
--------
                                                          -RCRA-    -
TSCA-
  Ingredient                                 CERCLA     261.33     8(d)
  -----------------------------------------  ------     ------    -----
-
  Hexane (110-54-3)                          5000       No         No
  Methylcyclopentane (96-37-7)               No         No         No
  Trace amount of Benzene  (10 ppm)          10         U019       No
  (071-43-2)


Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: Yes Pressure: No
Reactivity: No          (Mixture / Liquid)
```

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: 3[Y]E
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.
Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.

Avoid breathing vapor or mist.
Avoid contact with eyes, skin and clothing.

Label First Aid:

Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. In all cases call a physician.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 8.

Disclaimer:

****
****

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

****
****

Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

Appendix E

Indiana DNR Game Fish List

Indiana's Size and Bag Limits

SPECIES	DAILY BAG LIMIT	MINIMUM SIZE
Bluegill	None	None
Redear Sunfish	25	None
***Black Bass (in lakes) ***Black Bass (in rivers)	5 singly or in aggregate*	14 inches (exceptions) 12 inches
***Black Bass (in Lake Michigan)	3 singly or in aggregate*	14 inches
Yellow Bass	None	None
White Bass, Hybrid Striped Bass	12 singly or in aggregate*, no more than two fish may exceed 17 inches	no more than two fish may exceed 17 inches
Striped Bass	2	None
Rock Bass	25	None
Crappie	25	None
Walleye, Walleye-Sauger Hybrid, Sauger	6 singly or in aggregate*	14 inches (exceptions) None
Muskellunge and Tiger Muskellunge	1 singly	36 inches
Northern Pike	3	20 inches
Yellow Perch None	(**15 on Lake Michigan only)	None
Catfish: Channel, Blue, Flathead (in streams)	None	10 inches
Catfish: Channel, Blue, Flathead (in lakes and reservoirs)	10	None
Bullhead Catfish	None	None

* Singly or in aggregate means that the daily bag limit includes any combination of the species.
** Lake Michigan is closed for the commercial harvest of perch. The daily bag limit for sport fishing on Lake Michigan is 15.
*** Black bass include largemouth, smallmouth and spotted bass.

Source: http://www.in.gov/dnr/fishwild/fishng/general.htm.

Attachment 1. Fish species observed on August 8, 2001

Species	Number	Percent Abundance
Bailey's Branch, in pool approx. 20 m upstream of Broomsage Road		
Method: Electroshocking		
Blacknose dace	24	55.8
Orangethroated darter	6	14.0
Creek chub	5	11.6
Central stoneroller	5	11.6
Johnny darter	2	4.7
Green sunfish	1	2.3
Total Number	43	100.0
Total Species	6	
Mt. Pleasant Road, bedrock pool approx. 100 m downstream of bridge		
Method: Electroshocking		
Central stoneroller	81	53.6
Blacknose dace	15	9.9
Johnny darter	14	9.3
Orangethroat darter	14	9.3
Stripped shiner	7	4.6
Common shiner	5	3.3
Notropis sp.	5	3.3
Bluegill	3	2.0
Creek chub	3	2.0
Creek chubsucker	1	0.7
Green sunfish	1	0.7
Pimephales sp.	1	0.7
White sucker	1	0.7
Fantail darter	0	0.0
Total Number	151	100.0
Total Species	14	
Peerless Road at Murdock railroad trestle		
Method: Seined at three separate locations		
Creek chub	19	23.2
Notropis sp.	18	22.0
Striped shiner	9	11.0
Common shiner	8	9.8
Central stoneroller	7	8.5
Northern hogsucker	6	7.3
Orangethroat darter	3	3.7
Bluegill	2	2.4
Johnny darter	2	2.4
Esox sp. (juvenile)	2	2.4
Blacknose dace	1	1.2
Silverjaw minnow	1	1.2
Longear sunfish	1	1.2
Pimephales sp.	1	1.2
Pugnose minnow	1	1.2
White sucker	1	1.2
Total Number	82	100.0
Total Species	18	
Peerless Road Bridge, channel adjacent to Peerless Road approx. 30 m from bridge		
Method: Seined at three separate locations		
Bluegill	14	42.4
Creek chub	8	24.2
Longear sunfish	5	15.2
Blacknose dace	4	12.1
Johnny darter	1	3.0
Green sunfish	1	3.0
Total Number	33	100.0
Total Species	6	