Figure 1 - Collection of surface water samples for field screening in Barrow, Alaska.

Designing a hands-on environmental sampling training course for students that meets the requirements of industry

Keith Torrence, Ph.D., CPG-11647

Birgit Hagedorn, Ph.D.

A large percentage of new geology graduates will find employment within the environmental sector and will likely be engaged with clients and regulatory agencies on permitting, environmental baseline studies, contaminated site assessment, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and on supporting engineering projects. Compared to the traditional mining and oil & gas sectors, demand for environmental professionals is generally less volatile, is often based in major population centres and offers a greater degree of career stability. The environmental profession encompasses a wide range of degrees, including chemistry, engineering, geology, hydrology, environmental law, and biology. This can make for a varied and stimulating career choice.

As undergraduate studies rarely provide an adequate foundation for defensible environmental sampling and data

collection, environmental consulting companies generally provide on the job training of new staff in the field. This can limit training to project-specific tasks, with quality assurance and control considerations dictating sampling methodology, but on-the-job training often fails to provide background knowledge of sampling media and understanding of why these methodologies and regulations are in place and important. Further, each individual state can mandate sampling protocols and analytical methods, which can be challenging for out of state crews. Mistakes in the field can be difficult and expensive to rectify.

> A core focus of the workshop is to provide hands-on experience with sampling and monitoring equipment that is prevalent in the industry.

The State of Alaska regulates water quality, contaminated sites, air quality, and spill response through the Department of Environmental Conservation (DEC). This agency publishes a *Field Sampling Guide*[1] which provides fundamental guidelines, methods and equipment options for sample collection at sites under their jurisdiction. This guidance is supplemented by additional guidance documents and memoranda to address specific sampling issues and contaminants of concern. Much of this guidance is promulgated as regulations in 18 AAC 75 and 18 AAC 78.[2] Of note is that these regulations specify the minimum qualifications for environmental samplers and for environmental professionals who prepare work plans, investigative and other reports. Analytical data from samples that have been collected by technicians who do not meet these qualifications may not be acceptable to DEC.

At one level the role of an environmental sampler is straightforward. Analytical laboratories provide the appropriate bottles, jars and coolers. Soil and water samples must be collected at the correct locations, preserved and shipped to the laboratory within the specified holding time. In practice, environmental samplers are the eyes on the ground and are often required to adapt quickly to actual situations. This requires a basic understanding of the pollutant (e.g. gasoline) to be sampled and of its interaction with water and soil.

In Alaska, most remediation projects are undertaken in remote locations where the logistics of deployment and transport add greatly to the complexity (and cost) of the project. Staffing these projects with local people, who have experience of the conditions and the necessary field craft, makes economic sense for the consultant and the community: most villages in Alaska have chronic unemployment. Therefore, training of local hires in robust environmental sampling methodology benefits all parties. To meet this objective, we have designed a training program in environmental sampling, drawing on our decades of field experience. A kick-off workshop was held in Utqiagvik (Barrow), Alaska in 2015, with support from Ilisagvik College and, Ukpeaġvik Iñupiat Corporation. The goal of this initial workshop was to help local residents gain seasonal employment on the numerous federal remediation projects in the region. Since this first workshop, the training has been further developed based on student feed-back, state requirements, changing regulations and incorporation of topical issues, such as multi-incremental sampling and the specific requirements for sampling of polyfluorinated substances (e.g. PFAS). To date, over 50 students have participated in workshops. In 2016, the State of Alaska recognised this course as meeting the educational requirement to become a Qualified Environmental Sampler.

The core module of the workshop is the collection of soil and water samples using a methodology that would be acceptable to the Alaska Department of Environmental Conservation (ADEC) and following proper protocols to preserve and document sample collection using chain of custody forms. Other modules cover soil classification and screening methods, monitoring well design and measurements, groundwater sample collection, discharge measurements and overall contaminated site assessment. The latter was of great interest to many course participants given the high number of contaminated sites in rural Alaska.

Figure 2. Students collecting soil samples using a Dutch auger.

A typical workshop program is shown on page 30.

A core focus of the workshop is to provide hands-on experience with sampling and monitoring equipment that is prevalent in the industry. For example, multi-parameter water meters were used in preference to laboratory-grade individual pH meters as in our experience these are more commonly used by professional consulting companies. In-state analytical laboratories that are primarily used for environmental projects provided sampling bottles and instructions on sampling as required for their laboratory analysis for hands-on sampling. Considerable emphasis is placed on the proper calibration of monitoring and screening instruments (e.g. pH, turbidity, photo-ionization (PID) for volatiles) and the documentation necessary to support field measurements. Field exercises of 2 to 4 hours provide

1. Alaska Department of Environmental Conservation. Field Sampling Guidance, August 2016.
2. AAC -Alaska Admin Code; regulations promulgated by State Agencies.

Syllabus
Qualified Environmental Sampler

Day 1

Introduction to "Qualified Environmental Sampler" (classroom):

Conceptual site models, environmental media & contaminants, sampling plans, sampling strategies, safety protocols, general sample handling, quality control

Water Quality and sampling (classroom):

Water cycle, water in permafrost environments, water quality and contaminants, examples in Alaska, drinking water standards, water sampling strategies, field parameter, related instrumentation.

Field equipment (lab):

Introduction to field monitoring equipment, calibration procedure, storage, testing equipment and some standard analysis methods.

Day 2

Sample handling (classroom):

Handling of environmental samples, holding time, preservation, QC samples, packing of cooler, shipment, receiving and transport.

Water sampling exercise (lab).

Lab: Establishing a sampling plan, example University Lake, sampling location, sample IDs, calibration of equipment, sample container, sampling equipment list.

Field: Basic water quality measurement, sampling and preservation, discharge measurement, packing of cooler, chain of custody forms.

Q&A water sampling.

Discussion: Sample labelling, trip blanks, field blanks, field book, COC, temperature monitoring blank….

Day 3

Groundwater (classroom): Occurrence and sampling methods, different pump systems, contamination of groundwater by hydrocarbons (classroom).

Preparation for groundwater sampling (lab): Calibration of monitoring equipment, development of sampling plan, packing of sampling equipment.

Groundwater sampling (field), groundwater level, volume calculation, pump test, usage of flow-cell with YSI, Inc., equipment to determine stabilization of GW parameter.

Q&A: Groundwater sampling: Comparing groundwater and surface water samples, lessons learned.

Day 4

Soil and sediment (classroom):

What are soils and how do they form, permafrost soil, soil physical and chemical characteristics,

Contaminated soil, action levels, soil sampling and PID[3] screening, sampling strategy, soil classification, packing of sample container.

Soil sampling and description (field), Soil sampling grid, different sampling methods, field classification of soil, screening.

Determination of soil properties (lab): moisture content, wet and dry weight, soil grain size analysis (sieving and settling method).

Q&A Discussion and Certification

3. Photoionization Detector.

hands-on exercise of soil, surface water, and groundwater sampling to implement what was learned in the classroom. At the end of each module is a discussion of the material, with question and answer session and review of exercises.

From our experience of running these environmental sampler workshops we firmly believe that there is demand for this format of training with its emphasis on field exercises. Our original target cohort were seasonal workers, but a review of attendees over the past five years shows much broader backgrounds, including regulators and NGOs. Indeed, a challenge of the workshop has been to address the variation in the student's backgrounds and education, which ranges from bachelor or master degree in environmental sciences, chemistry, geology or engineering with or without job experience, through environmental samplers with 20+ years of experience to people completely new to the job and with no exposure to environmental training.

Discussions in the classroom and feedbacks at the end of the workshop highlight the value of this training across the range of people that were exposed to it within the last five years. It is difficult to keep track of the students and their employment, but meetings with some of them at environmental conferences or on the job working with environmental companies suggests that their evaluation of the workshop is very positive. For the last two years the Alaska Forum on the Environment has adapted this workshop as a module in their Apprenticeship program for workforce development in the environmental field. Based on the feedback from students we continue to develop course modules and plan to run future workshops outside of Alaska and, indeed, outside of the United States.

About the Authors

Dr Keith Torrance is an environmental geochemist who has worked on contaminated site assessment and remediation projects in Alaska since 2010. He recently joined the University of Strathclyde in Glasgow, Scotland to work on the EU-funded SURICATES project, investigating the beneficial reuse of dredged sediments from Scottish canals. He is a Certified Professional Geologist (CPG-11647) and a Chartered Geologist (CGeol).

Birgit Hagedorn has a PhD in Geochemistry from the University of Heidelberg, Germany. She did research for 25 years in the Arctic and Antarctica and trained a number of students in water and permafrost sciences before she started her environmental and analytical consulting company in Anchorage, Alaska.