Chapter 17
Passive Treatment Walls

17-1. General

The process of passive treatment walls, installation methods, and their applications are described in the chapter's first section. The second portion of the chapter is a hazard analysis with controls and control points listed.

17-2. Technology Description

a. Process.

Passive treatment walls (also called reaction walls) are installed in the ground to treat materials in groundwater that can be readily converted to a non-toxic or inert form. The technology's purpose is to passively route contaminated groundwater through reactive media.

The materials used to construct the wall must:

- Not be made from toxic materials.
- Not produce toxic products or byproducts from the reaction.
- Be thick enough to react with all of the targeted material present.
- Be porous enough to permit the groundwater to flow through.

b. Installation.

The reactive media can be installed by a variety of trenching techniques, including a backhoe or clamshell. Other techniques for installing the reactive cell include caissons, a continuous trencher, mandrel, or pressurized jetting techniques. For funnel and gate configurations, the funnel walls are placed as impermeable barriers with techniques such as sheet piling or slurry walls. See Figure 17-1 for an example layout.

The wall is installed downgradient from the contaminated groundwater. The water may be channeled or forced to flow through the treatment wall by constructing slurry walls to channel the flow. The method is passive in that the target material flows downgradient dissolved in the groundwater through the reaction wall without pumping or recovery. However, treatment walls typically use destructive or essentially irreversible conversions that chemically or biologically alleviate the toxicity problem.

c. Applications.

The technique is most effective for chemicals that are readily soluble in water, have low retardation factors in the subsurface (little interaction with the soil), and are readily reacted into non-toxic forms. An example is the construction of a funnel and gate system containing iron filings as the reactive media for the treatment of TCE in a groundwater plume. The reactive media are designed to react with all of the TCE and its toxic breakdown products such as vinyl chloride.

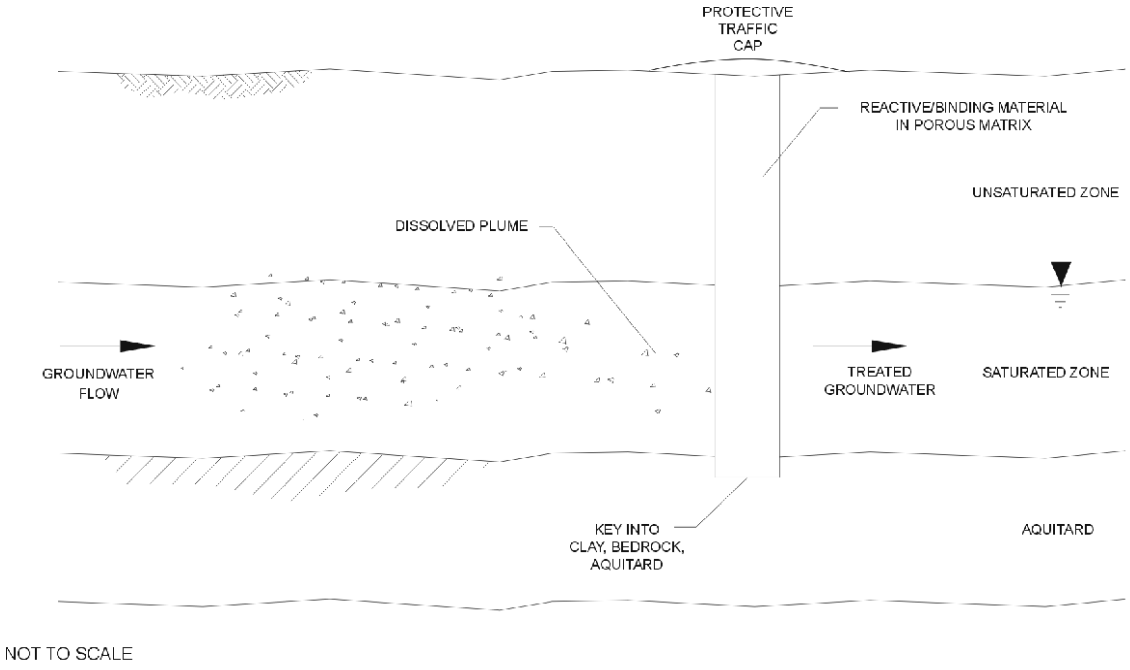

FIGURE 17-1. PASSIVE TREATMENT WALLS

17-3. Hazard Analysis

Principal unique hazards associated with passive treatment walls, methods for control, and control points are described below.

a. Physical Hazards.

(1) *Equipment Hazards*.
Description. During installation of sheet pile walls, workers may be seriously injured or killed by heavy equipment such as front-end loaders, cranes, and pile drivers.

Control. Controls for equipment hazards include:

- Use spotters, and require and maintain backup alarms on all heavy equipment.
- Approach operating equipment from the front and within view of the operator. Do not proceed into the swing radius of equipment until presence is clearly acknowledged by the operator.

CONTROL POINT: Construction

(2) *Utility Hazards.*

Description. During the excavation of the trench, prior to the installation of the passive treatment wall, fire or explosion hazards may exist if excavation equipment ruptures an underground utility such as electrical or gas lines.

Control. Controls for utility contact hazards include:

- Establish and document utility clearances. Contact local utilities and public works authorities to determine the locations of all utilities. When there is any doubt or uncertainty, conduct a utility survey, probe with a metal rod prior to excavation, or hand excavate to determine the exact location of utilities. Once utilities are located, careful excavation by backhoe may be allowed.
- Post an observer to the side to supervise when raising equipment.
- Maintain safe distances as recommended in EM 385-1-1, Section 11.

CONTROL POINT: Construction

(3) *Trench Hazards.*

Description. Entry into an unshored or unbenched trench poses a safety hazard of trench wall collapse. An inhalation hazard exists if the trench serves as an accumulation point for off-gassing of toxic materials (such as chlorinated solvents) from the soil.

Control. Controls for trench hazards include:

- Inspect excavations daily with a competent person. See EM 385-1-1, Section 25.
- Shore walls to prevent collapse according to the requirements of 29 CFR 1926.650-652.
- Provide emergency egress to workers entering the excavations and trenches at intervals that do not exceed 25 feet.
- Consider trench entry as a confined-space entry (see 29 CFR 1910.146).
- Train workers in confined space hazards and on safety procedures to be employed in confined space entry, including engulfing hazards from unshored trench walls.
- Develop a pre-entry confined space permit. Implement a confined-space entry program to assess the hazards.
- Test the atmosphere within the excavation to determine the level of airborne contaminants and oxygen prior to entry.
- Use engineering controls such as forced ventilation to eliminate any hazardous atmosphere detected through the pre-entry atmosphere testing. PPE respiratory protection should be considered a last option for working in trenches.

CONTROL POINT: Construction

(4) *Steam Pressure Washing.*

Description. Steam pressure washing of equipment may expose workers to thermal, burn or injection hazards, eye hazards from flying projectiles dislodged during pressure washing, slip hazards from wet surfaces, and noise hazards.

Control. Controls for steam pressure washing include:

- Use insulated gloves (e.g., silica fabric gloves) and keep all body parts away from the ejection point of the steam pressure discharge nozzle.
- Wear safety goggles and hearing protection.
- Wear slip-resistant boots.
- Drain water away from the decontamination operation into a tank or pit.
- Drain walking surfaces and keep free of standing liquids or mud.

CONTROL POINT: Construction, Operations, Maintenance

(5) *Respirable Quartz Hazard*.

Description. Depending on soil types, exposure to respirable quartz may be a hazard. Consult geology staff to confirm the presence of a respirable quartz hazard (e.g., to determine if soil types are likely to be rich in respirable quartz). As an aid in determining respirable quartz exposure potential, sample and analyze site soils for fines content by ASTM D422 (R2002): "Standard Test Method for Particle Size Analysis of Soils" followed by analysis of the fines by X-ray diffraction to determine crystalline quartz content.

Control. Controls for respirable quartz include:

- Wet the soil periodically with water or amended water to minimize worker exposure. Consult 29 CFR 1910.1000, Table Z-3, to calculate acceptable respirable dust concentrations based on percent silica in the quartz.
- Use respiratory protection, such as an air-purifying respirator equipped with N, R or P100 particulate air filters.
- Train workers in the potential inhalation hazards associated with crystalline silica exposures.

CONTROL POINT: Design, Construction, Operations

(6) *UV (Ultraviolet) Radiation.*

Description. During site activities, workers may be exposed to direct and indirect sunlight and corresponding UV radiation. Even short-term exposure to sunlight can cause burns and dermal damage. Hot and humid conditions may also result in heat stress, which can manifest itself as heat exhaustion and heat stroke.

Control. Controls for UV radiation include:

- Minimize direct sun exposure by wearing sun hats, long-sleeved shirts, full-length pants, and by applying UV barrier sunscreen. Loose clothing and sun hats should not be worn around moving parts that may snag the worker and draw him into a danger zone. All UV skin barrier creams should be pre-ap-

proved. Some creams contain zinc and other constituents that can cause false readings in analytical samples.
- Shade work and break areas if possible.
- Minimize exposure to heat stress by taking frequent breaks, drinking adequate fluids, and working during the early morning and late afternoon hours.

CONTROL POINT: Construction, Operations

(7) *Electrocution*.
Description. Personnel may be exposed to electrocution hazards when working around electrical utilities such as overhead power lines.

Control. Controls for electrocution include:
- Note overhead power line location, either existing or proposed, in the predesign phase.
- Keep all lifting equipment, such as cranes, forklifts, and pile drivers at least 10 feet from a power line and according to Occupational Safety and Health
- Administration (OSHA) regulation 29 CFR 1926.550 and EM 385-1-1, Section 11.

CONTROL POINT: Design, Construction, Operations

(8) *Traffic Hazards*.
Description. During field activities, equipment and workers may come close to public vehicular traffic. Also, equipment may need to cross or use public roads. The general public may be exposed to traffic hazards and the potential for accidents.

Control. Controls for traffic hazards include:
- Post warning signs according to the criteria of the "Department of Transportation Manual on Uniform Traffic Devices for Streets and Highways."
- Develop a traffic management plan before remediation activities begin to help prevent accidents. EM 385-1-1, Section 21, provides plan details.
- Use traffic spotters donned in highly visible hazard vests.

CONTROL POINT: Design, Construction, Operations

(7) *Emergency Wash Equipment*.
Description. Emergency shower/eye wash equipment required per 29 CFR 1910.151 is not always provided with adequate floor drains, thereby creating potential electrical hazards and walking surface hazards during required testing and use.

Control. A control for emergency wash equipment includes:

- See American National Standards Institute ANSI Z 358.1 – 1998: "Emergency Eyewash and Shower Equipment" for design requirements.
- Equip showers/eye wash equipment with accompanying functional drains to isolate and collect the shower/eye washwater from unprotected electrical equipment and walking surfaces that, when wet, create slipping and electrical hazards.

(8) *Design Field Activities.*
Description. Design field activities associated with subsequent construction may include surveying, biological surveys, soil gas surveys, geophysical surveys, trenching, drilling, stockpiling, contaminated groundwater sampling, and other activities. Each of these field activities may expose the survey personnel to physical, chemical, radiological, and biological hazards.

Control. Controls for hazards resulting from predesign field activities include:
- Prepare an activity hazard analysis for predesign field survey activities. EM 385-1-1, Section 1, provides guidance on developing an activity hazard analysis.
- Train workers in hazards identified.

CONTROL POINT: Design

b. Chemical Hazards.

(1) *Contaminants (Soil).*
Description. Workers may be exposed via inhalation, ingestion, or dermal exposure to contaminants during trench excavation. Dusts and volatile organic compounds (VOCs) entrained with waste materials may become airborne during the excavation, exposing workers to the contaminants.

Control. Controls for contaminants in the soil include:
- Place the trench outside the area of contamination to the extent practical.
- Apply water to control airborne dusts.
- Use personal protection equipment (PPE) such as an air-purifying respirator with organic vapor cartridges to help control worker exposure.
- Train the workers in both the potential contaminated dust hazards and the proper use of the controls, including the PPE.

CONTROL POINT: Design, Construction, Operations

(2) *Treatment Wall.*
Description. Workers may be exposed to materials such as iron pyrites, coal (dust), metal chelators, and microbes used as the treatment medium during installation of the treatment wall. In addition, metals or other contaminants in the wall material may pose a higher risk during replacement or maintenance operations.

Control. Controls for chemicals in treatment walls include:

- Wet materials periodically to control airborne dust.
- Use PPE selected by a qualified health and safety professional based on the contaminants in the wall matrix. For example, for chelated metals, use an air-purifying respirator with N, R or P95 particulate air filters, chemically inert coveralls, and chemically inert gloves (e.g., nitrile).
- Review and follow handling procedures contained in each product's MSDS.

CONTROL POINT: Construction, Maintenance

c. *Radiological Hazards*.

No unique hazards are identified.

d. Biological Hazards.

No unique hazards are identified.