



**4-Day Field Sampling Course
COURSE OUTLINE
SOIL, SOIL GAS & GROUND-WATER SAMPLING FIELD COURSE
May 17 - 20, 2010
Calgary, AB, Canada**

Contact Frank Magdich at Oak Environmental for more information or to register - # (403) 250-9810 or frank@oakenviro.com

Principal Instructors:

Gillian L. Nielsen, Principal, The Nielsen Environmental Field School

David M. Nielsen, C.P.G., C.G.W.P., P.Hg., The Nielsen Environmental Field School

Monday, May 17, 2010 - Carriage House Inn – 9030 MacLeod Trail S

7:30 a.m. - 8:00 a.m.

Course Registration

8:00 a.m. - 8:30 a.m.

Welcome, Overview of Course Objectives and Materials, Introduction to Course Instructors

- *Gillian L. Nielsen*

8:30 a.m. – 9:30 a.m.

Planning an Effective Environmental Sampling Program – The Sampling & Analysis Plan

- Components of an Effective Sampling & Analysis Plan
- Selecting Appropriate Analytical Parameters and Methods
- Quality Assurance/Quality Control Practices and Procedures
- Detailed Media-Specific Standard Operating Procedures
 - Selection and Operation of Sampling Devices
 - Sample Collection Methods
 - Sample Description
 - Field Parameter Measurement
- Field Decontamination Procedures
- Sample Handling and Shipment
- Documentation of Sampling Events

- *Gillian L. Nielsen*

9:30 a.m. – 9:40 a.m. Break

9:40 a.m. – 10:30 a.m.

Strategies for Three-Dimensional Sampling of Environmental Media

- Conducting an Effective Site Reconnaissance Program
- Selecting Environmental Media to be Sampled
- Selecting Strategies for Sampling
 - Determining Sample Type
 - Grab vs. Composite Samples

10:30 a.m. – 10:40 a.m. Break

10:40 a.m. – 11:45 a.m.

Strategies for Three-Dimensional Sampling of Environmental Media

- Selecting Strategies for Sampling
 - Determining Most Effective Sample Locations
 - Haphazard Sampling
 - Judgmental Sampling
 - Statistical Sampling
 - Aerial Search Sampling
 - Hybrid Sampling
 - Multi-Incremental Sampling

- Gillian L. Nielsen

11:45 a.m. – 1:00 p.m. Lunch Break (Provided at Carriage House Inn)

1:00 p.m. – 2:00 p.m.

Field Equipment Decontamination Procedures

- Objectives of Field Equipment Decontamination
- Clarification of Important Terminology
- Field Decontamination Methods and Protocol Selection
- Potential Problems Associated with Use of Chemical Desorbing Agents for Cleaning
- Verifying Effectiveness of Decontamination

- Gillian L. Nielsen

2:00 p.m. – 2:10 p.m. Break

2:10 p.m. – 3:10 p.m.

Field Quality Assurance/Quality Control

- The Difference Between Field Quality Assurance and Field Quality Control
- Understanding the Importance of Field QA/QC
- Typical Components of a Field QA/QC Program
- In-Depth Discussion of Objectives and Collection Methods for Field Quality Control Samples
 - Trip Blanks
 - Temperature Blanks
 - Field Blanks
 - Equipment Blanks
 - Blind Duplicates
 - Blind Spiked Samples
 - Field Split Samples

- How Many Field QC Samples Should Be Collected

- Gillian L. Nielsen

3:10 p.m. – 3:20 p.m. Break

3:20 p.m. – 4:20 p.m.

Environmental Sample Handling and Shipment

- Preparation of Samples for Shipment
- Using Sample Tamper-Proofing Mechanisms
- Avoiding Common Errors Associated with Using Chain-of-Custody Forms
- Hand Delivery of Samples vs. Lab Couriers vs. Commercial Carriers for Getting Samples to the Lab for Analysis
- Ensuring Compliance with Applicable Shipping Regulations (DOT and IATA)
 - Determining What Hazard Characteristics Samples Have
 - How Hazard Characteristics Affect Sample Shipment Methods
 - What Can Happen If Samples Are Not Shipped in Compliance with Regulations

- Gillian L. Nielsen

4:20 p.m. – 4:30 p.m. Break

4:30 p.m. – 5:30 p.m.

Sampling Event Documentation

- Written vs. Electronic vs. Audio-Visual Recording of Field Activities
- The Dangers of Using Forms for Field Note Taking
- Some Do's and Don'ts When Documenting Field Observations and Measurements
- How to Make Sure Your Field Records are Admissible in Court
- New Laws Affecting E-Documents You Need to Be Aware Of
- Digital vs. Traditional Cameras

- Gillian L. Nielsen

5:30 p.m. Course Adjourns for the Day

Tuesday May 18, 2010 - Carriage House Inn – 9030 MacLeod Trail S

8:00 a.m. – 8:50 a.m.

Fundamentals of Soil Sampling

- Typical Objectives of Soil Sampling Programs
- Understanding the Complexities of a Soil Sample
- Common Soil Sampling Strategies
 - VOCs/SVOCs
 - Petroleum Hydrocarbons
 - Metals
 - Bacteria

- Gillian L. Nielsen

8:50 a.m. – 9:00 a.m. Break

9:00 a.m. – 9:50 a.m.

Fundamentals of Soil Sampling

- Factors that Influence Selection of Sampling Equipment
- Selection and Operation of Available Sampling Devices
 - Hand-Operated Sampling Devices
 - Mechanically Assisted Hand-Operated Devices
 - Test Pits
 - Direct-Push Methods
 - Drilling-Rig Based Methods
- *David M. Nielsen*

9:50 a.m. – 10:00a.m. Break

10:00 a.m. – 10:50 a.m.

Soil Sample Handling and Processing for VOCs Using Method 5035A

- Objectives of Method 5035A
- Volumetric Sample Collection Methods – EnCore Samplers
 - Overview of Field Techniques and Equipment Requirements
 - Limitations of the Method
- Chemical Preservation/Extraction Methods
 - Overview of Field Techniques and Equipment Requirements
 - Limitations of the Method
- *Gillian L. Nielsen*

10:50 a.m. – 11:00 a.m. Break

11:00 a.m. – 11:50 a.m.

Soil Gas Sampling

- Understanding How Soil Gas Behaves in the Subsurface
- Soil Gas Sampling Probe Installation Options
- *Gillian L. Nielsen*

11:50 a.m. – 12:00 p.m. Break

12:00 p.m. – 12:30 p.m.

Soil Gas Sampling

- Soil Gas Sample Collection, Handling & Analysis
- *Gillian L. Nielsen*

12:30 p.m. – 1:45 p.m. Lunch (On Your Own)

1:45 p.m. – 5:30 p.m.

Field Session 1: 2 Concurrent Sessions of 110 Minutes Each
(Location approximately 15 minute drive from Carriage House Inn)

Station 1: Direct-Push Sampling and Field Sample Analysis

Direct-Push Sample Collection Methods

- **Discrete and Continuous Soil Sampling Methods**
- **Soil Gas Sampling**
- **Formation Profiling Using an Electrical Conductivity Probe**
- **Collection of Ground-Water Samples Without a Well**
- **Direct-Push Well Installation Methods**
- *David M. Nielsen, Nielsen Environmental Field School*
- *Direct-Push Contractor – G & R Envirocore*

Station 2: Field Soil Sample Preparation and Analysis & Soil Gas Sample Analysis Methods

- **Preparation of Soil Samples for VOC Analysis Using Method 5035 Techniques**
- **Field Analysis of Soil Gas Samples**
- *Gillian L. Nielsen, Nielsen Environmental Field School*

5:30 p.m. Adjourn for the Day

Wednesday May 19, 2010 - Carriage House Inn – 9030 MacLeod Trail S

8:00 a.m. - 8:30 a.m.

Discussion of Previous Day's Field Sessions and Practical Problem Solutions
- *Gillian L. Nielsen*

8:30 a.m. – 9:20 a.m.

The Science Behind Ground-Water Sampling – Part 1

- Objectives and Purposes of Ground-Water Sampling
 - Conditions Under Which Ground-Water Typically Occurs
 - Definition of a “Representative” Sample
 - Factors Affecting the Representative Nature of Ground-Water Samples
 - Sampling Point Placement, Design, Installation, Development and Maintenance
 - Formation and Well Hydraulics
 - Between Sampling Events
 - During Sampling Events
 - Chemistry of the Water Column Above and Within the Well Screen
- *David M. Nielsen*

9:20 a.m. – 9:30 a.m. Break

9:30 a.m. – 10:20 a.m.

The Science Behind Ground-Water Sampling – Part 2

- Factors Affecting the Representative Nature of Ground-Water Samples
 - Well Purging and Sampling Methods and Associated Issues
 - Agitation and Aeration of the Water Column in the Well
 - Over-pumping

- Sampling-Related Pressure and Temperature Changes
- Exposure of the Sample to Atmospheric Conditions

- *David M. Nielsen*

10:20 a.m. – 10:30 a.m. Break

10:30 a.m. – 11:20 a.m.

Commonly Used Purging and Sampling Methodologies

- Objectives of Purging
- Comparison of Traditional Strategies for Purging High-Yield Wells
 - Well-Volume Purging
 - Purging to Field Indicator Parameter Stabilization
 - Using Packers to Isolate Parts of the Water Column
- Problems with Traditional Purging Methods
- Placement of the Purging Device Within the Water Column
- Approaches to Purging Low-Yield Wells
 - Purging to Dryness, Sampling During or After Recovery
 - Physical and Chemical Effects of Purging the Well Dry
 - Alternative Strategies for Low-Yield Wells

- *David M. Nielsen*

11:20 a.m. – 11:30 a.m. Break

11:30 a.m. – 12:30 p.m.

Low-Flow Purging & Sampling and No-Purge Sampling

- Low-Flow Purging and Sampling
 - Fundamental Concepts of Low-Flow Purging and Sampling – What It Is and How It Works
 - Requirements for Equipment and Flow Rates
 - Well Hydraulics During Low-Flow Purging & Sampling
 - Procedures Used for Low-Flow Purging and Sampling
 - Measuring Drawdown to Stabilization
 - Measuring Field Indicator Parameters to Stabilization
 - Dedicated vs. Portable Sampling Equipment
 - Advantages and Limitations of Low-Flow Purging & Sampling
- No-Purge Sampling
 - Fundamental Concepts of No-Purge Sampling – What It Is and How It Works
 - Equipment Used for No-Purge Sampling
 - Procedures Used for No-Purge Sampling
 - Advantages and Limitations of No-Purge Sampling

- *David M. Nielsen*

12:30 p.m. – 1:30 p.m. Lunch Break (On Your Own)

1:30 p.m. – 2:30 p.m.

Selection and Operation of Ground-Water Purging and Sampling Devices

- Purging and Sampling Device Selection Criteria
- Impacts of Sampling Devices on Sample Chemistry

- Dedicated vs. Designated vs. Portable Sampling Equipment
- Overview of Available Sampling Devices, Their Operational Characteristics, and Limitations
 - Types of Devices Available
 - Bailers
 - “Equilibrated” Grab Samplers
 - Peristaltic and Suction-Lift Devices
 - Electric Submersible Pumps
 - Piston Pumps
 - Gas-Drive Pumps
 - Bladder Pumps
 - Inertial-Lift (Tubing/Check Valve) Pumps

- *David M. Nielsen*

2:30 p.m. – 3:00 p.m. Break & Travel to the Field Site

3:00 p.m. – 5:30 p.m.

**Field Session 2 (Rotating Between 2 Stations, 75 Minutes Each)
(Location approximately 15 minute drive from Carriage House Inn)**

Station 1: Conventional Sampling Practices

- **Overview of the Health & Safety and Housekeeping Aspects of Ground-Water Sampling**
 - Inspection of the Well to be Sampled
 - Preparation of the Work Area
 - Wellhead Screening
 - Field QA/QC
- **Conventional Well-Volume Purging and Sampling**
 - Water-Level and Well-Depth Measurements
 - Determining Purge Volumes
 - Portable Pumping System (Electric Submersible Gear-Drive Pump)
 - Implementation of Well-Volume Purging and Sampling
- **Sample Collection and Handling**
 - Field Filtration of Samples
 - Field Preservation of Samples
 - Preparation of Samples for Shipping

- *Gillian L. Nielsen, Nielsen Environmental Field School*

Station 2: Low-Flow Purging and Sampling

- **Equipment Setup for Low-Flow Purging – Description and Operation**
 - Dedicated Pumping System (Bladder Pump)
 - Water Level Measurement Devices
 - Flow-Through Cells for Field Parameter Measurement
 - Multi-Parameter Sondes for Measuring Field Parameters
- **Determining Drawdown at Various Flow Rates**
 - Initial Water-Level Measurement
 - Measuring Water Levels During Pumping

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- **Determining Water-Level Stabilization**
 - **Determining Stabilization of Water Chemistry**
 - **Pump Operation – Maintaining Flow Rates**
 - **Field Parameter Measurement to Stabilization**
 - **Collecting Water Samples Following Field Parameter Stabilization**
 - **Sampling for VOCs With Zero Headspace**
- *David M. Nielsen, Nielsen Environmental Field School*

5:30 p.m. Course Adjourns for the Day

Thursday, May 20, 2010 - Carriage House Inn – 9030 MacLeod Trail S

8:00 a.m. – 8:30 a.m.

Discussion of Previous Day's Field Sessions and Practical Problem Solutions
- *Gillian L. Nielsen*

8:30 a.m. – 9:20 a.m.

Water Level and Product Thickness Measurement

- Uses of Water-Level and Product Thickness Data
 - Accuracy and Precision in Water-Level Measurement
 - Sources of Error in Water Level and Product Thickness Measurement
 - Techniques and Equipment Available for Water-Level Measurement
 - Accuracy of Water-Level Measurement Methods
 - Options for Determining Product Thickness in Monitoring Wells
- *Gillian L. Nielsen*

9:20 a.m. – 9:30 a.m. Break

9:30 a.m. – 10:20 a.m.

Field Parameter Measurement During Purging

- Parameters Traditionally Measured and Why They May Not Be Meaningful
 - Temperature, pH, Conductivity
 - More Meaningful Parameters
 - Specific Conductance, Dissolved Oxygen, Redox Potential
 - Significance and Use of Turbidity as a Field Parameter
 - Instrumentation Options for Field Parameter Measurement
 - In-Situ, Flow Cells, Ex-Situ
 - Calibration of Field Parameter Analysis Instrumentation
 - Common Errors in Field Parameter Measurement
- *Gillian L. Nielsen*

10:20 a.m. – 10:30 a.m. Break

10:30 a.m. – 11:20 a.m.

Field Filtration of Ground-Water Samples

- Objectives and Purposes of Sample Filtration

- Naturally-Occurring vs. Artificial Particulate Matter in Wells
- Overview of Filtration Methods
 - Vacuum Filtration
 - Pressure Filtration
 - In-Line Filtration
- Which Parameters Should Be Filtered and Which Should Not
- Filter Preconditioning – Objectives and Procedures

- Gillian L. Nielsen

11:20 a.m. – 11:30 a.m. Break

11:30 a.m. – 12:30 p.m.

Preservation of Ground-Water Samples

- Objectives and Purposes of Sample Preservation
- Physical vs. Chemical Sample Preservation Techniques
 - Advantages and Limitations of Each

Collecting Samples Following Purging

- Proper Procedures for Ground-Water Sample Collection
- Order of Sample Collection
- Proper Bottle-Filling Techniques

- Gillian L. Nielsen

12:30 p.m. – 2:00 p.m. Lunch Break (On Your Own) & Travel to the Field Site

2:00 p.m. – 5:00 p.m.

**Field Session 3 (Rotating Between 2 Stations, 90 minutes each)
(Location approximately 15 minute drive from Carriage House Inn)**

Station 1: Hands-On Interactive Field Demonstration of No-Purge Sampling Devices

- **Passive Diffusion Bag Samplers**
- **The HydraSleeve**

- David M. Nielsen

Station 2: Field Calibration and Operation of Field Indicator Parameter Measurement Equipment

- **Description of the Equipment**
- **Description of Different Types of Dissolved Oxygen Sensors**
- **Calibration of pH Sensors, Dissolved Oxygen Sensors, ORP Sensors and Conductivity Sensors**

- Gillian L. Nielsen

5:00 p.m. Course Adjourns

