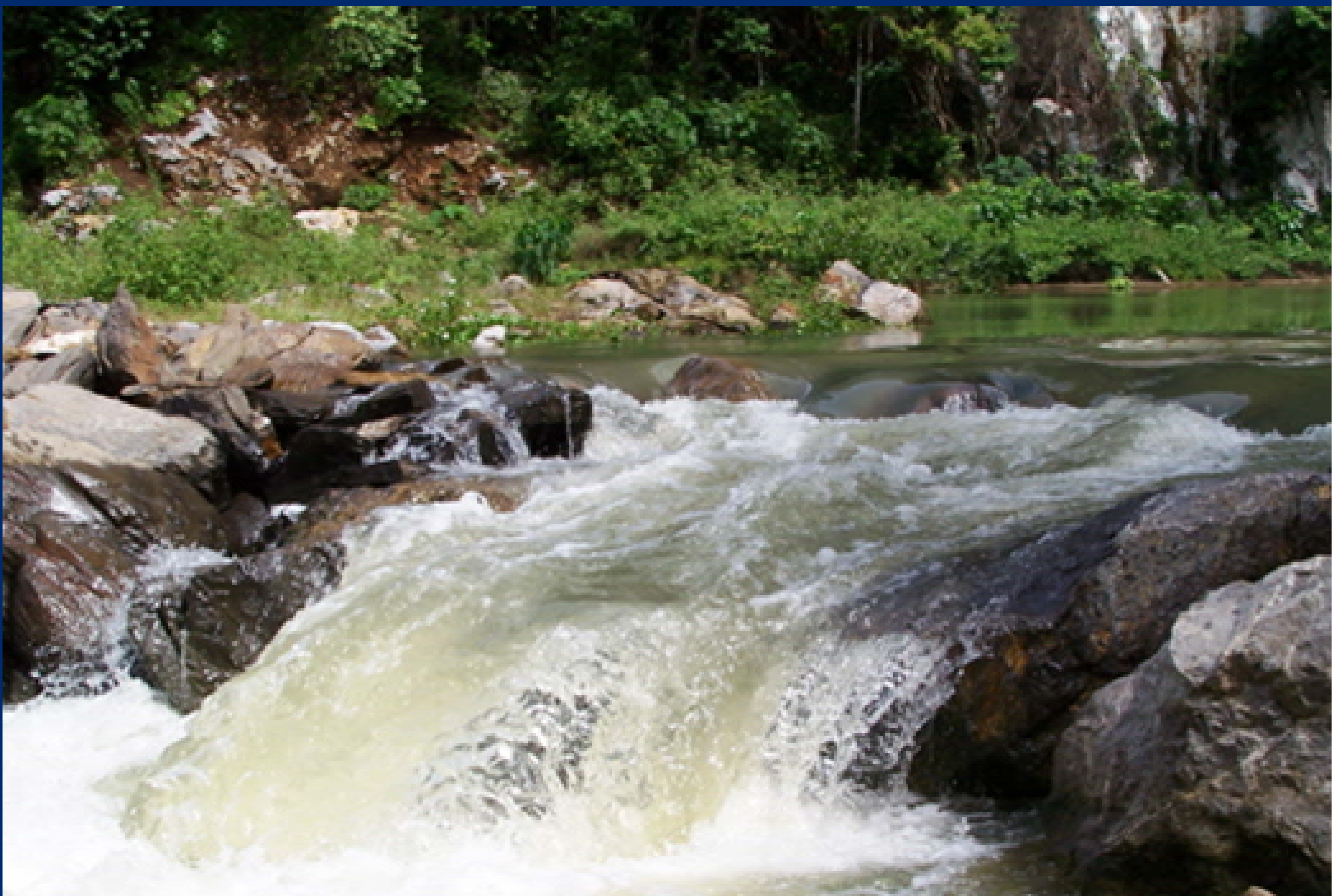
SAMPLING AND ANALYSIS PLAN FOR GROUNDWATER AND SURFACE WATER SAMPLING IN KRUENG ACEH BASIN



DECEMBER, 2005

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Photo credit: ESP Banda Aceh/Nanggroe Aceh Darussalam.

A water steam on Lhoknga Village, Aceh Besar District located at N 05^0 27’38.1” and E 95^0 15’ 41.3 “.

SAMPLING AND ANALYSIS PLAN FOR GROUNDWATER AND SURFACE WATER SAMPLING IN KRUENG ACEH BASIN

Title:	**Sampling and Analysis Plan for Groundwater and Surface Water Sampling in Krueng Aceh Basin**
Program, activity, or project number:	**Environmental Services Program, DAI Project Number: 5300201.**
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EXECUTIVE SUMMARY

The Krueng Aceh basin drains the area lying between the northern end of the Bukit Barisan range and the volcanic slopes of Gunung Seulawah. The lower parts of the main basin are characterized by low annual rainfall (< 2000 mm) rising to only 3000 mm in the upper catchment area. The catchment area is 1780 km^2 with the river having a total length of 113 km. The width of the river varies from 51 m upstream to 57 m at midstream to 60 m at it's mouth with an average slope of 0.0044 m/m. Approximately 602 million cubic meters of water a year are available. The Krueng Aceh Valley is underlain by unconsolidated to semi-consolidated deposits of Quaternary Age. It is believed that these deposits form aquifers which are capable of supplying amble amounts of water of good quality for farms and villages.

Figure 1 Krueng Aceh Gauging Station

This report presents a "Sampling and Analysis Plan" (SAP) for a proposed water quality monitoring program for the Krueng Aceh in Nanggroe Aceh Darussalam Province, Indonesia. This plan is based on the findings of a preliminary assessment of the Krueng Aceh hydrochemical characteristics. This program was based on the fact that little is understood about the impacts of irrigation and pollution sources in the Krueng Aceh. The objective of this report is to provide background information on surface water and groundwater in the Krueng Aceh Basin; to provide the results of a field parameter (pH, temperature, and specific conductivity) survey of the Krueng Aceh performed by the ESP team as well as to summarize the results of a pollution survey for the entire Krueng Aceh Basin, and to present a "Sampling and Analysis Plan" for the Krueng Aceh.

For this assessment, the following approach was taken:

1. A literature survey was completed;
2. Over a two-day period (22 and 23, November 2005), a four person team consisting of Phillip Brown, Asep Mulyana, Edison, and Ivan completed a field parameter survey of the Krueng Aceh.
3. A pollution study conducted by MAPAYAH and PeNA was reviewed and summarized.

4. A "Sampling and Analysis Plan" was developed for the proposed sampling effort.
5. A "Field Sampling Manual" was also prepared to ensure that samples are taken consistently with analytical procedures..

On the 22nd and 23rd of November 2005, an ESP team conducted a field water quality survey of the Krueng Aceh and several of its tributaries. The survey consisted of using field instruments to measure pH, specific conductance (conductivity or EC), temperature, and making field notes from the upper portions of the Krueng Aceh watershed to it's mouth. Field parameters were measured at a total of 24 sites. The results of this survey are summarized below:

Specific Conductance: This is a measurement of the electroconductivity of water and an indicator of the concentration of total dissolved solids. Overall the Krueng Aceh waters appear to be of good quality with low specific conductance and total dissolved solids. Water samples ranged between 70 µS/cm at the head waters of Krueng Inong which the water source for the town of Jantho in the southwest corner of the basin to 550 µS/cm on the Krueng Agam just before it enters the Krueng Aceh. A Specific Conductance measured at the headwaters of the Krueng Agam was 140 µS/cm. Along the main stem of the Krueng Aceh (Point 17) to Peunayong Bridge (Point 25), specific conductance gradually increased from 230 µS/cm to 330 µS/cm. Using a factor of 0.66 to convert specific conductance to total dissolved solids, all samples were acceptable for WHO drinking water recommendations for palatability. However, there may be sources of water high in total dissolved solids in the Krueng Agam from either natural or man made sources and theses sources should be investigated.

pH: pH ranges from 0 to 14 with a pH value of 7 indicating a neutral solution. A pH less than 7 indicates an acid solution and pH greater than 7 indicates an alkaline solution. The current drinking water standard for pH in Indonesia is a range of pH standard values between 6.5 and 8.5 std. units. The pH for the Krueng Aceh ranged between 7.6 and 8.2. These high values are within the Indonesian Standards. The high values indicate the influence of mineralization for limestone and volcanic bedrock draining into the Krueng Aceh river system.

Temperature: Temperature is very important and influences both pH and specific conductance readings. It is also an indicator of pollution. Polluted discharges either increase or decrease temperatures in water bodies. Extreme charges in temperature along a reach of a river is an indicator that a discharge of other waters may be occurring. These waters could be a groundwater discharge in the form of a spring, the inflow of a tributary or a pollution source. There are no standards for temperature for drinking water in Indonesia. For the Krueng Aceh system, waters ranged between 22.6°C in the headwaters of Krueng Inong to 27.2 °C for the Krueng Agam just before it enters the Krueng Aceh. From Point 17 to Point 26, the main stem of the Krueng Aceh ranges from 25.6 °C at Point 17 to 26.8 °C at Point 25 (Peunayong Bridge). Higher temperatures with higher conductivities in the Krueng Agam and at the Peunayong Bridge deserve a closer look otherwise the changes in temperature are in general within a few degrees.

In October, 2005, two NGOs - Masyaraka Penyanang Alam dan Lingkungan Hidup (MAPAYAH) and Peduli Nanggroe Atjeh (PeNA) conducted a survey of pollutions sources in the Krueng Aceh basin. The results of this survey are presented in Table 4-2 and indicate that sources included areas of high sediment yield due to deforestation, solid waste dumps, sand and gravel operations and non-point sources from agriculture. Each of these has the potential to contaminate surface water and groundwater resources. However, due to the limited number of parameters the extent of contamination from these sources cannot be determined at this time. It is felt that detailed analysis of water samples taken from the sampling locations selected during the preliminary investigation would give an indication of the impacts of these sources on the overall water quality of the basin.

From the results of these surveys, a detailed "Sampling and Analysis Plan" was developed and presented in the report. This plan presented sample locations, sampling methodologies, and field procedures to be used during the initial survey. It was also recognized that this plan could be modified based on field conditions.

APPENDICES

APPENDIX A
FIELD MANUAL FOR THE COLLECTION OF WATER SAMPLES

APPENDIX B
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APPENDIX A – FIELD MANUAL FOR THE COLLECTION OF WATER SAMPLES

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1. INTRODUCTION

This manual is intended to be guide for field operations as well as one that could be used for training personnel. This manual is divided into four parts which are described as follows:

1. Preparation for the field.
2. Field Parameter Measurement
3. Sample Collection
4. Quality control and quality assurance

As procedures are modified or if field equipment changes, this manual should be updated accordingly.

2. PREPARATION FOR THE FIELD

Preparation for the field is one of the most important processes in sampling. If done correctly, it can save time and money. Prior to going to the field, it is important that you are trained, you have the necessary information for the project, you have the tools to do the job, and the field equipment is calibrated and working properly. In preparation for the field the following items should be packed and ready to go. All the following procedures may not be necessary for each sampling event. Use those procedures applicable to your sampling plan or customize this list.

2.1. LOGISTICS

- Arrange for site access.
- Arrange transportation

2.2. SITE HISTORY

Review past water quality data and earlier work done at the site.

2.3. EQUIPMENT AND FIELD PREPARATION

Review the PA and QA/QC plan.
Organize equipment

Check that equipment is in good working condition:
1. Test and recharge/replace batteries as necessary.
2. Test the equipment with tap water or calibration standards.
3. Inspect the equipment for defects, loose bolts, frayed wiring, etc.
4. Check the instruments' ability to calibrate and function properly.
5. Check that all equipment is properly decontaminated and stored for transport.

2.4. SITE INFORMATION

1. Directions to the site and site access roads/site access keys
2. Contact names, addresses and phone numbers
3. Site map showing sampling locations
4. Calculator and/or purge volume conversion tables

2.5. DOCUMENTATION AND REFERENCE MATERIALS

1. *Sampling Field Manual*
2. Sampling and analysis plan (SAP) and QA/QC plan
3. Specific Field Sheet and Field Procedures Documentation sheet
4. Field note book and waterproof pens
5. Clipboard with waterproof cover
6. Chain of custody forms and other sample tracking forms
7. Camera and film

2.6. SAMPLING EQUIPMENT

1. Plastic sheet or equivalent ground cover
2. Sample bottles, thief, isokinetic sampler or other sampler and accessories (inert material)
3. Sampling pump and accessories (inert material)
4. Cable or rope (no cotton or cloth) and tripod
5. Calibrated buckets
6. Waterproof grease markers or pens (Sharpies™ are a potential source of VOCs)
7. Sample containers (provided by lab) - **bring extra,** and water proof labels/tags
8. QA/QC sample bottles
9. Sample transfer containers and wide mouth funnel
10. Filtering apparatus and all accessories
11. Filter membranes (0.45 micron) and pre-filters, or
12. Disposable in-line filters

2.7. FIELD MEASUREMENTS AND EQUIPMENT

1. Thermometer or temperature instrument
2. Conductivity meter and calibration standards (KCl)
3. pH meter, buffer solutions (pH 4, 7 and 10) and beakers
4. Dissolved oxygen meter and membrane replacement kit and/or Eh meter
5. Turbidity meter
6. All meters fully charged and operational; spare batteries
7. Closed flow through cell
8. Squirt bottles filled with reagent grade water

2.8. DECONTAMINATION EQUIPMENT

1. Non-phosphate cleaner and scrub brushes
2. Wash and rinse tubs or buckets and wastewater containers
3. Laboratory reagent grade water (two gallons is usually sufficient)
4. Clean containers to transport equipment

2.9. SAMPLE PRESERVATION AND SHIPPING

1. Sample preservatives, transfer pipettes and pH paper
2. Coolers sufficiently large to hold all samples, including QA/QC samples
3. Crushed or cubed ice (frozen cold packs discouraged, need temp. blank)
4. Bubble wrap, Ziplock™ bags or equivalent to protect sample containers

2.10. TOOLS AND MISCELLANEOUS

1. Adjustable wrench, screw drivers, hammer, scissors, knife, duct tape, etc.
2. Plastic garbage bags for contaminated waste
3. Bailer retrieval device (e.g., weighted hook)
4. Drum bung wrench and racket socket set (typ. 15/16" socket for 55 gallon drums)

2.11. PERSONAL PROTECTIVE EQUIPMENT

1. Safety glasses and/or splash shield
2. Mask
3. Overalls

4. Inner and outer gloves (compatible for contaminants)
5. Hard hat and steel toed boots
6. Air monitoring equipment
7. First aid kit and eye wash kit

3. FIELD PARAMETER MEASUREMENT

Prior to filtration and filling of sample bottles, the raw water should be measured for field parameters such as conductivity, temperature, pH, turbidity, redox potential and dissolved oxygen. Field analysis could be complete using a variety of field instruments which are designed specifically for taking field measurements. Operating instructions and calibration procedures for these instruments should be review and studied prior to going into the field. Follow the manufacturer's instructions for your instrument and familiarize yourself with the methodology in the most recent version of Standard Methods for the Examination of Water and Wastewater.

The following presents general instructions for use of these meters in the field.

Take in-field measurements immediately, or less preferably, within 30 minutes of collection. Avoid exposing instruments and samples to extreme heat or cold. Specific conductance, pH, dissolved oxygen and Eh can change rapidly due to aeration, oxidation and the loss or gain of dissolved gasses as you remove the water sample from the river or stream. Minimize atmospheric contact with the sample.

3.1. TEMPERATURE

1. Place the thermometer or probe into a closed flow-through cell or sample bottle and allow the purge water to continuously flow past the thermometer or probe. If you use a sample bottle, allow the water to overflow while measuring temperature.
2. Allow the thermometer or probe to equilibrate with the water for a minute or more, then record the temperature. Do not remove the thermometer or probe from the water when taking the reading.
3. Decontaminate the thermometer or probe and store properly.

3.2. SPECIFIC CONDUCTANCE (CONDUCTIVITY AND ELECTRIC CONDUCTANCE)

Measure specific conductance before pH (unless using a flow-through cell). In addition, as specific conductance is a temperature sensitive measurement, adjust readings to 25° C.

1. Calibrate the conductivity instrument and probe against a standard potassium chloride (KCl) solution. Do this in the field, or less preferably, in the laboratory. Calibrate the instrument according to the manufacturer's instructions. Recalibrate at least daily; more often is recommended and prudent. Record calibration data.
2. If required, set the instrument to the anticipated range for measurement (e.g., x100 mhos/cm (mS/cm)).
3. If your instrument automatically compensates for temperature, record the measurement as "field specific conductance at 25° C." Don't forget to multiply the measurement by the range at which the instrument is set.
4. If your instrument does not automatically compensate for temperature, measure the temperature of the sample and set the instrument's temperature dial to the sample temperature. Record the measurement as the "field specific conductance at 25° C." Don't forget to multiply the measurement by the range at which the instrument is set.
5. If your instrument cannot compensate for temperature, apply a correction factor as specified in the manufacturer's instructions or by using the following formula:

   specific conductance @ 25oC = sample conductivity (mhos/cm)
   1 + 0.0191 x (sample temp. in °C - 25)

   Note: Conductivity meters that do not automatically correct readings to 25° C usually include a conversion table or chart for correcting data to 25° C.
6. Decontaminate the electrode and store properly.
   Note: Most problems related to collecting poor conductivity data include: weak batteries; fouling of the electrode (chemical cleaning may be necessary); insufficient submersion of the probe into the sample; allowing the probe to touch the container walls; improper or no instrument calibration; not allowing the probe to equalize with the sample temperature; and improperly or not converting readings to 25° C.

3.3. PH

1. Calibrate the pH instrument with pH buffer solutions that span the range of expected water sample pH values. Two fresh pH buffer solutions (7.00 and 4.00 or 7.00 and 10.00) having temperatures within 5° C of the samples are required for instrument calibration. Properly fill the probe with a salt solution, if required. Follow the manufacturer's instructions for the procedures and frequency of instrument calibration. Calibrate the instrument at least daily; more often is recommended and prudent. Record calibration data.
2. Place the calibrated pH probe into a closed flow-through cell and allow the purge water to continuously flow past the probe.
3. If you measure pH from a sample container, fill a container for this measurement only. Do not insert a pH probe into a sample that will later be analyzed for other parameters.
4. Allow the pH probe to equilibrate with the water for a minute or more, then record pH. Do not remove the pH probe from the water while taking the reading. Read pH measurements to the nearest 0.1 pH units.
5. Rinse the pH probe with reagent grade water and store in the buffer solution or as recommended by the equipment's manufacturer.

3.4. TURBIDITY

Measure the turbidity of a sample the same day you collect it, preferably in the field immediately after collection. If you cannot measure sample turbidity soon after collection, you may store samples in the dark for up to 24 hours before measuring turbidity. Shake the sample vigorously before measuring. Standard Methods for the Examination of Water and Wastewater discusses interferences and procedures for measuring turbidity.

1. Use a turbidity meter according to the manufacturer's instructions. Read turbidity to the nearest 0.1 Nephelometric Turbidity Unit (NTU) and record your measurement. In addition, provide this measurement to the laboratory if any samples will be analyzed for metals.
2. When you do not use a turbidity meter, describe the turbidity (e.g., slight, moderate) and record your observations or have a laboratory determine sample turbidity within 24 hours of sample collection.

3.5. DISSOLVED OXYGEN

You can measure dissolved oxygen (DO) with an electrometric method (dissolved oxygen meter), colorimetric method, the Winkler method, or with the iodometric method. (See most recent version of Standard Methods for the Examination of Water and Wastewater.) Dissolved oxygen meters usually require calibration before use and a visual check of the probe to verify that the membrane is not damaged.To function properly, most DO probes require that water continuously flow past the membrane while measurements are being taken. Therefore, use either a DO probe equipped with a circulator or, less preferably, slowly raise and lower the probe in the water column while taking readings. If your DO meter is not responding as expected or is very sluggish, you may need to change the probe's membrane; follow the manufacturer's instructions for doing this.

3.6. COLOR

1. Note the color against a white background. If filtering is required, note the color after filtering. Document whether you noted sample color for a filtered or nonfiltered sample.
2. Describe the color by common descriptors (e.g., light gray), or use an industry-recognized and standardized color description method (e.g., a color comparison disk for water). Record your observations.

3.7. ODOR

It is neither required nor advocated that smelling of samples is necessary.

1. If you do not know the type and approximate concentration of substances in a sample, do not attempt to smell it. Record sample odor only if you notice it unintentionally.
2. If the type and concentration of substances are known carefully wave your hand over the sample and note any distinct odor. Do not "stick your nose" in the sample to check for odor. Record any noticeable odor (e.g., pungent, solvent).

3.8. EH (OXIDATION-REDUCTION POTENTIAL)

Eh is usually measured with a noble metal (e.g., platinum) and a reference electrode system using a pH meter that reads millivolts. Take field measurements of Eh in an air-tight flow-through cell or similar air-tight device. Read Eh measurements to the nearest 10 millivolts (mV). Follow the equipment manufacturer's instructions and refer to the most recent version of Standard Methods for the Examination of Water and Wastewater.

3.9. OTHER WATER QUALITY MEASUREMENTS

Other water quality measurements that may change physically and chemically soon after collection include dissolved carbon dioxide and alkalinity. These parameters are best measured in-field and immediately after collection. Follow the equipment manufacturer's instructions and the most recent version of Standard Methods for the Examination of Water and Wastewater for measuring these parameters.

4. SAMPLE COLLECTION

The following presents a brief overview of recommended surface water field sampling methods. Included in this section are:

1. Techniques to prevent sample contamination.
2. Field rinsing of equipment
3. Surface-water sampling collection methods at flowing water and still water sites.
4. Groundwater sampling collection methods for shallow wells
5. Sample filtration
6. Sample preservation
7. Sample bottle labeling and filling
8. Sample handling and storage

For more details, consult U.S. Geological Survey TWRI Book 9 – NATIONAL FIELD MANUAL FOR THE COLLECTION OF WATER-QUALITY DATA (1999). This reference is available in the Unit's library.

4.1. TECHNIQUES TO PREVENT SAMPLE CONTAMINATION

Sample contamination can be caused by poor sampling-handling, atmospheric input, poorly cleaned equipment, and the use of equipment not designed for the analytes targeted for the study. Contamination from these sources can be prevented or minimized by using sound field practices. These practices include:

1. Being aware of and recording potential sources of contamination at each field site.
2. Wearing appropriate disposable, powderless gloves changing them before each step during sample collection and prior to sampling avoiding touching contaminated surfaces.
3. Using equipment constructed of relatively inert materials in respect to the analytes being tested.
4. Using only equipment cleaned using appropriate procedures.
5. Rinsing equipment only as directed for some analytes should not be field rinsed.
6. Using correct sample-handling procedures including the minimization of the number of sample handling steps; having clean hands when handling samples; and being trained prior to sampling.
7. Collecting samples in enclosed chambers if possible to minimize contamination for atmospheric sources.
8. Following a prescribed order for collecting samples (going from less contaminated sites to more contaminated sites).
9. If sampling for trace organic and inorganic compounds, Clean Hands(CH)/ Dirty Hands (DH) techniques should be used. This requires the use of two people. The CH takes care of all operations involving equipment that contacts the sample. The DH takes care of operations that might come into contact with potential sources of contamination. Both CH and DH where disposal gloves throughout the operation.

4.2. FIELD RINSING EQUIPMENT

To field rinse a surface-water sampler:

1. Put on appropriate disposable powderless gloves.
2. Partially fill and rinse the sampler with the water to be sampled and avoid getting sand in the rinse water.
3. Shake and/or swirl and drain the rinse water from the sampler.

4.3. SURFACE-WATER SAMPLE COLLECTION AT FLOWING-WATER AND STILL-WATER SITES

Methods used to collect surface-water samples are dependent the nature of the water body with considerations being given to:

1. Safety of field personnel.
2. Nature of stream flow.

3. Field measurement profiles (Is the stream or lake well mixed?)
4. Temporal heterogeneity.
5. Weather conditions.
6. Fluvial sediment transport.
7. Sources of potential pollution.
8. Study requirements.

To obtain, a representative sample of a flowing stream one of several methods should be considered depending on the requirements of the study. These methods are generally categorized as being either isokinetic or nonisokinetic. Isokinetic methods involve the collection of depth integrated water samples using a sampler that allows for a discharge weighted sample along a water column (its vertical). This calls for the use of a depth-integrating sampler that is designed to collect a water sample for a stream vertical. This sampler allows for the velocity in the nozzle at the of intake of the sampler is nearly the same as the immediate stream velocity, when running sampler down and up the vertical at a uniform speed.

Using a depth-integrating sampler, either the equal discharge-incremented (EDI) or equal-width incremented sample (EWI) sampling method is used. The EDI method calls for the collection of depth-integrated sample integrated across a stream cross section based on flow.

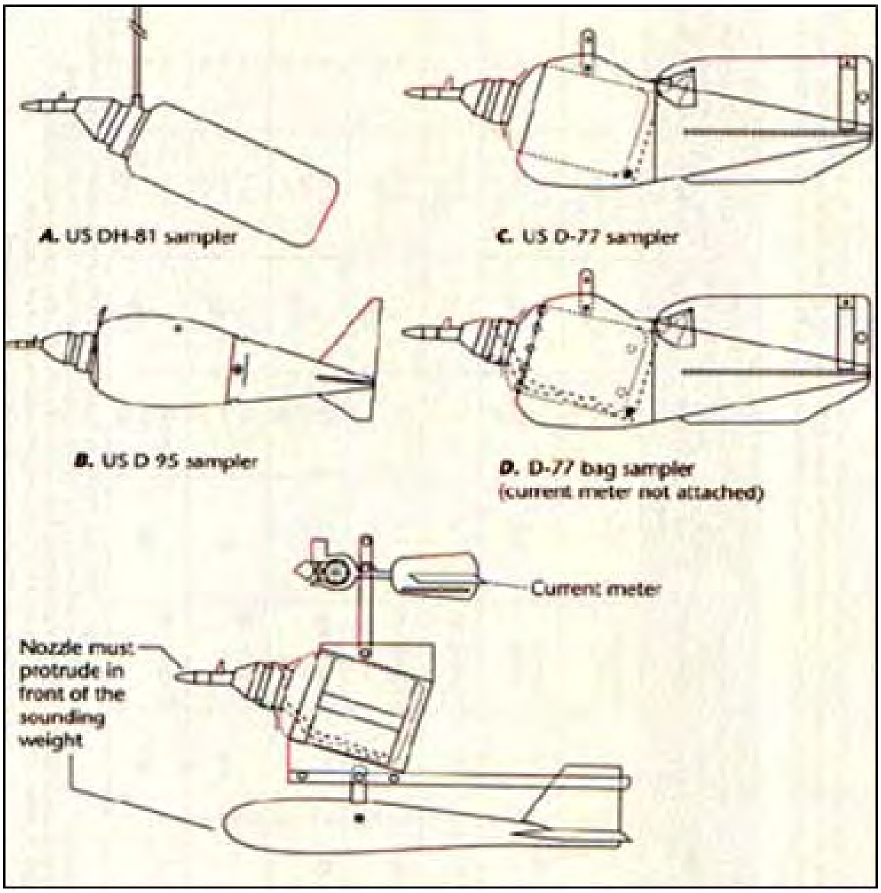

Figure 2 Isokinetic Field Sampling Equipment

ISOKINETIC SAMPLING METHODS

- Use isokinetic, depth-intergrating sampling equipment.
- Use same size sample container.
- Collect samples using the same transit rate at each vertical .
- Composite the subsamples in a churn splitter or process subsamples through a cone splitter

Use the following steps:
1. Prepare for sampling (evaluate site, prepare equipment)
2. Select number of equal width or discharge increments.
3. Select transit rates
4. Collect Subsamples
5. Composite subsamples

The EDI verticals are located at the centroid, a point within each increment at which the stream discharge is equal on either side of the vertical. The EWI divides the stream into increments based on width with the depth intergrated sample being taken at the mid-point of the increment. Using either method, once the samples are collected at each vertical they are composited to make one representative sample.

For isokinetic sampling, several items must be considered. These include:
1. Variation in field measurement values (specific conductance, pH, temperature and dissolved oxygen) along a cross section.
2. The distribution of discharge and suspended materials along a cross section.
3. The type of sampler.
4. The location of side-channel eddies and turbulance.

Nonisokinetic samples involve grab samplers or automated point samplers.
Nonisokinetic sampling methods are used when:
1. Velocity of flow is so high that depth integrated samplers can not be used properly or safely.
2. Extreme low-flow conditions and the stream is too shallow or the velocity of the stream does not meet the minimum requirement of the sampler.
3. When automatic samplers are required.
4. In still water.
5. Study objectives dictate that nonisokinetic sampling methods be used.

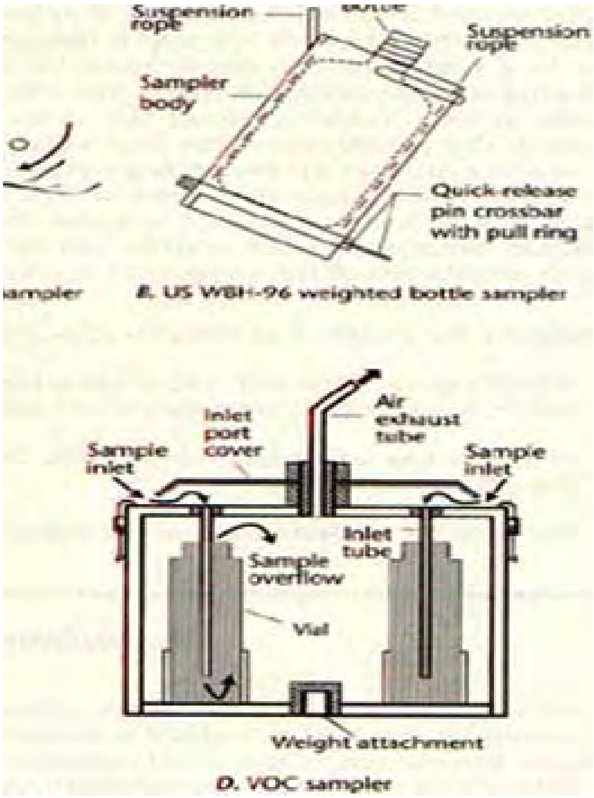

Figure 3 Non-isokinetic Field Sampling Equipment.

These methods include:

***Dip sampling method**:* This involves the dipping of a narrow-mouthed bottle into a water body. Care must be taken to avoid collecting particulates that are re-suspended as result of wading or perturbing the sampler. To collect the sample a dip sample: in water that is shallow wade to where the sample will be collected and immerse a hand-held, narrow mouth bottle at he centroid of flow or at multiple locations along the cross-section. Stand downstream of the bottle while it is being filled. Where the water is too deep to wade, lower the weighted sample bottle using a rope or cable at the centroid of flow or at multiple locations along the cross-section.

SAMPLING STILL OR SLOW MOVING WATER

In sampling situations that involve still or slow moving water a thief-type sampler is ofter used to obtain a sample at a discrete depth. Procedures using a thief sampler are as follows:

a. Lower opened sampler slowly to desired depth.
b. Isolate the sample by activating the mechanism that closes the sampler.
c. Dispense sample to sample bottle or compositing devise.
d. Repeat to obtain sample at different depth.

***Discrete sampling method**:* This involve obtaining a sample at a discrete depth. Using a thief-type sample obtain a sample in still water or slow moving water at eh centroid of flow or at mulitple verticals at selected depths along the cross-section.

***Pump sampling method**:* This involves the use of a suction lift or submersible pump designed to collect water-quality samples. These can be portable or permanently installed and automated for sampling. A portable pump can be used to collect a depth-integrated sample by continuously pumping at a specified depth. The Unit has purchased an ISCO automatic sampler. Basic instructions for this pump type sampler is presented in Appendix G.

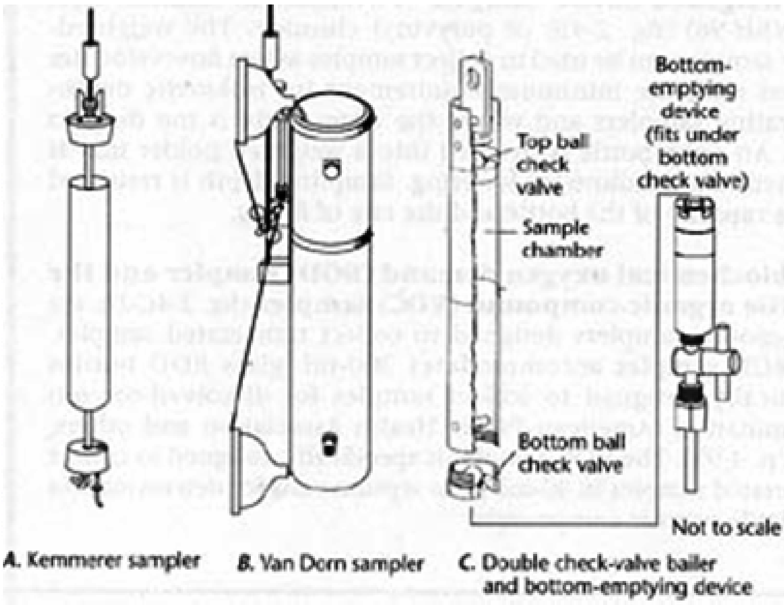

Figure 4 Thief Sampler for Discrete Depth Sampling.

4.4. GROUNDWATER SAMPLING

Groundwater samples will be taken with either disposable bailers, submersible pump, or platter pumps. Prior to sampling the water level in the well and the depth of the well will be measured. This measurement will be completed using a water level meter accurate to 2 mm or other suitable measurement devise. To prevent cross contamination, after measurements are taken, the meter and its sounding line will be washed off with detergent and water and then rinsed with a weak acid solution followed a distilled water rinse. The volume of water in the well will then calculated using the formula:

V = ⑥ r^2 h

Where:
V = volume of water in the well
⑥ = constant
r = radius of the well
h = height of the water column

The well will then be pumped or bailed and at least three well volumes will be evacuated prior to sampling. After the well has been sampled, sample will be filtered as necessary and sample bottles with proper preservatives will be filled using (if possible) a disposable bailer. If raw samples are required, the sample bottles will be filled directly. After sampling the bailers will be disposed of and the pumps will be cleaned in the same fashion as the water level sounder.

4.5. SAMPLE FILTRATION

Filter samples immediately after collection, document when you filtered the samples. Use a 0.45 micron pore size filter membrane for filtering. If possible, rinse or flush the filter membrane and filtering device with a minimum of 0.5 liters (500 mls) of reagent grade water before use. Avoid applying high pressure (>50 psi) when filtering samples. For silt-laden or turbid samples, use a pre-filter (e.g., glass microfiber) or a filter membrane of larger diameter or larger surface area Allow 150 mls or so of sample to pass through the filtering device before filling sample containers. Rinse sample containers once with filtrate.

IMPORTANT: Immediately after or during collection, field filter samples collected for metals analyses. There are three exceptions:
1. Total metals results are required
2. Three consecutive in-field turbidity readings (spaced 2 minutes or more apart) are all 5 NTUs or less. Low turbidity values (<5 NTUs) for the sample should reflect the naturally mobile colloids and particulates moving through the water. Record that the samples were not filtered and that they have turbidity readings of 5 NTUs or less.
3. The parameters being collected are not subject to change during sample storage (e.g., changes in dissolved gas content, pH, Eh, redox potential, and dissolved/solid phases), If a sample is not subject to change and is held for extended periods of time, filtering may be done later. Record the filtering place, time and method.

Filtering procedures for sample bottles are as follows:
1. After collecting the sample, gently pour the sample directly into the self-contained device fitted with a disposable filter membrane. If possible, use positive pressure filtration rather than vacuum filtration, which causes excessive sample aeration and agitation.
2. Attach the pressure line to the device.
3. Discard the first 150 mls or so of filtered sample. Collect the subsequent filtered samples into appropriate sample containers.
4. Immediately preserve the samples, replace the cap, label the samples, and place them on ice in a cooler.
5. Record "sample field filtered (Y)" and the "time samples filtered." Dispose of the used in-line filter - do not reuse it.

4.6. SAMPLE PRESERVATION

Table 1 includes sample preservation for a variety of compounds and parameters. You may add preservative to sample bottles before or immediately after sample collection. (Filter the sample, if required, before adding preservative.) If you add preservative to a container before adding the sample, take care to minimize sample overflow that may dilute the preservative. Checking and Adjusting the pH of a Preserved Sample.

When using a pH meter to check the pH of a preserved sample, follow these procedures:

1. If applicable, check and fill the reference electrode with solution as recommended by the instrument's manufacturer.
2. Calibrate the instrument according to the manufacturer's instruction. Two fresh pH buffer solutions (7.00 and 4.00 or 7.00 and 10.00) having temperatures within 5° C of the samples are typically required for instrument calibration.
3. Pour a small portion of the preserved sample into a separate container. Immerse the electrode into the separate container and wait for the reading to stabilize. Do not swirl or stir the electrode while taking the reading unless recommended by the manufacturer.
4. If sample pH needs adjustment, add additional preservative to the original sample and repeat Step 3.
5. If sample pH is acceptable, dispose of the separate sample (do not pour it back into the original sample container), replace the lid on the original sample and place it on ice in a cooler.
6. Rinse the electrode with reagent grade water and store the electrode in the buffer solution or as recommended by the manufacturer.

Table 1 Sample Collection, Containers, Preservation and Holding Times.

PARAMETER	FILTERED/ UNFILTERED	CONTAINER VOLUME AND TYPE (ml)	PRESERVATIVE	NOTES	HOLDING TIME
Physical parameters, common ions	Unfiltered	500 Plastic	none	Cool, 4°C	Indefinite
Metals (Total Recoverable)	Unfiltered	250 Plastic	HNO_3 to pH <2		6 months
Gross Alpha and Beta	Unfiltered	1000 Plastic	HNO_3 to pH <2	Cool, 4°C	6 months
Nitrate and Nitrite, Ammonia, TKN, total P	Unfiltered	1000 Plastic	H_2SO_4 to pH <2	Cool, 4°C	28 days
Organic Carbon, dissolved	Filtered	25 Plastic	H_2SO_4 or HCl to pH <2	Cool,4°C	28 days
Organic Carbon, total	Unfiltered	25 Glass	H_2SO_4 or HCl to pH <2	Cool, 4°C	28 days
Cyanide (Total)	Unfiltered	500 Plastic	NaOH to pH>12	Cool, 4°C	14 days

When using pH paper to check the pH of a preserved sample, follow these procedures:

1. Gently tip the sample container on its side to wet the inside of the lid and remove the lid.
2. Touch the pH paper to the droplets inside the lid and read the pH. Do not put the pH paper directly into the sample container. Compare the color of the pH paper to color-pH provided by the manufacturer.

3. If sample pH needs adjustment, add additional preservative to the sample, rinse the container lid with reagent grade water, replace the container lid and repeat Steps 1 and 2.
4. If sample pH is acceptable, rinse the container lid with reagent grade water, shake the lid to remove any excess water and replace the lid.

4.7. SAMPLE BOTTLE LABELING AND FILLING PROCEDURES

Take in-field water quality measurements before or immediately after sample collection. Open only one sample container or one set of sample containers immediately before filling. Preserve samples within 15 minutes of collection and immediately place on ice. Minimize the contact of extraneous contamination with sample containers and equipment. Common extraneous contaminants include perfumes, cosmetics, bug spray, sun tan lotion, Sharpie® , spray lubricants and engine fumes. Sample up wind or remove extraneous contaminants before opening containers and collecting samples. Use waterproof labels. Write on them with a permanent, waterproof marking device (e.g., grease pencil).

Labels should include:

1. A unique sample number (if applicable).
2. Site/project name or other identifier.
3. Date and time sample collected.
4. Sample collectors initials.

Type of preservation added and analysis required. Use extra caution when collecting samples that have a "medium" or "high" potential to volatalize from water. Remember to keep complete and accurate records. Record all field information before proceeding to the next site. Order of Filling Sample Containers Collect sample parameters in the following order:

1. Unfiltered samples for in-field water quality measurements.
2. Volatile organic compounds (VOCs).
3. Non-filtered, non-preserved (e.g., sulfate, total chromium VI, mercury, semi- and non-volatiles, pesticides, PCBs).
4. Non-filtered, preserved (e.g., nitrogen series [ammonia, nitrates, nitrites, etc.], phenolics, total phosphorous, total metals, cyanide, totalorganic carbon).
5. Filtered, non-preserved (e.g., dissolved chromium VI).
6. Filtered, preserved immediately (e.g., dissolved metals)
7. Miscellaneous parameters.

Collect sulfate samples before sulfuric acid preserved samples (e.g., nitrogen series). Collect nitrogen series samples before nitric acid preserved samples (e.g., boron, dissolved metals).

Finally, the number of sample bottles required depends on the number of different extraction, clean-up, analytical methods and quality control (QC) needed for the project. Remember that laboratories are required to duplicate and spike samples at a set frequency. Collecting insufficient sample volumes may result in higher detection limits, because sample volume must be reduced to accommodate QC requirements.

4.7.1. PROCEDURES FOR FILLING SAMPLE CONTAINERS

1. Tip the sample container at a slight angle and allow a slow steady stream of water to run down its inner wall. Hold the sampling discharge tube close to the sample container but do not touch it.
2. Immediately after filling a sample container, if not already done, add any required preservative (filter first, if required), replace the cap, add the label, and place the sample in a plastic bag (optional) on ice in a cooler.
3. Record the "time sample collected." To avoid confusion, you may wish to record sample collection time in military time (e.g., 1300 instead of 1:00 pm, 1845 instead of 6:45 pm, etc.,)

Note: If a sample container already has preservative in it before you fill it (common for VOC vials), do not rinse the container before filling and take care to minimize sample overflow that may dilute the preservative.

4.7.2. VOLATILE ORGANIC COMPOUNDS (VOCS)

1. If a laboratory hasn't already done so, add sufficient preservation to the container.
2. Tip the container at a slight angle and allow a slow, steady stream of water to run down its inner wall.
3. Fill the sample container until the water forms a positive meniscus at the brim, then immediately replace the cap.
4. Invert the sample container and tap it lightly to check for bubbles. If bubbles are present, fill a new sample container (containing preservative) and check for bubbles the same way. If bubbles are unavoidable, collect numerous samples and save those with the least amount of bubbles. Do not try to reopen and add more water to samples that have bubbles. Refill a used container only if you again add sufficient preservative and refill it with water from the same site, to avoid cross-contamination between samples.
5. Label the sample, place it in a plastic bag (optional), then immediately place it on ice in a cooler. Record the "time sample collected." Semi-volatiles and Pesticides When collecting semi-volatiles and pesticides, unless project objectives or regulations require otherwise, use similar, but less rigourous, procedures as those described for collecting VOC samples. Use the same equipment decontamination and storage procedures you use for collecting VOC samples. When collecting semi-volatiles and pesticides, the type of sample container,volume and preservative may be quite different than that required for VOC samples. In addition, leave approximately ½ inch of air space when filling sample bottles to allow for expansion. Otherwise, the bottles may break.

Note: Do not filter VOC or other organic samples. Turn off any nearby gasoline engines or sample up wind of any engine exhaust. Remember to store one trip blank per cooler when collecting volatile (VOCs, GRO, and PVOCs) samples. Store empty VOC containers on ice to help you reduce VOC volatilization when you fill them.

4.7.3. INORGANICS

Inorganic samples (e.g., dissolved metals) are quite susceptible to aeration, oxidation, precipitation, coprecipitation, extraneous contamination and cross-contamination during sampling, filtering and handling. Therefore, take extra care to avoid sample aeration before filtering (if required) and preserving. Unless specified, field filter inorganic samples and preserve immediately after collection.

4.7.4. OTHER SAMPLE PARAMETERS

Other sample parameters subject to rapid change (by aeration and subsequent changes in redox state, or addition or loss of dissolved gasses) once a sample is taken include: chromium VI, pH, Eh, oxygen, inorganic carbon, alkalinity, TOC, ammonium, nitrate/nitrite, sulfide, cyanide, molybdenum, mercury, selenium, dissolved iron (ferrous iron - FE+2), manganese, zinc, cadmium, lead, vanadium, arsenic and phosphate. Take precautions to avoid altering these parameters during sampling. Add preservative, if required, immediately and place on ice in a cooler. For those interested in monitoring indicators of biodegredation that

may be occurring in water at a site, use a field test kit (e.g., colorimetric), sensor probe or other field test (e.g., portable gas chromatogram) to quantify pH, dissolved oxygen, nitrate, sulfate, ferrous iron, redox potential and manganese in the field immediately after sample collection. In addition,alkalinity, methane and carbon dioxide should be measured in the field immediately after collection, or less preferably, in the laboratory.

4.8. SAMPLE HANDLING AND STORAGE

After samples are collected, filtered (if required), labeled and preserved (if required), they must be placed immediately on ice. Keep samples at or below 4° C, but above freezing throughout storage, handling and shipping. Make sure there is enough ice for the duration of sample storage and transport. Discourage the use of frozen cold packs (e.g., "blue ice"). If you do use them, place a temperature blank in the cooler so the laboratory can document the temperature of the samples when they arrive. Breakable sample containers (e.g., glass vials) should be separated by bubble wrap, foam, ice, etc. At least a portion of each container must contact the ice, otherwise the protective layer (e.g., bubble wrap) may insulate the sample from the cooling effects of the ice. Placing samples in a plastic bag can help minimize the chance of cross-contamination among samples should a container break.

5. QUALITY ASSURANCE/QUALITY CONTROL

Field QA/QC efforts must match the data quality objectives established or required for the project and sampling event. Remember that QA/QC procedures and samples are not optional All QA/QC samples must be collected, handled and processed in the same exact manner as the other analytical samples being collected. Make sure the laboratory receives sufficient sample volumes or additional containers to perform required QC procedures. All sampling and decontamination wastewaters and materials must be stored, handled and disposed of properly.

5.1. QUALITY CONTROL SAMPLES

5.1.1. FIELD BLANK (FIELD RINSATE BLANK, DECONTAMINATION BLANK, EQUIPMENT BLANK)

Collect one field blank for every 10 samples or less collected. Decontaminate the sampling equipment for the field blank the same way you do when collecting other samples. After decontaminating the sampling device (e.g., bucket or pump), fill it with laboratory reagent grade water, then collect a sample of the reagent grade water - this is your field blank. The field blank should be analyzed for the same parameters as the samples.

5.1.2. FIELD DUPLICATE

Collect one field duplicate for every 10 samples or less collected The field duplicate should be analyzed for the same parameters as the samples. When using a grab sampler, collect the duplicate from the same sample of water as the original sample is collected, bailer volume permitting.

5.1.3. FIELD SPLIT SAMPLES

Field split samples should be take at least once per sampling event. Collect the sample, filter if required, and dispense into two or more containers. Preserve the samples if required and send them to separate laboratories for analysis. The samples must be analyzed by identical laboratory analytical methods to be comparable.

5.2. EQUIPMENT DECONTAMINATION

Check with your laboratory for recommended equipment cleaning solutions and procedures for each analyte you are sampling. Collection of inorganic compounds may necessitate a dilute acid equipment rinse first. Collection of organic compounds may require a pesticide grade isopropanol, acetone, methanol or hexane equipment rinse. If you use pesticide grade hexane, take extra safety precautions because hexane is quite flammable. Use your professional judgment to decide which of the following procedures to use:

Minimum decontamination procedures include:
Disassemble the equipment if possible. Use a weak non-phosphate detergent (e.g., Alquinox® , Liquinox®) and water solution, and scrub the equipment inside and out. Visually inspect the equipment to ensure no visible contamination is present

1. Thoroughly rinse the equipment with organic-free tap water. Reassemble the equipment, if applicable.
2. Store and transport the equipment in clean plastic, aluminum foil, or a container that will protect the equipment from extraneous contamination.

More rigorous decontamination procedures include:

1. Wash equipment with a non-phosphate detergent solution and scrub with an inert brush. For internal mechanisms and tubing, circulate the detergent solution through the equipment.
2. Thoroughly rinse the equipment with organic-free tap water.
3. For organic (e.g., VOCs) sample collection, rinse equipment with an organic desorbing agent (e.g., pesticide grade isopropanol, acetone, methanol or hexane).
4. For inorganic sample collection, rinse equipment with inorganic desorbing agent (e.g., dilute [0.1 Normal] reagent grade hydrochloric acid or nitric acid solution). For stainless steel and low-carbon steel, a more dilute hydrochloric acid solution (1 percent) is recommended. Note: If you use organic or inorganic desorbing agents, check with your laboratory regarding potential analytical interferences caused by desorbing agents and their proper use and disposal.
5. Rinse the equipment with organic-free tap water only if you are using an inorganic desorbing agent.
6. Rinse with laboratory reagent grade water. If practical, allow the equipment to air dry before its next use or storage.
7. Store and transport the equipment in clean plastic, aluminum foil or a container that will protect it from extraneous contamination.

Other decontamination methods such as high pressure steam cleaning, hot-water power wash, ultrasonic cleaning and other methods decontaminate most equipment satisfactorily.

5.3. SAMPLE TRACKING, SECURITY AND CHAIN OF CUSTODY PROCEDURES

Sample tracking, security and chain of custody procedures provide a legal record of sample transport, possession and handling.

Sample Identification: Use waterproof labels or a similar method to identify each sample container. Use a permanent waterproof marker. Avoid placing labels on container lids; however, if you do place a label on a lid, make sure it's attached to the container as well. Labels should include the following information:

1. a unique sample number
2. site/project name
3. date and time sample collected
4. sample collectors initials
5. preservation and analysis required
6. Sample Seals

5.3.1. SHIPPING CUSTODY SEAL

Use tape or a lock to seal the container for shipping. If you use tape, write your signature, the date and time on the tape.

5.3.2. CHAIN OF CUSTODY RECORD

Complete a chain of custody (COC) record for each sampling event. Each time the samples change possession, whoever relinquishes and whoever receives the samples must sign, date and time the chain of custody form. Figure 2-2 and 2-3 in the Sampling and Analysis Plan are examples of chain of custody form.

APPENDIX B – ANALYTICAL & TESTING OF DRINKING WATER (PERMENKES NO.907/MENKES/VII/2002) – SUCOFINDO

SUCOFINDO

WORK SHEET ANALYTICAL & TESTING LABORATORY

LAB NO : **DATE RECEIVED** :

SECTION : **DATE TO BE COMPLETED** :

SAMPLE : **MARKING** :

ANALYSIS : Drinking Water
(Permenkes NO.907/MENKES/VII/2002)

Parameter	Unit	Test Results	Threshold Limit Value	Methods *) Part Number
1. Bacteriological				
a). Microbiological				
Escherichia Coli	Colony / 100 mL		0	9222 G
Total Coliform	Colony / 100 mL		0	9222 B
2. Chemical				
a). Inorganic Chemical				
Antimony	mg/L		0.005	3111 B, 3030 E
Mercury	mg/L		0.001	3112 B
Arsenic	mg/L		0.01	3114 C, 3030 F
Barium	mg/L		0.7	3111 D
Boron	mg/L		0.3	3500-B-C
Cadmium	mg/L		0.003	3111 D
Chromium	mg/L		0.05	3111 B
Copper	mg/L		2	3111 B, 3030 E
Cyanide	mg/L		0.07	4500-CN^--E
Fluoride	mg/L		1.5	4500-F-D
Cobalt	mg/L		0.01	3111 B, 3030 E
Molybdenum	mg/L		0.07	3500-Mo-B
Nickel	mg/L		0.02	311 B
Nitrite	mg/L		3	4500-NO_2-B
Nitrate	mg/L		50	4500-NO_3^--B
Selenium	mg/L		0.01	3114 C, 3030 F
b). Inorganic Chemical				
Ammonia	mg/L		1.5	4500-NH_3-C **
Alumunium	mg/L		0.2	3111 D, 3030 E
Chloride	mg/L		250	4500-Cl-D
Total Hardness as $CaCO_3$	mg/L		500	2340 B
Hydrogen Sulfide as H_2S	mg/L		-	4500-S^{2-}-D
Iron	mg/L		0.3	3111 B
Manganese	mg/L		0.1	3111 B
pH	-		6.5 – 8.5	4500-H^+-B
Sodium	mg/L		-	3125 B
Sulfate	mg/L		250	4500-SO_4^{2-}-E
Zinc	mg/L		3	3111 B, 3030 E

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WORK SHEET ANALYTICAL & TESTING LABORATORY

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SECTION : **DATE TO BE COMPLETED** :

SAMPLE : **MARKING** :

ANALYSIS : Drinking Water
(Permenkes NO.907/MENKES/VII/2002)

Parameter	Unit	Test Results	Threshold Limit Value	Methods *) Part Number
c). Organic Compound				
Carbon Tetrachloride	µg/L		2	6630 C
Dichloromethane	µg/L		20	6630 C
1,2 Dichloroethane	µg/L		30	6630 C
1,1,1 – Thrichloroethane	µg/L		2000	6630 C
Vinyl Chloride	µg/L		5	6630 C
1,1 – Dichloroethane	µg/L		30	6630 C
1,2 – Dichloroethane	µg/L		50	6630 C
Thrichloroethane	µg/L		70	6630 C
Tetrachloroethane	µg/L		40	6630 C
Benzene	µg/L		10	6630 C
Toluene	µg/L		700	6630 C
Xylenes	µg/L		500	6630 C
Benzo(a)pyrene	µg/L		0.7	6630 C
monochlorobenzene	µg/L		300	6630 C
1,2 dichlorobenzene	µg/L		1000	
1,4 dichlorobenzene	µg/L		300	6630 C
Trichlorobenzene (total)	µg/L		200	6630 C
Others				
Di(2-ethylhexil)adipate	µg/L		80	Gas Chromatography
Di(2-ethylhexyl)phtalate	µg/L		8	Gas Chromatography
Acrylamide	µg/L		0.5	Gas Chromatography
Ephichlorohydrin	µg/L		0.4	Gas Chromatography
Hexachlorobutadiene	µg/L		0.6	Gas Chromatography
Edetic acid (EDTA)	µg/L		200	Gas Chromatography
Nitriloacetic acid	µg/L		200	Gas Chromatography
Tributyltin oxide	µg/L		2	Gas Chromatography
d) Organic compound				
Toluene	µg/L		24 – 170	Gas Chromatography
Xylene	µg/L		20 – 1800	Gas Chromatography
Ethylbenzene	µg/L		2 – 200	Gas Chromatography
Styrene	µg/L		4 – 2600	Gas Chromatography
Monochlorobenzene	µg/L		10 –12	Gas Chromatography
1,2-dichlorobenzene	µg/L		0.3 – 30	Gas Chromatography
Trichlorobenzene (total)	µg/L		5 – 50	Gas Chromatography
2-chlorophenol	µg/L		600 – 1000	Gas Chromatography
2,4 – dichlorophenol	µg/L		0.3 – 40	Gas Chromatography
2,4,6 – trichlorophenol	µg/L		2 – 300	Gas Chromatography

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ANALYSIS : Drinking Water
(Permenkes NO.907/MENKES/VII/2002)

Parameter	Unit	Test Results	Threshold Limit Value	Methods *) Part Number
e). Pesticides				
Alachlor	µg/L		20	Gas Chromatography
Aldicarb	µg/L		10	Gas Chromatography
Aldrin / dieldrin	µg/L		0.03	Gas Chromatography
Atrazine	µg/L		2	Gas Chromatography
Bentazone	µg/L		30	Gas Chromatography
Carbofuran	µg/L		5	Gas Chromatography
Chlordane	µg/L		0.2	Gas Chromatography
Chlorotoluron	µg/L		30	Gas Chromatography
DDT	µg/L		2	Gas Chromatography
1,2 – dibromo – 3 chloropropane	µg/L		1	Gas Chromatography
2,4 – D	µg/L		30	Gas Chromatography
1,2-dichloroprophane	µg/L		20	Gas Chromatography
1,3-dichloroprophane	µg/L		0.720	Gas Chromatography
Heptachlor & heptachlorepoxide	µg/L		0.03	Gas Chromatography
Hexachlorobenzene	µg/L		1	Gas Chromatography
Isoproturon	µg/L		9	Gas Chromatography
Lindane	µg/L		2	Gas Chromatography
MCPA			2	Gas Chromatography
Molinate	µg/L		6	Gas Chromatography
Pendimethalin	µg/L		20	Gas Chromatography
Penachlorophenol	µg/L		9	Gas Chromatography
Permetrin	µg/L		20	Gas Chromatography
Propanil	µg/L		20	Gas Chromatography
Pyridate	µg/L		100	Gas Chromatography
Simazine	µg/L		2	Gas Chromatography
Trufularin	µg/L		20	Gas Chromatography
Chlorophenoxy herbicides other than 2,4-D and MCPA				
2,4 – DB	µg/L		90	Gas Chromatography
Dichloroprop	µg/L		100	Gas Chromatography
Fenoprop	µg/L		9	Gas Chromatography
Mecoprop	µg/L		10	Gas Chromatography
2,4,5 – T	µg/L		9	Gas Chromatography
F.Disinfectant and its related compound product				
Monochloramine, di-and trichloramine	µg/L		3	Gas Chromatography
Chlorine	µg/L		5	Gas Chromatography
Bromate	µg/L		25	Gas Chromatography
Chlorite	µg/L		200	Gas Chromatography
2,4,6 – trichlorophenol	µg/L		200	Gas Chromatography
Formaldehyde	µg/L		900	Gas Chromatography

SUCOFINDO

WORK SHEET ANALYTICAL & TESTING LABORATORY

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SAMPLE	:	**MARKING**	:

ANALYSIS : Drinking Water (Permenkes NO.907/MENKES/VII/2002)

Parameter	Unit	Test Results	Threshold Limit Value	Methods *) Part Number
Bromoform	µg/L		100	Gas Chromatography
Dibromochloromethane	µg/L		100	Gas Chromatography
Bromodichloromethane	µg/L		60	Gas Chromatography
Chloroform	µg/L		200	Gas Chromatography
Chlorinated acetic acids				
Dichloroacetic acid	µg/L		50	Gas Chromatography
Trichloroacetic acid	µg/L		100	Gas Chromatography
Chloral hydrate (trichloroacetaldehyde)	µg/L		10	Gas Chromatography
Dichloroacetonitrile	µg/L		90	Gas Chromatography
Dibromoacetonitrile	µg/L		100	Gas Chromatography
Trichloroacetonitrile	µg/L		1	Gas Chromatography
Cyanogen chlorine (as CN)	µg/L		70	Gas Chromatography
3. Radioactivity				
Gross alpha activity	µg/L		0.1	Pico rad
Gross beta activity	µg/L		1	Pico rad
4. Physical				
Colour	TCU		15	2120 B
Taste	-		Tasteless	2160 C
Odour	-		Odorless	2150 B
Temperature	°C		Ambient air temp ±3°C	2550 B
Turbidity	NTU		5	2130 B
Total Dissolved Solid	mg/L		1000	2540 C

*) : Standard method 20 th edition – APHA-AWWA-WEF.

Checked :

Approved :

APPENDIX C – TRIP REPORT BY PHILLIP E. BROWN AND ASEP ATJU S MULYANA (NOVEMBER 10 – DECEMBER 20, 2005)

TRIP REPORT
BY PHILLIP E. BROWN AND
ASEP ATJU S MULYANA
NOVEMBER 10 – DECEMBER 20, 2005

The following presents a day by day summary of Phillip E. Brown and Asep Atju S Mulyana while working on USAID-ESP in Indonesia between 10 November and 27 November, 2005:

Thursday (10 November 2005) – Phil Brown left Denver, Colorado via Los Angeles, Narita, and Singapore to Jakarta, Indonesia

Saturday (12 November 2005) – Phil arrived in Jakarta and went to the ESP office where he met with Bill Parente and was briefed on current ESP activities

Sunday (13 November 2005) – Off day – Met with Steve Jones in the evening and briefed on ESP activities in Banda Aceh.

Monday (14 November 2005) – Phil went to the ESP office and gave Asep a detailed briefing on hydrologic activities to date in Banda Aceh. Also Phil met with Reed Merrill (Deputy COP) and we discussed the project activities in Banda Aceh as well as in Subang and Cianjur Provinces in West Java. Phil was asked to review proposals for water resource evaluations for Subang and Cianjur as part of ESP's integrated watershed management program. Proposals from three groups were reviewed. These included FORKKAMI, Institute Pertanian Bogor (University), and University of Indonesia – Jakarta. Of the three proposals, FORKKAMI stood out as the best in terms of approach, personnel, and cost. Things that make it the proposal appealing is the way they proposed to do the water balance study and the strength and background of the people they proposed to do the work.

In the afternoon, Phil was included in a meeting with IRD and the Aceh Regional Assessment teams to discuss the proposed WATSAN needs assessment program. Please see notes of the WATSAN teams for details of this meeting.

Tuesday (15 November 2005) – Asep and Phil flew to Banda Aceh. Phil met with John Pontius and Asep was given a tour of the tsunami affected area including the Kr Guepe watershed area. In the office, Phil completed rough drafts of work plans for follow-on activities from his proceeding trip and prepared for a meeting to take place the following day with the ESP watershed management team. Asep field trip is described below.

GPS Point of Measurement

1. ESP Banda Aceh Office, Coordinate N 05° 33' 05.8" and E 095° 21' 01.5", altitude 46 feet.
2. Leupenung River (Krueng), Coordinate N 05° 22' 18.9" and E 095° 16' 18.6". Distant of old bridge foundation is 70 meter, width of the river 60 meter and fluctuation level river water ± 2 meter, altitude 67 feet.

3. Krueng Sarah Bridge, Coordinate N 05° 22' 28.8" and E 095° 15' 43.7". Distant of old bridge foundation is 81 meter, width of the Bailey bridge 50 meter, height Bailey bridge from the surface water level 4.1 meter, deep of river/water at embankment 3.3 meter, at mid river 4.3 meter and at embankment river 2.2 meter, altitude 87 feet, maximum flooding water level at floor of Bailey bridge.
4. Krueng Aceh Bridge (Cot Iri), Coordinate N 05° 32' 07.9" and E 095° 22' 23.1", width of bridge 315 meter, distant foundation bridge to the river stream 109 meter, width of the stream river 72 meter, height the bridge from surface water 9 meter and depth of river/water 1 meter.

Wednesday (16 November 2005)
Met with the BMG at the Airport. Discussed with Head of Geophysics and Meteorology Bureau of Banda Aceh Province, Mr. Samsuir, DHS at Sultan Iskandar Muda, Airport:

1. ESP-USAID has a planed to be installing several Hydromet monitoring system in Kreung Aceh watershed, Kreung Geupu Watershed and Weh Island.
2. On 2006, Geophysics and Meteorology Bureau of Banda Aceh Province cooperation with The Aceh Reconstruction and Rehabilitation Body would be construct 11 (eleven) Automatic Weather Station for entire of Aceh Province, such as:
   - Banda Aceh City, at Blang Bintang/Iskandar Muda Airport.
   - Banda Aceh City, at Geophysics and meteorology Office in Mataee Area.
   - Meulaboh County, at Cut Nyak Dien Airport.
   - Sabang City (Weh Island), at Maemunah Saleh Airport.
   - Lok Seumawe City, at Malikul Saleh Airport.
   - Aceh Besar (Jantho) County, at Indrapuri Township.
   - Seumelu island, at Senabang, Lasikin Airport.
   - Bandar Meriah County, at Rambelle Airport.
   - Tapak Tuan City, at Cut Ali Airport.
   - Aceh Besar County, at Saree,Seulawah Valley Area.
   - South West Aceh County, at Tangan-tangan Township.
3. Mr. Samsuir was suggested ESP-USAID team to discuss and coordination with Mr. Kowangit (BRR) and Mrs. Sriworo B. Harjono (Head of National Geophysics and Meteorology Bureau in Jakarta, Jln. Angkasa I No. 2 Kemayoran, Jakarta Pusat. Telp. (021) 6542983 extt. 300/306, HP. 08161980225.

Prepared and presented a lecture on the ESP water resource management program to the ESP Staff

Thursday (17 November 2005)
Met with BRR and prepared a proposal for cost-sharing hydromet stations. Discussion with Mr. Teguh Pratomo, staff Office of the Aceh Reconstruction and Rehabilitation Body (BRR) for possibilities cooperation between BRR office with ESP-USAID to construct AWS and Hydromet in Aceh and We Island. Discussion was conducted at BRR Office, Jln. Moh. Thaher No. 20, Long Batee, Banda Aceh, NAD, Telp. 0651-636666 dan HP. 08123029492, e-mail: teguhpratomo@yahoo.com.

Continued working with ESP staff on the development of a work plan.

Friday (18 November 2005)
Went with Norman Van't Hoff to (get location name) the site of the ESP pilot WATSAN project in Lam Kruet village in Loknga. Here we found that the soil was not quite as sandy as once thought but sandy clay. Tested water in one well for total dissolve solid concentrations and found that it was about 900 mg/l. Also found a wide range in depths to water ranging

from about 1 meter below ground surface to more that 2 meters. The meaning of this is uncertain. It could indicate that the clays could cause the water to be perched in small locations or that there mounding in the principle water table. Here we also discussed the possibility of developing a designed wetland for all the houses instead of doing on pilot project. We were very concerned about the gradient. Maps produced thus far do not seem to fit the existing topography.

After Lam Kruet, we went to Kr. Geupu. Here I asked for Norman's opinion on the watershed. All in all, he felt it was interesting. He noted deforestation in the lower portion and excessive bank erosion. Phil noticed that right around the bridge some was removing gravel to build up a river crossing to replace the bridge which was destroyed by the tsunami.

In the office, Phil prepared for the water resource management meeting. At this meeting, the team walked through the various tasks and subtasks. Assignments were made to who would be doing the work. At this meeting, an idea was entertained to develop a small meteorological station at schools throughout the basin. The kids could be in charge of making meteorological readings and reporting them. This compliments not only the work we want to do in hydromet monitoring but also USAID school programs.

Saturday (19 November 2005) the team went to Sabang on Weh Island. The objective of the trip was to further define Concept 3 – Water Supply/Water Balance. Team members on the trip included:

Phil Brown
Asep Atju S Mulyana
Jefry Budiman
Suhendi
Sher Singh
Norman Van't Hoff

As mentioned in an earlier trip report, the water supply system currently feeds 3300 households. The water is pumped from the lake at 50 L/sec – 24 hours a day. In addition, water supply trucks with 4 m^3 capacity feed water to communities not connected to system. These trucks make 15 trips a day. Water is sand filtered and not chlorinated. In addition, the PDAM has two wells which are used for communal toilets and owns two springs (Reuteu and Anenh Itam) which produce about 25 L/sec. They would like to further develop these springs for about 500 household out side the city. There is a perennial spring fed stream that they believe has the potential of supplying 100 L/sec.

The first meeting was with PDAM where we met with Husaini, S.T., and Sabang PDAM director. He told us that the GOI had given them a mandate to stop pumping from the lake which supplies Sabang in four months. He felt that he could not do this because he had not received the funds from BRR to pump water from the "Crack" to the village and that it would be very difficult to meet this deadline. He also told us that at one time that they had dreams of 80 l/sec from the dam that was constructed by the Public Works Department but they didn't have a lot of faith in the dam. His main areas of concern are:

1. Meeting the plans to supply water from the "Crack" as detailed by an emergency plan and is pending funding from BRR.
2. Supply the current ferry port with a local supply source
3. Developing water supply from the spring source (water fall).
4. Developing a long-term water supply for the resort area.

Husanaini gave us a PowerPoint presentation of the geology of the lake basin with a slide of the water levels in the lake.

After the meeting, we visited the "crack" which was flowing about 80 liters/sec and spring fed waters at Reuteu and Aneh Itam . Asep took pH readings which indicated that the waters were alkaline with a pH of around 8.3.

That evening Norman, Phil and Sher met with the American Red Cross including Susan Brock - health, Ricardo Caivano – Senor Country Representative, and Teh Tai Ring – Project Manager Water and Sanitation. During this meeting, we discussed many including how best to work together, water supply development, and sanitation. A meeting was set in ESP's office for Monday, 21 November.

Sunday (20 November 2005) – The team was joined by Ronnie Sutrisno, Ridwan Habibie, and Eri Irianto. We proceeded to the dam where Phil gave a lecture on hydraulics and dam construction. We also visits the major stream which the American Red Cross is considering for water supply to German Red Cross villages that they are involved with in WATSAN planning and development. Sher, Phil, and Asep visited the water supply like and water treatment plant. We found the site in general disrepair. Leaky fuel tanks, open hatches, lack of security, and other factors which could be handled by good housekeeping indicated that the PDAM either lack capacity to understand these problems or just did not care. Photographs from Sabang are presented below.

Water Treatment Facilities of "Tirta Aneuk Laot" Sabang Water Supply, Sabang Island, N. Aceh Darussalam Province.

Oil and grease waste from the workshop discharge and polluted the Aneuk Laot Lake of the water resources for public water supply, Sabang Island, N. Aceh Darussalam

Land used surrounding"Aneuk Laot Lake"te components are discharges to the water reservoir, Sabang Island, N. Aceh Darussalam Province.

"Embung Raya Seunara" of the water reservoir. It was developed in 2003, Sabang Island, N. Aceh Darussalam.

"Ujung Karang" spring water, coordinate N 05° 51' 52.4" and E 95° 21' 14.5", pH = 8.3, T = 27.7 °C and conductivity 490 µ S. Sabang Island, N. Aceh Darussalam Province.

"Reuteuk" Spring Water, coordinate N 05° 51' 41.3" and E 95° 21' 20.9", Sabang Island, N. Aceh Darussalam Province.

"Aneuk Laot" spring Water complex, location bellow the "Aneuk Laot Lake", Sabang Island, N. Aceh Darussalam Province.

”Aneuk Laot” spring Water complex, location bellow the ”Aneuk Laot Lake”, Sabang Island, N. Aceh Darussalam Province.

”Aneuk Laot” spring Water complex, location bellow the ”Aneuk Laot Lake”, Sabang Island, N. Aceh Darussalam Province.

Upstream "Krueng Inong" river (Sub-stream of Krueng Aceh River), land used for logging activities, N. Aceh Darussalam Province.

Slush and burned system for prepared land on cultivation activities, Upstream "Krueng Inong" river (Sub-stream of Krueng Aceh River), N. Aceh Darussalam Province. Coordinate N 05° 15' 04.5" and E 95° 35' 51.8"

Monday (21 November 2005) – Had a meeting with the American Red Cross in our office. Included in this meeting were Dlaaphine B. Rauch-Houekpon, Program Director, Susan Brock, Teh Ring, and Jeff. In the meeting, our team including Steve J, Bennett, Aart, Phil, and Asep was brief on ARC activities.

These included:

1. Papua Aceh where they are working on WATSAN for the 5 villages being constructed by British Red Cross.
2. Sabang (Weh Island) where they on working on island wide water supply – and WATSAN for German Red Cross villages.
3. Aceh Besar where there program is focused on WATSAN for 1500 houses being constructed by the Canadian Red Cross in Kahzu.
4. Calang where they are working on water supply for about 1500 houses being constructed by UNHCR and 600 being constructed by German Red Cross. They have also developed a database on who is doing what where. Basically as it stands now ARC is doing water supply, UNDP – solid waste and no one is looking at sanitation and drainage.

Other activities involve the development of transitional housing with temporary WATSAN.

Tuesday (22 November 2005) – Asep, Phil, Ivan and Edison began the collection of data on the Aceh River. This work consisted of a field trip up the Aceh River to its headwaters. Its objective was to perform a temperature, conductivity, and pH survey of the river and identify potential sampling points for the completion of Concept 2: Hydrochemical Survey. On this trip, we made several valuable observations which are summarized below. The tables below present water monitoring data for the Krueng Aceh collected by PEB, Asep, Ivan and Edison and potential source of pollutions as viewed by a survey completed by local NGO's. Photographs of the field monitoring are also presented below.

Field Water Quality Data – 22 and 23 November 2005

No	Location (River name)	Coordinate	pH	Conductivity (µ S)	Temp. (° C)	Notes
1	Jantho Water Reservoir area	N 05° 15' 04.5" E 95° 35' 51.8"	-	-	-	Deforestation
2	Krueng Inong Jantho Water Reservoir	N 05° 14' 57.6" E 95° 34' 47.0"	7.8	70	22.6	Top River Krueng Inong
3	Fish pond construction	N 05° 16' 03.6" E 95° 36' 03.4"	-	-	-	-
4	Elementary School	N 05° 16' 25.3" E 95° 35' 56.8"	-	-	-	-
5	Krueng Inong	N 05° 17' 13.1" E 95° 35' 52.8"	7.8	180	24.5	-
6	Krueng Inong	N 05° 22' 00.0" E 95° 34' 15.6"	8.1	200	25.2	-
7	Jointing Krueng Agam River and Krueng Inong River	N 05° 22' 07.5" E 95° 34' 24.0"	7.8	520	27.2	-
8	Saree	N 05° 27' 09.4" E 95° 41' 48.2"	8.1	140	21.5	Top River Krueng Agam
9	Saree	N 05° 27' 10.3" E 95° 34' 52.0"	8.0	140	21.5	Top River Krueng Agam

10	Krueng Agam	N 05° 21' 27.9" E 95° 35' 51.8"	8.2	550	27.2	
11	Seulimum water reservoir	N 05° 22' 17.7" E 95° 33' 45.2"	8.2	340	26.6	
12	Krueng Aceh River	N 05° 23' 06.5" E 95° 31' 37.1"	8.1	290	26.8	
13	Sub-Krueng Aceh	N 05° 23' 00.8" E 95° 31' 27.4"	7.7	420	26.4	
14	Krueng Keumireu	N 05° 23' 47.9" E 95° 29' 28.7"	7.7	170	25.9	
15	Krueng Keumireu	N 05° 21' 27.7" E 95° 29' 44.2"	7.9	170	24.6	Top of river November 23,05
16	Gauge water station Krueng Keumireu	N 05° 21' 22.8" E 95° 29' 43.1"	-	-	-	-
17	Krueng Aceh River	N 05° 24' 11.8" E 95° 29' 29.2"	7.8	230	25.6	
18	Krueng Jreue water reservoir	N 05° 22' 18.8" E 95° 25' 58.6"	8.2	280	24.1	
19	Krueng Jreue River	N 05° 24' 36.7" E 95° 27' 07.2"	8.2	290	25.2	
20	Krueng Aceh River	N 05° 24' 47.2" E 95° 26' 45.5"	8.0	270	25.9	
21	Montasik Bridge Downstream Aceh River	N 05° 28' 10.5" E 95° 23' 39.5"	8.0	280	26.4	
22	Lubuk Bridge Downstream Aceh River	N 05° 29' 38.3" E 95° 22' 25.8"	7.9	280	26.3	
23	Up-Lambaro Rubber Reservoir Downstream Aceh River	N 05° 31' 06.0" E 95° 21' 43.1"	8.0	280	26.6	
24	Bellow-Lambaro Rubber Reservoir Downstream Aceh River	N 05° 31' 08.5" E 95° 21' 45.4"	8.0	280	26.5	
25	Pente Pirak Bridge Downstream Aceh River	N 05° 33' 13.1" E 95° 19' 14.4"	7.6	230	26.1	
26	Peunayong Bridge Downstream Aceh River	N 05° 33' 37.1" E 95° 19' 06.6"	7.7	330	26.8	
27	Beurawe Bridge Downstream Aceh River	N 05° 33' 11.4" E 95° 19' 58.4"	7.9	280	26.6	

Pollution sources in the Krueng Aceh watershed collected by NGO's

No	Location (River name)	Coordinate	pH	Conductivity (µ S)	Temp. (° C)	Notes
1	Up-stream krueng Jreu	N 05°22'20,6" E 95°25'15,6".				Deforestation
2	Krueng Inong Jantho	N 05°14'52,6" E 95°35'43,1".				Deforestation
3	Sub-Krueng Inong Jantho	N 05°15'04,6" E 95°35'51,9".				Deforestation
4	Up-stream krueng Jreu	N 05°22'20,3" E 95°25'19,4"				Deforestation
5	Sub-krueng Jreu	N 05°22'19,0" E 95°25'19,7".				Quarry
6	Sub-krueng Jreu	N 05°22'20,6" E 95°25'19,6".				Quarry
7		N 05°19'25,5" E 95°35'49,5"				Stone Crusher
8	Krueng Aceh	N 05°30'24,1" E 95°21'41,5"				Garbage Disposal
9	Seulimum Traditional market	N 05°23'45,5" E 95°41'31,7"				Garbage Disposal
10	Saree Traditional market	N 05°21'58,1" E 95°40'49,2"				Garbage Disposal
11	Krueng Aceh	N 05°24'43,3" E 95°27'05,6".				Rice Field Water Waste discharge
12	PLTD Lueng Bata	N 05°32'20,7" E 95°20'32,3".				Diesel-Water Waste Discharge

Irrigation system to supporting rice cultivate at Upstream "Krueng Inong" river (Sub-stream of Krueng Aceh River), N. Aceh Darussalam Province.

School location is one candidate for precipitation station installation, up-stream Krueng Inong, (Sub-stream of Krueng Aceh River), N. Aceh Darussalam Province. Coordinate N 05° 16’ 25.3” and E 95° 35’ 56.8”

Fish pond construction for aqua-culture activities on up-stream Krueng Inong, (Sub-stream of Krueng Aceh River), N. Aceh Darussalam Province. Coordinate N 05° 16’ 03.6” and E 95° 36’ 03.4”

Gauge station at Krueng Aceh River, N. Aceh Darussalam Province.

Quarry mining activities on river stream, Krueng Aceh River N. Aceh Darussalam Province. Coordinate N 05◦ 22' 17.7" and E 95◦ 33' 45.2"

Sand and gravel quarry mine on Krueng Keumireu River (Sub-stream of Krueng Aceh River), N. Aceh Darussalam Province. Coordinate N 05° 23' 47.9" and E 95° 29' 28.7"

Land used for cultivation on up-stream Krueng Agam (Sub-stream of Krueng Aceh River), Saree, N. Aceh Darussalam Province. N 05° 27' 09.4" and E 95° 41' 48.2". Cultivation activities are very possible to pollute the water resources by pesticide, herbicides, fertilizer, etc.

Sand and gravel quarry mine at Krueng Aceh River), N. Aceh Darussalam Province. Coordinate N 05º 24' 47.2" and E 95º 26' 45.5"

Existing general condition of land used up-stream of the Krueng Agam (Sub-stream of Krueng Aceh River), Saree, N. Aceh Darussalam Province.

Measuring the water quality activities on Krueng Aceh, Saree, N. Aceh Darussalam Province. Coordinate N 05° 23' 06.5" and E 95° 31' 37.1"

Wednesday (23 November 2005) – In the morning, Asep, Phil, Ivan and Edison continued the field survey of the river. In the afternoon, Phil left the team and joined with Sher Singh to visit the Health Department general laboratory (Unit Pelaksana Teknis Daerah – UPTD). The objective of this visit was to evaluate the labs capability in analyzing water samples. At the lab, we met several of their staff including Dr. Ormaia Nyaoemon KKea (081168103) and Zulfendi (08126925309). We found the small and clean with several new pieces of equipment donated by AmeriCares. The staff appeared to be well trained and had developed a QA/QC program for analysis. The staff training was completed by AmeriCares under the leadership of Tom Turley (0811926631 and 081318033792) from Jakarta. They gave us a list of analytes that under Indonesia Law they should analyzed for water supplies and waste water. These analytes are summarized below. The analysis of one set of samples either for water supply or waste water cost 400,000 rp. COD and BOD can be added for a cost of 20,000 rp each. Phil asked them to prepare for us a list of methods that they use for analysis and if they would mind if we gave them a set of standardized samples for their analysis to evaluated them and they said no problem.

Thursday (24 November 2005) – Worked on data tables and traveled to ESP's office in Jakarta.

Friday (25 November 2005) – Reviewed and summarized reports completed by IWACO and others for the Aceh River. In the afternoon, Phil and Asep visited the main Laboratory for PT. Sucofindo in Cibitung Bekas where we met with Dr. Widodo and Kemal Mustafa. They gave us a tour of their laboratory and price list for doing various chemical analyses. In general, the cost for doing a complete analysis meeting Indonesia criteria for fresh water was about 630,000 and for wastewater were about 1,100,000. The laboratory was very impressive. They follow similar QA/QC procedures as those used in the United States. It was clean and very efficient. They supply all sample bottles w/preservatives in tidy cardboard boxes and process all samples coming to the laboratory in a receiving room. We obtained from them the exact procedures they use for analysis. For the most part, they use USEPA approved methods. They also told us that they have laboratory in Medan. This could be useful to the project. Phil asked them if they would be willing to analyze a sample with known concentrations from us to check their procedures and they said they would. We also asked if they would be willing to help build the capacity of the laboratory for the health department in Aceh and they were not adverse to the thought.

Saturday (26 November 2005) – Phil finalized trip report and timesheet. He also purchased 2 pH meters, 2 salinity probes, and pH paper as well as calibration solutions for the salinity probe and pH 7 buffer solution.

Sunday (27 November 2005) – Phil left Jakarta on personal leave.

Sunday (11 December 2005) – Phil returned to Jakarta and talked to Asep on the phone during which plans were made for their return to Aceh the following morning.

Monday (12 December 2005) – Phil and Asep returned to Banda Aceh. On their returned they were briefed on current events in the office. This included the assessment work currently being done by Sher Singh's team and others. Asep also told Phil about what he accomplished in Jakarta during Phil's absence. Unfortunately, much of Asep time in Jakarta was spent on other ESP concerns rather than Aceh; therefore, he did not have the time to go to Bandung to collect data on wells from the Dept. of Mines and Geology or further our discussions with BMG. With this in mind, we decided to at least dedicate some of our time on this trip to revisit BMG to see if we could work directly with them on establishing met stations. In addition, Phil was able to review PowerPoint presentations prepared by Asep on basic hydrology and our on-going work in Aceh. We will endeavor to incorporate these into our proposed training program. Finally, Phil reviewed several reports which have been recently collected. The main report of interest was:

Wahana Cipta Inti, 2005, The Aceh Besar Master Plan of Water Supply – Development Water Infrastructure in Aceh Province.

This report gave valuable current information of water resources, development potential, and the reticulation system in Aceh Besar. Water sources and production units based on this report are presented in the following table.

Water Intake	Type of Source	Installed Capacity (m^3/hr)	Status	Area Served (District)
Glee Taron	Spring	128	In-use	Peukan Bada & Lohknga
Mataie 2	Spring	216	In-use	Darul Imarah
Kr. Montaia	River	54	In-use	Jantho
Kr. Aceh	River	216	In-use	Ingin Jaya
Kr Luthu	River	54	In-use	Montasik
Kr Bunga	River	36	Not in-use	Seulimeum
Total		702		

Source: PDAM Tirta Mountaia, 2005

The existing operating capacity is 666 m^3/hour (out of Kr. Bunga System).

Tuesday (13 December 2005) – The initial part of the day was spent developing forms to be filled in during the initial "Livelihood Village Assessment" which will be completed in the later part of December by the team. During this assessment, an effort will be made to collect water samples from supply wells for field and laboratory analysis. Asep drafted up the initial field formed to be filled out. It anticipated that data collected during this visit will be placed in a database which is currently being designed.

Asep, Suhendi, and Phil revisited the BMG at the airport and met once again with the Head of Geophysics and Meteorology Bureau of Banda Aceh Province, Mr. Samsuir. We told him of our concept to cost-share at least two automatic weather stations. This concept he really liked. He called directly his office in Jakarta and Asep was able to discuss our program with them. They also told us they would be happy to work with us. During our meeting with Mr. Samsuir, we were given specifications for equipment and the preferred compatible equipment (CIMEL) which their current communications system. In terms of cost sharing, he told us that at our sites (tentatively the Banda Aceh Airport and Meulaboh) that they would supply the sites, security, fencing, foundations, and calibration should we provide the equipment. We also told him of our plans for School Met program. He said he personally would love to help and would provide his services in teaching children about meteorology. He told us he was formally a teacher. We also talked of our plans in Kr. Geupu and he also offered assistance. THIS MEETING WAS GREAT!!!!

After the meeting with BMG, we met with Pak Fauzi the Director of Flood Control and Coast Pacification Project-The Public Work Agency of NAD Province. He also was very helpful to us and gave us two publications. These included:

1. Departemen Permukiman Dan Pengembangan Wilayah-Kantor Wilayah Pekerjaan Umum Daerah Istimewa Aceh, 2000, DATA DEBIT SUNGAI PROPINSI DAERAH ISTIMEWA ACEH TAHUN 2000.
   This report contained methodologies used for gauging streams, monthly flow data and analysis for several rivers in the region for the calendar year of 1999. We were also told that we could get digital copies of these data in the Jakarta office.
2. The second report which was provided in hard copy and digitally was:

Pemerintah Provinsi Nanggroe Aceh Darussalam Dinas Sumber Daya Air, 2003, DATA SATUAN WILAYAH SUNGAI, SWS 01.01–SWS01.08.

This report contained basis data as presented below for all rivers in the region.

DATA OF RIVER UNIT AREA (RUA) NANGROE ACEH DARUSSALAM PROVINCE

Name of the river			**Krueng Aceh**	**Krueng Geupu**
Length		**(Km)**	**113.00**	**53.00**
Width	Downstream	(M)	60.00	11.00
	Midstream	(M)	57.00	10.45
	Upstream	(M)	51.00	9.35
Debit	Max	M^3/Sec	85.20	53.00
	Min	M^3/Sec	10.38	1.37
	Average	M^3/Sec	19.10	3.86

Name of the river			**Krueng Aceh**	**Krueng Geupu**
Water Resources		**M^3/Year**	**602,337,600.00**	**121,728,960.00**
Slope (I)	Downstream	(M)	0.00412	0.02620
	Midstream	(M)	0.00433	0.02751
	Upstream	(M)	0.00474	0.03013
Drainage Basin Area		(Km^2)	1,780.00	91.00
Est. Gauging Equip			ARR & AWLR	---
Irrigated Area		(Ha)	D.I. Kr. Aceh	---
Irrigated Width		(Ha)	7,384.00	---
Flood Plain		(Ha)	2,100.00	92.00
Remark's			Sedimentation in River mouth	---

Sources: 1. Data of River Debit Aceh Nangroe Darussalam Year 1993 s/d 1999.
2. Realization of Irrigation Development by CV.Studio 78 Year 1993
3. Inventory of Critical Flood Area Aceh Nangroe Darussalam by PT.Wahana Adya Ye 1993

He also gave us .jpg maps of hydrographic regions and yearly flooded areas.

For the future program he would like to support and have a good relationship with ESP-USAID Aceh program. His agency would participate and send several technical staff to attend the "Hydrology and Hydro-Met Training Class" next January-February 2006 in Banda Aceh.

Wednesday (14 December 2005)- Phil initiated the design and construction of Access Database for the groundwater and surface water data to be collected over the next three year. Initial work was completed on the input form design. The format of this form will be very similar to field survey form that is being developed by Asep. Asep calibrated field instruments and developed a field survey plan as well as prepared training material the hydrology survey equipment for following survey on hydrology Aceh West Coast**.**

Thursday (15 December 2005)- Phil traveled with Aart to Lamkruet and visited the Pheukrueng Raba spring which is approximately 2 km east of the town and a possible water source. Photos of the spring and basic data are presented below. After Lamkruet, they went to Lhoong and met with Dr. Agung who is head of the medical clinic there. He told us that they had very hard problem finding water and that the only good well was contaminated with E. Coli. After visiting the well head it was easy to see why. It was within a meter of their septic tank. They then proceeded to find alternative water resources for the clinic. About 150 m south of the clinic is Kr. Lung which appeared to be flowing very clear. In talking to locals, it appears that the river flows all year around but the flow is very low during the dry season. By placing a shallow well in the alluvium of the river or a pipe under the river and pumping the water to filtration system might be the way to go to provide water for the clinic. They also met with a local school principal and he told them that he was very keen in working with ESP on the school met system.

Asep trained the WSM team ESP-USAID Aceh employees on field hydrologic survey procedures and equipment operation. After training, they conducted a field survey to collect hydrologic data and information on Aceh West Coast as presented below.

No. 1

Date : Dec 15, 2005	**Sampler's : Asep Mulyana-Hendra-Ivan**	**Time : 10.45 AM**
Village Name	Street : Empe Raseu River Kampung : Lampuu Desa : Meunasah Balee Kecamatan : Lhoknga Kabupaten : Aceh Besar Propinsi : NAD Phone number :	
Name owner of well	- (river and spring)	
Coordinates of well or spring	N 05 ° 30' 38.2" and E 95 ° 13' 34.9"	UTM
Depth of well	- meter	
Surface of groundwater level	-	
Altitude	- meter	
Diameter of Well	Open hole Ø : - Cm	Casing Ø : - Cm
Distance from the septic tank	- meter	
Field data :		
Odor	No : Weak : Strong	H_2S :
pH	8.3	
Conductivity	- μ S	
Salinity	314 ppm	
Temperature	24.8 °C	
Turbidity	Clear Cloudy	Dark
Dissolved Oxygen	-	
Weather	Rainy Cloudy	Sunny

Notes

- Founded the remnant small water storage which is the PDAM constructed on 1980, and it was destroyed by flooded.
- Presently the local people are using the water resources for drinking, washing, bathing and others.
- SPD-USAID program is doing construct the small water treatment and it will use the raw water material from this river.

Pictures :

No. 2

Date : Dec 15, 2005	**Sampler's : Asep Mulyana-Hendra-Ivan-Setyabudi**	**Time : 12.49 AM**
Village Name	Street : - Kampung : - Desa : Lamkreut Kecamatan : Lhoknga Kabupaten : Aceh Besar Propinsi : NAD Phone number : -	
Name owner of well	-	
Coordinates of dug well or spring	N 05 ° 28' 37.7" E 95 ° 13' 34.9"	UTM
Depth of dug well	7.5 meter	
Surface of groundwater level	0.6 meter	
Altitude	- meter	
Diameter of Well	Open hole Ø : 100 Cm	Casing Ø : - Cm
Distance from the septic tank	- meter	
Field data :		
Odor	No : Weak :	Strong : H_2S :
pH	6.5	
Conductivity	- μ S	
Salinity	933 ppm	
Temperature	27.3 °C	
Turbidity	Clear Cloudy	Dark
Dissolved Oxygen	-	
Weather	Rainy Cloudy	Sunny

Notes

- Local people used the water for drinking water and others their necessity.
- Well dry during the dry season.
- Turbidity and salinity are high.
- No septic tank was established.
- The well is constructed after Tsunami.

Pictures :

No. 3

Date : Dec 15, 2005	*Sampler's : Asep Mulyana-Hendra-Ivan-Setyabudi*	*Time : 12.59 AM*	
Village Name	Street : - Kampung : - Desa : Lamkruet Kecamatan : Lhoknga Kabupaten : Aceh Besar Propinsi : NAD Phone number :		
Name owner of well	-		
Coordinates of dug well or spring	N 05 ° 28' 36.9" and E 95 ° 14' 40.7"	UTM	
Depth of well	6.9 meter		
Surface of groundwater level	0.6 meter below ground surface.		
Altitude	73 meter		
Diameter of Well	Open hole Ø : 100 Cm	Casing Ø : - Cm	
Distance from the septic tank	- meter		
Field data :			
Odor	No : Weak :	Strong :	H_2S :
pH	6.3		
Conductivity	- μ S		
Salinity	887 ppm		
Temperature	27.8 °C		
Turbidity	Clear Cloudy	Dark	
Dissolved Oxygen	-		
Weather	Rainy Cloudy	Sunny	

Notes

- Azimuth to next dug well is N 220 ° E, and horizontal distance = 10 meter.
- Salinity is high.
- Water resources are proposed for drinking water and others necessity.
- The well is constructed after Tsunami.

Pictures :

No. 4

Date : Dec 15, 2005	**Sampler's : Asep Mulyana-Hendra-Ivan-Setyabudi**		**Time : 13.04 AM**
Village Name	Street : - Kampung : - Desa : Lamkruet Kecamatan : Lhoknga Kabupaten : Aceh Besar Propinsi : NAD Phone number :		
Name owner of well	-		
Coordinates of dug well or spring	N 05 ° 28' 36.5" and E 95 ° 14' 40.6"		UTM
Depth of well	7.75 meter		
Surface of groundwater level	0.3 meter below ground surface.		
Altitude	78 meter		
Diameter of Well	Open hole Ø : 1 meter		Casing Ø : - Cm
Distance from the septic tank	- meter		
Field data :			
Odor	No :	Weak :	Strong : H_2S :
pH	6.6		
Conductivity	- μ S		
Salinity	512 ppm		
Temperature	27.5 °C		
Turbidity	Clear	Cloudy	Dark
Dissolved Oxygen	-		
Weather	Rainy	Cloudy	Sunny

Notes

- Azimuth to the next well N 190 °E and horizontal distance 32 meter.
- The well is constructed after Tsunami.
- Turbidity and salinity are high.

Pictures :

No. 5

Date : Dec 15, 2005	**Sampler's : Asep Mulyana-Hendra-Ivan-Setyabudi**	**Time : 13.09 AM**
Village Name	Street : - Kampung : - Desa : Lamkreut Kecamatan : Lhoknga Kabupaten : Aceh Besar Propinsi : NAD Phone number :	
Name owner of well	Syaiful Kamal	
Coordinates of well or spring	N 05 ° 28' 35.3" and E 95 ° 14' 40.4"	UTM
Depth of dug well	7.2 meter	
Surface of groundwater level	0.2 meter below ground surface.	
Altitude	76 meter	
Diameter of dug Well	Open hole Ø : 1 meter	Casing Ø : - Cm
Distance from the septic tank	- Meter	
Field data :		
Odor	No : Weak :	Strong : H_2S :
pH	7	
Conductivity	- μ S	
Salinity	433 ppm	
Temperature	27.3 °C	
Turbidity	Clear Cloudy	Dark
Dissolved Oxygen	-	
Weather	Rainy Cloudy	Sunny

Notes

- Turbidity is high and well is constructed after Tsunami.

Pictures :

No. 6

Date : Dec 15, 2005	**Sampler's : Asep Mulyana-Hendra-Ivan-Setyabudi**	**Time : 13.16 AM**
Village Name	Street : - Kampung : - Desa : Lamkreut Kecamatan : Lhoknga Kabupaten : Aceh Besar Propinsi : NAD Phone number :	
Name owner of well	-	
Coordinates of dug well or spring	N 05 ° 28' 34.4" and E 95 ° 14' 47.7"	UTM
Depth of dug well	4.35 meter	
Surface of groundwater level	0.8 meter below ground surface.	
Altitude	87 meter	
Diameter of Well	Open hole Ø : 1.5 meter	Casing Ø : -Cm
Distance from the septic tank	- meter	
Field data :		
Odor	No : Weak :	Strong : H_2S :
pH	5.5	
Conductivity	- μ S	
Salinity	620 ppm	
Temperature	28.4 °C	
Turbidity	Clear Cloudy	Dark
Dissolved Oxygen	-	
Weather	Rainy Cloudy	Sunny
Notes	Pictures :	

No. 7

Date : Dec 15, 2005	**Sampler's : Asep Mulyana-Hendra-Ivan-Setyabudi**		**Time : 14.00 AM**
Village Name	Street : - Kampung : - Desa : - Kecamatan : Lhoknga Kabupaten : Aceh Besar Propinsi : NAD Phone number :		
Name owner of well	(spring water and river)		
Coordinates of well or spring	N 05 ° 27' 38.1" and E 95 ° 15' 41.3"		UTM
Depth of well	? meter		
Surface of groundwater level	-		
Altitude	46 ft		
Width of river	43 meters		Casing Ø : - Cm
Distance from the septic tank	- meter		
Field data :			
Odor	No :	Weak :	Strong : H_2S :
pH	7.6		
Conductivity	- µ S		
Salinity	162 ppm		
Temperature	23.8 °C		
Turbidity	Clear	Cloudy	Dark
Dissolved Oxygen	-		
Weather	Rainy	Cloudy	Sunny

Notes

- Debit the spring or river dependent the season, and needed assessment to define water debit in dry season.
- Generally water parameters are suitable as raw material for drinking water.

Pictures :

No. 8

Date : Dec 15, 2005	**Sampler's : Asep Mulyana-Hendra-Ivan-Setyabudi**	**Time : 14.20 AM**
Village Name	Street : - Kampung : - Desa : Lamkreut Kecamatan : Lhoknga Kabupaten : Aceh Besar Propinsi : NAD Phone number :	
Name owner of well	Lam Kruet Great Mosque	
Coordinates of well or spring	N 05 ° 28' 42.6" and E 95 ° 14' 45.4"	UTM
Depth of well	2.4 meter	
Surface of groundwater level	1.8 meter below ground surface.	
Altitude	80 meter	
Diameter of Well	Open hole Ø : 1.5 meter	Casing Ø : - Cm
Distance from the septic tank	± 3 meter	
Field data :		
Odor	No : Weak :	Strong : H_2S :
pH	6.3	
Conductivity	- μ S	
Salinity	417 ppm	
Temperature	28.7 °C	
Turbidity	Clear Cloudy	Dark
Dissolved Oxygen	-	
Weather	Rainy Cloudy	Sunny

Notes

- The well is very close with the septic tank and possibly affected by septic tank, so it is need to analyze of bacteria, nitrate and nitrite component.
- The salinity is high and the conductivity would be high too.

Pictures :

No. 9

Date : Dec 15, 2005	**Sampler's : Asep Mulyana-Hendra-Ivan-Setyabudi**		**Time : 10.45 AM**	
Village Name	Street : - Kampung : - Desa : Lamkreut Kecamatan : Lhoknga Kabupaten : Aceh Besar Propinsi : NAD Phone number :			
Name owner of well	Contruction Quarry Mine			
Coordinates of well or spring	N 05 ° 29' 59.1" and E 95 ° 13' 54.9"		UTM	
Depth of well	- meter			
Diameter of Well	Open hole Ø : - Cm		Casing Ø : -	Cm
Distance from the septic tank	- Meter			
Field data :				
Odor	No :	Weak :	Strong :	H_2S :
pH	-			
Conductivity	- µ S			
Salinity	- ppm			
Temperature	- °C			
Turbidity	Clear	Cloudy	Dark	
Dissolved Oxygen	-			
Weather	Rainy	Cloudy	Sunny	

Notes

- The mining activities was begun early 1960. The mining practices without mine design, mine planed, reclamation planed, safety and health procedures.
- All activities are very dangerous for miners (no personal protector) and very high risk impacts to the environment.
- Mining activities are creating unstable slope, and very possibilities for landslide or rock fall accident and could be kill some miners or burry the equipments.
- All miners don't have knowledge or understand the basic concept of mining activities, and they don't understand what kind of the risk they will get. Etc.

Pictures :

Friday, 16 December 2005 – In the morning Asep finalized field notes from the hydrologic survey completed the day before and Phil continued working on the database design. In the afternoon, both Phil and Asep flew to Jakarta. Phil went into the office and brief Bill and Reed on activities in Aceh.

Saturday, 17 December 2005 – Phil and Asep met with Pak Yanto the Sales and Marketing manager for Pila and Company who the suppliers of unattended low consumption CIMEL Automatic Weather Stations. These are French made and have a recording capacity of 2 to 16 channels with various operating modes depending on the application: local, memory card transfer, telephone link, GSM, satellite. Operating software is available for meteorological, climatic, agroclimatic and aeronautical applications. These are preferred stations by BMG.

CIMEL AWS

Phil also talked to Bill and Reed and it was decided to concentrate on American made products, installation, and training.

Monday, 19 December 2005 – Phil finalized expense report, did a final briefing to Reed and Bill and left to the US.

APPENDIX D – SUMMARY PRELIMINARY POLLUTION SURVEY KRUENG ACEH, NANGGROE ACEH DARUSSALAM PROVINCE BY NGO'S

PRELIMINARY POLLUTION SURVEY KRUENG ACEH – NANGGROE ACEH DARUSSALAM PROVINCE

BY : NGO's
1. Masyarakat Penyayang Alam dan Lingkungan Hidup (MAPAYAH)
2. Peduli Nanggroe Atjeh (PeNA)

MAPAYAH FOUNDATION

PeNA

MASYARAKAT PENYAYANG ALAM DAN LINGKUNGAN HIDUP (MAPAYAH)

PEDULI NANGGROE ATJEH (PENA)

Krueng Aceh or Aceh River is the bigest and largest river in Nangroe Aceh Darussalam Province. The water resources this river coming from some significant tributaries, such as :

- Sub DAS Krueng Jreu.
- Sub DAS Krueng Keumireu (Cot Glie area and vicinity).
- Sub DAS Krueng Inong (Jantho area and vicinity).
- Sub DAS Kr. Agam/Buga (Seulimum area and vicinity).

The PDAM (The Local Water Supply Compny) is pumping and used the Krueng Aceh water resources for water raw material to supply for all costumer, also the local people using the water resouces for others purpose such as; for rice field irrigation, aqua culture activities, industries, pactories and others used.

For understanding the real condition and identify the set of the problems, then conducted the preliminary river survey are included some tributaries; sub-DAS Lambaro and vicinity, Sub-DAS Krueng Jreu (ndrapuri and vicinity), ub-DAS Krueng Keumireu (Cot Glie and vicinity), Sub-DAS Krueng Inong (Jantho and vicinity), Sub-DAS Krueng Agam/Buga (Seulimum and Saree and vicinity).

Field Founded Activities

Field finding shown that almost upper stream the Krueng Aceh was critical by uncontrolled activities, and moreover founded the small river was dry.

A. Illegal logging and forest fires are found at :

1. Illegang logging are founded at embankment of upper stream of Krueng Jreu coordinate N 05°22'20,6" E 095°25'15,6" and Sub-DAS krueng Inong, Janthoe, coordinate N 05°14'52,6" E 095°35'43,1".
   In some cases the illegal logging at embankment river caused landslide and river abrassion
2. People ignited or burn the forest or bushes during preparation for cultivation or during hunting. Forest or bushes fires found at Sub-DAS Krueng Inong, coordinate N

05°15'04,6" E 095°35'51,9" and Sub-DAS krueng Jreu, coordinate N 05°22'20,3" E 095°25'19,4" also in Sub-DAS krueng Kemireu.

B. Quarry mine (regolith) activities which are take place nearby the embankment of the river and in stream river;

1. Quarry mine nearby Sub-DAS Krueng Jreu, coordinate N 05°22'19,0" E 095°25'19,7".
2. Quarry mine in stream river of krueng Jreu, N 05°22'20,6" E 095°25'19,6". And almost along in every river found the quarry activities.

C. Solid waste (domestic waste), the leachet from the domestic waste very possible polluted the surface or groundwater resources.

1. Solid waste disposal nearby the krueng Aceh, coordinate N 05°30'24,1" E 095°21'41,5"
2. Seulimum traditional market which disposed nearby embankment of the Krueng Seulimum, coordinate N 05°23'45,5" E 095°41'31,7"
3. Saree traditional market, coordinate N 05°21'58,1" E 095°40'49,2"

D. Waste water from ricefield and diesel power plant

The farmer used huge volume number of herbiced, pesticide and insecticide to increase the harvest. Discharge waste water which was polluted by the chemical component that could be pollurte the river water resources. Coordinate water discharge from ricefield N 05°24'43,3" E 095°27'05,6" and discharge from diesel power plant which was polluted by hydrocarbon, coordinate N 05°32'20,7" E 095°20'32,3".

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