TAB #27: Expedited Site Characterization: Process

DESCRIPTION:

The expedited site characterization (ESC) process is a framework for rapidly characterizing and resolving issues at contaminated sites. The framework has been described with other names including accelerated site characterization, rapid site characterization and expedited site assessment. This TAB discusses how key components of the framework interact to make ESC an efficient and cost-saving process. Unlike Traditional Site Characterization (TSC), ESC relies more on scientific methodology to develop and refine its conceptual model. Other major differences between ESC and TSC are presented, in a chart. The advantages of ESC over TSC are also addressed.

INTRODUCTION

The **ESC** process applies the principles of total quality management to site characterization. It includes good characterization practices, effective use of prior data, employing a range of measurement types, experienced people, etc.

Key elements of ESC include:

- **Immediate data integration.**
- **A dynamic work plan.**
- **An experienced multidisciplinary team.**
- **Documented prediction of measurements to validate the conceptual model.**
- **Introduction of appropriate innovative technologies into the process to complement and enhance baseline technologies.**

A site characterization is conducted where a hazardous substance has been released, and there is potential for the contamination to reach people or adversely affect the natural ecology. Detailed site characterization objectives are specific for each site, and are determined in consultation with the appropriate regulators.

When site characterizations are complete, they provide accurate information about the presence and distribution of contaminants, thereby facilitating cost-effective and efficient remediation. When they are incomplete, they can provide inaccurate or misleading information which can delay effective remediation, increase overall corrective action costs, and result in an increased risk to human health and the environment.

THE CONCEPTUAL MODEL

The product of site characterization is a verified conceptual model. The conceptual model is developed from analysis of site operating history, regional geology and hydrology, validated results from prior investigations, and field investigation results. It identifies the contaminant locations, the receptors, and the pathways that contaminants can take to reach the receptors. Receptors are people, animals, or the ecology that might be adversely impacted by exposure to the contaminant. The model includes detailed descriptions of the site hydrology and geology. It describes the site with sufficient certainty that a reliable risk assessment can be developed. This enables a high confidence remedial action decision by a regulatory agency. If remedial action is necessary, the model is the starting point for the remedial system design.

The Remedial Action Decision Makers include both the site owner/operator and the regulatory authorities. The credibility and accuracy of the conceptual model are essential to a successful site characterization. The model's credibility determines whether the decision makers accept it, and the accuracy determines whether it leads to an efficient and cost effective remedial system.

The goal of characterization is to increase the certainty of the conceptual model sufficiently, so that the decision maker can confidently make a correct determination.

TRADITIONAL SITE CHARACTERIZATION (TSC)

Site characterization, as most often practised today, is called traditional site characterization, or the traditional methodology. It relies exclusively on sampling and analytical methods that regulators have often approved (e.g. monitoring wells and laboratory sample analysis). The traditional methodology has evolved over the past several years. The federal and provincial regulations, and the decisions of individual regulators have encouraged a conservative approach which does not foster trust in the scientific relationship among such elements as hydrology, geology, and contaminant distribution.

ESC Versus TSC

The focus for a traditional site characterization is usually on installing groundwater monitoring wells that are sited with limited subsurface information. The sampling and analysis plan is typically rigid, and is defined in the office by a senior scientist for the junior personnel to execute. Data analysis and conceptual model development occur off-site and may take weeks or months to complete. The end product of the characterization is the mapping of the extent of the contamination, rather than the source areas and the significant contaminant mass. The process tends to be two-dimensional, time consuming, attended by relatively high costs, and the site conditions are often mis-understood.

Unlike TSC, the field manager is responsible for the entire process within an expedited site characterization program. Information about regional and site-specific geology/hydrogeology as well as a knowledge of the petroleum contaminant fate and transport, are necessary for making and revising sampling and analytical decisions. An ESC manager must therefore have extensive site characterization experience and knowledge about all aspects of the ESC process.

Table 1 outlines a comparison of 'Traditional Site Characterizations' (TSD) versus 'Expedited Site Characterizations' (ESC).

Table 1. Comparison of TSC and ESC

Component	Traditional Site Characterization	Expedited Site Characterization
Work Plan	Rigid	Dynamic
Tasking	All tasks independently accomplished by independent teams in multiple field mobilizations.	All tasks accomplished by an integrated, experienced, multidisciplinary team in minimal field mobilizations.
Management	Junior staff in the field, and Manager in the office.	Senior scientists in the field.
Data Analysis	All tasks independently accomplished by independent teams in multiple field mobilizations .	All tasks accomplished by an integrated, experienced, multidisciplinary team in minimal field mobilizations
Data Management	Prior data not integrated into model; incomplete analysis/integration of measured data.	Daily data analysis/integration in the field.
Technical Strategy	Focus on plan view map. Sampling location based on limited information.Sampling locations are pre-determined.	Use of multiple complementary technologies; sampling locations depend on existing data; minimal well installation; location of most significant contaminant mass in 3-dimensions.
Time	4 months - 2 years	3-5 weeks
Innovative Technologies	May or may not be used; not integrated into the process. Mostly monitoring or boreholes wells.	Standard practice allows on-site iterative process.
Sampling	Boilerplate; many	Judgment based sampling.

	extraneous samples.	

THE DYNAMICS OF ESC

The dynamics of ECS are shown in Schema 1, and then expanded in statements 1 to 5.

Schema I: The ESC Approach

1. Generally, the effective use of innovative technologies, in ESC, has contributed much to the efficiency of the process. Each critical site feature is measured in two or more different ways, and consequently, the use of any of the selected innovative technologies doesn't provide unacceptable risk.
2. A multi-disciplinary team is in the field at the same time: ESC is a team activity, the team visits the site before the investigation, plans the investigation, and then returns to the field to conduct the investigation. The team members communicate face to face. This is opposite to a conventional investigation where tasks are organized into independent subcontracts, and results are mostly communicated through reports.
3. For each ESC measurement, the results are predicted before the measurement is made. Predictions are shared with interested regulators and field personnel. As the ESC investigation proceeds and the conceptual model matures, these predictions can become increasingly evident. The regulator's participation in the process, greatly enhances his/her belief in the investigation results.
4. During the field investigation, the samples and measurement results are analyzed immediately and thus the data quality level can be readily evaluated by the regulators. Often this requires an off-site laboratory. Samples are not only analyzed, but also validated during the field investigation, typically within 24 hours of the time that the samples are taken. Immediately after data are analyzed, they are integrated into the conceptual model, and if necessary, the model is modified and updated.
5. An ESC investigation uses a dynamic workplan, and this allows the measurement plan to be adjusted.

OPTIMUM PATH SELECTION OF EXPEDITED SITE CHARACTERIZATION

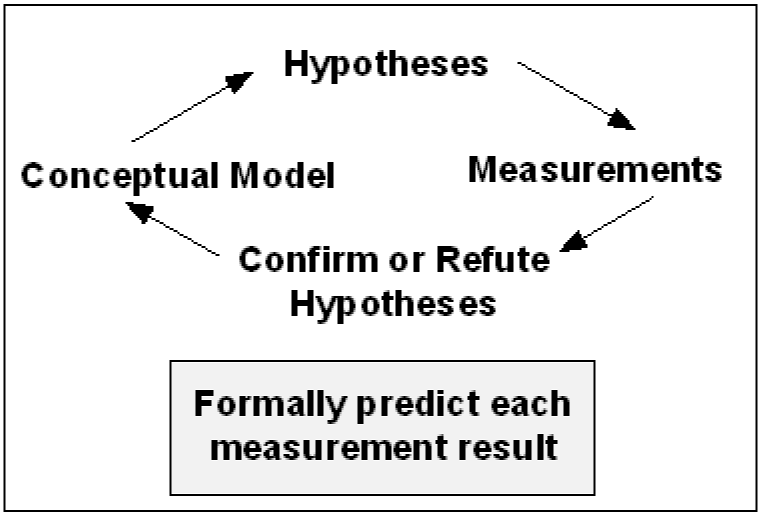
Every site investigation has an optimum or best path to an accurate characterization result. The optimum path is the fastest, most cost-effective sequence of steps from the initial model to an accurate, verified conceptual model that satisfies regulators, site owners, and remedial system designers.

Characteristics:

- **Thorough evaluation of existing data and integration into the conceptual model.**
- **Hydrological, and geological characterization to guide the search for the contaminant plume.**
- **Non-invasive or minimally invasive measurements to guide the characterization.**
- **Judgment-based sampling.**
- **Multiple measurements to corroborate each critical hypothesis of the conceptual model.**
- **Wide spectrum of measurements.**
- **Employment of the most cost- and result-effective measuring techniques.**
- **Receptive to discovery, and receptive to the unexpected.**

SCIENTIFIC METHODOLOGY

ESC is a scientific methodology (**Schema II**). It differs from the traditional methodology in its assumption that all features of the conceptual model, important to the decision maker, must be tested. The scientific method demands that every critical hypothesis be supported by confirmatory measurements. The conceptual model is comprised of hypotheses. The scientific method begins with an understanding of what is already established from accepted theory and past measurements. It approaches the objectives of the investigation by postulating hypotheses based on regional understanding and prior data. Specific measurements are selected to test one or more of the hypotheses. The hypotheses are subsequently revised or replaced based on the results. The conceptual model is refined. New hypotheses are postulated ,if necessary, and the cycle continues.



Schema II: The Conceptual Model and Critical Hypotheses.

ESC PROJECT TEAM

Unlike the hierarchical organization structure, in traditional characterization efforts, where a lead contractor subcontracts tasks to specialists, ESC embraces a team organization. **Schema III** is an overview of the various partners in the ESC process. The critical disciplines are part of the team. While some team members may be subcontractors, they do not function independently. They participate in all team activities and have equivalent responsibilities and status as the other team members. Some support functions are subcontracted to non-team entities, such as off-site analytical laboratories services, the drilling of the few monitoring wells that are deemed necessary, and support of a cone penetrometer truck system.

THE ADVANTAGES OF ESC OVER TSC

In comparison to TSC, the ESC approach has the following advantages.

- **A 50% faster completion rate.**
- **A 50% (or more) reduction in operational costs.**
- **Safer and fewer invasive penetrations.**
- **Greater accuracy.**
- **Provision of greater credibility in results.**
- **Employment of more technically skilled teams.**

Schema III: Overview of hte ESC Process

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