Environmental Restoration: Part 6 - Engineered Remediation

An Online Continuing Education Course for Engineers

Course Number: EN-4024

Credit: 4 Hours / 4 PDH / 4 CPD

Environmental Restoration: Part 6 – Engineered Remediation

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General Overview

This course, Part 6, is the sixth and final one in a series of six sequential courses, Parts 1 through 6, that present the history and steps taken to remediate the environmental hazards created by the land disposal of Chemical and radioactive wastes on the campus of a research institute. The practice of shallow land burial of hazardous wastes was widely used throughout the US between the 1960s and the 1980s. However, since the late 1980s both federal and state legislations were promulgated requiring the environmental regulatory agencies throughout the US to investigate operating, decommissioned and abandoned landfills of all types having in mind the ultimate goal of mitigating the impacts these waste disposal sites have on the natural environment.

I decided to write this series of courses, six in all, from the perspective of a Manager who leads a team charged with the implementation of an environmental Remedial Investigation (RI), Feasibility Study (FS) and Engineered Remediation (ER) of a hazardous waste disposal site. This perspective is especially interesting to develop because a manager is usually associated with a project from its inception and he or she has a unique overview and comprehensive understanding of the scope of work that needs to be implemented. Students, who are interested in environmental issues, will be able to follow and gain an in-depth understanding, not only of the technical and contractual aspects of the project. Even more, they will be able to appreciate the countless difficulties posed by the competing goals and desires of the various parties involved in implementing an environmental investigation of a hazardous waste disposal site. Students will learn to analyze - and then reconcile – the different goals and objectives of the owners, regulators, environmental consulting firms, the interested public and the news media. Finally, the significant impacts of these interactions on scope, budget and schedule are presented and discussed as the process of completing the project unfolds.

This series of courses draws from numerous environmental investigations that I managed across the US. As such, the scenarios that are presented are similar to those a professional environmental engineering practitioner faces in real life. The case that is developed here is used as an example and a vehicle to present and discuss concepts and project implementation strategies that I gained through my long and varied experience working in the engineering consulting business. This information is not usually found or taught in traditional or standard academic courses dealing with environmental issues or investigations. In their entity this series of courses can be considered an implementation guide for conducting environmental investigations at hazardous waste disposal sites. Students will gain unique and useful insights into the data, analyses, interpretations, recommendations and conclusions that were made and that they could then easily adapt to the situations they are likely to encounter themselves in managing their own projects.

More specifically, the environmental problems are those encountered at a decommissioned hazardous and low-level radioactive waste disposal site owned by a research institute. The presentations are sequenced in the order in which investigations would be conducted by an environmental consulting firm contracted to perform and supervise the work that would be done in order to assess the magnitude of the problem and develop appropriate mitigation strategies for the rehabilitation of the site.

Starting with the use of the site for the disposal of chemical and radioactive wastes over a period of twenty years and following the eventual decommissioning and passive custodial maintenance of the site, the presentation unfolds by addressing the following topics in sequential order:

- Initial concerns raised by the regulatory agencies,
- Request for Proposals issued by the research institute,
- Bidding process and the selection of an environmental consulting firm,
- Contract negotiation,
- Compilation and review of existing data,
- Development of work plans and preparation of sampling and testing procedures,
- Implementation of geologic and hydrologic investigations at the site,
- Evaluation of the data collected and assessment of impact on public health,
- Development and evaluation of engineering options for remediation,
- Recommendation of a preferred engineered remedial option,
- Implementation of the corrective action plan, and
- Post remediation monitoring to assess the outcome.

The introduction of each course in the series summarizes briefly the key points covered by the preceding courses in the sequence. This was done to help the students remember all that has unfolded prior to getting involved in a new topic. In addition, each course in this series was structured as a stand-alone presentation of the topics listed in the **"Course Overview"** section found at the beginning of each course. This was done to accommodate the students that have a particular interest in one aspect of the work only.

The titles of the courses in this series are:

Part 1 – History Leading to Contract Award
Part 2 – Existing Information and Regulatory Concerns
Part 3 – Project Plans and Procedures
Part 4 – Phase 1 Field Investigations
Part 5 – Phase 2 Field Investigations
Part 6 – Engineered Remediation

Part 6 Course Overview

This course, **Part 6: *Engineered Remediation,*** briefly reviews the key points of the previous courses in the sequence (Parts 1 through 5), and presents the results of the risk assessment and feasibility study. This phase of work started with the performance of a risk assessment to determine if an emergency situation exists that would require immediate attention, and the development of a set of corrective action objectives to guide the engineering feasibility study.

The engineering feasibility study starts by evaluating the "No Action" alternative. This assessment is required by the Environmental Protection Agency (EPA), and includes addressing what may happen if nothing is done at the site. The "No Action" alternative is considered the baseline against which the other remediation options are compared.

The following step considered the nature and extent of existing institutional control measures to assess their adequacy to protect humans from inadvertently contacting the waste, or the plume of contaminants. Institutional controls also include ensuring that records of the site contents, spatial distribution of trenches and boundaries of the waste disposal area exist in several state and federal government repositories. These steps are taken to ensure that no one "forgets" that there is hazardous and radioactive waste buried in this area.

The next stage involved the identification of a universe of appropriate engineering options for the remediation of the waste disposal area and the down-gradient plume of contaminated groundwater. The technical and regulatory feasibility of the proposed options are first evaluated to determine their relative effectiveness in mitigating existing conditions. Then, based on an assessment of overall appropriateness and cost effectiveness, a preferred engineered option is selected for inclusion in the Corrective Action Plan that is submitted for regulatory review and approval prior to implementation. The process is somewhat more complex because engineering alternatives are considered both individually and in combination and by the inclusion of auxiliary measures that could enhance the overall performance of the selected engineered remediation option.

Following regulatory review and approval, the proposed measures are cleared for implementation. The final design drawings are then prepared and construction can proceed in accordance with the established specifications. Following completion of the construction, effectiveness of the engineered remediation measures is ascertained and documented through the results of the ongoing monitoring program. The monitoring program is usually continued for a period of at least five years following the implementation of the corrective measures to ascertain that the contaminant levels have dropped to below the applicable regulatory limits.

This course series ends with the presentation of graphs from four down-gradient monitoring wells documenting the steady decrease in the concentration of the marker contaminant chloroform. These graphs show a clear decrease in the concentration of the marker contaminant in the monitoring wells over the monitoring period of five years. These graphical results attest to the efficacy of the remedial measures that were implemented at the site.

Introduction

A research institute ("Institute") operated a small (0.65 acre) hazardous chemical and radioactive waste burial facility on its campus for about 20 years, starting in the mid 1960s. All waste buried at the site resulted from the use of radioactive elements and chemicals in research experiments. Waste brought to the disposal site was in both solid and liquid form, and the liquids were in various types and sizes of containers. The waste was placed into narrow trenches dug into the soil at the burial site. The trenches were about 8 to 12 feet deep. Once waste reached about 4 feet from the surface, dirt was used to fill the trench to grade.

When the site was decommissioned and no longer used, it was fenced, posted and locked. Minimal grounds maintenance was done until the State Radiation Protection Agency (RPA) notified the Institute that they were to keep the fence clear of vegetation and the area within the fence mowed and free of trees. The following photo shows the disposal area after the site was decommissioned and the grounds maintenance started:

Figure 1: Decommissioned waste disposal site at the Institute

Yearly testing of soil, surface water and vegetation by the State RPA following decommissioning of the site showed no evidence of significant radioactive contamination outside the burial area. In the late 1980s the State RPA recommended that the Institute install a series of monitoring wells to allow sampling and testing of the groundwater. In response, and under the guidance of the State Groundwater Protection Agency (GPA), the Institute installed five monitoring wells around the waste disposal site. The location of the five wells is shown on the following figure.

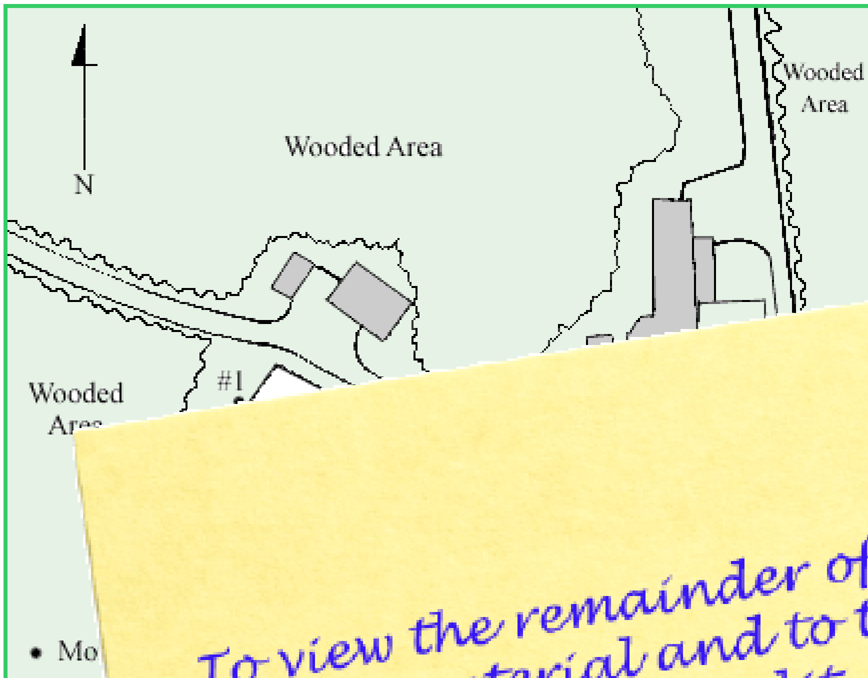

Figure 2.

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Because the di… ntained hazardous chemicals and radioactive isotopes, no additional field investigations could be started until a project-specific Health and Safety Plan was developed. A project-specific Quality Assurance Plan was also created, and the technical requirements were developed as part of the Sampling and Testing Plan. A set of Project Procedures was written to guide the field sampling and analysis programs that incorporated the requirements of each of the project plans. The relationship of the various plans, procedures and the field and laboratory activities is shown on the following flowchart.