DRY CLEANER REMEDIATION GUIDANCE DOCUMENT

Colorado Department of Public Health and Environment

Hazardous Materials and Waste Management Division
Colorado Department of Public Health and Environment

(303) 692-3300

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1.0 INTRODUCTION

Dry cleaning was historically performed using petroleum-based solvents that had dangerously low flash points with the potential to cause fires and explosions. The dry cleaning industry started off using turpentine and kerosene to wash clothing before moving to benzene and gasoline. Over time, better petroleum-based solvents were introduced, having higher flash points, such as Stoddard Solvent and mineral spirits, which gained widespread acceptance in the industry. Near the turn of the century, chemists learned to synthesize nonflammable chlorinated hydrocarbons and produce them in large quantities, making them better suited for use as a dry cleaning solvent. The favored dry cleaning chlorinated hydrocarbons include carbon tetrachloride, trichloroethylene, Freon 113 and perchloroethylene. Various problems associated with the use of one or more of these chemicals (toxicity, aggressiveness to certain materials, ozone depletion) resulted in perchloroethylene becoming the primary cleaning solvent used at dry cleaners. In an effort to move away from this toxic, highly mobile and difficult to remediate compound, the dry cleaning sector is now looking for alternatives to perchloroethylene, exploring the use of several new methods that include: new wet cleaning techniques that use biodegradable soaps; the use of both liquid carbon dioxide and silicone, and; new petroleum-based solvents with higher flashpoints that rely on more technically advanced machines to reduce the risk of fire and explosion

This guidance document is devoted entirely to the investigation, evaluation, and cleanup of releases of perchloroethylene from former and existing dry cleaning facilities in the Colorado. The Colorado Department of Public Health and the Environment's (the Department's) purpose for creating this guidance document is to 1) make the owner/operators of these facilities aware of their cleanup responsibilities, 2) share our expectations and experience with the parties performing any required corrective action, 3) reduce the number of phases necessary to collect all the required data, thereby expediting the cleanup process, 4) reduce costs associated with this remedial activity by targeting work to only those activities that will support a desired outcome, and 5) provide the owner/operators with a clear idea as to what is involved and what the final outcome may be (thereby allowing for realistic property management/development). This guidance document will: identify which program within the Department will oversee the cleanup; the regulatory requirements that must be met; minimum data collection needs (source characterization, extent & magnitude); remedial options; and long-term considerations (monitoring, use of institutional controls).

For many of the dry cleaning facilities undergoing chemical release investigation and/or cleanup, time is critical since the completion of a real estate or business transaction is pending on the outcome. The Department has worked hard over the last several years to reduce the length of our review and approval process and our reliance on a multi-phased approach to characterizing and remediating sites. With the accumulated experience of Department personnel and the environmental consulting industry in remediating sites and development of newer and more powerful field analytical tools, site work can proceed seamlessly through investigation phases to remediation and closeout. It is our intent to improve the speed, efficiency and effectiveness of corrective actions associated with dry cleaning facilities.

This guidance document sets forth the Department's positions on the covered subjects to the best of its abilities, based on knowledge and the available science at the time it was authored. However, the Department may ultimately make a decision not contemplated by this document. The Department makes regulatory, remedial and penalty decisions based on circumstances as they are presented to the Department; this guidance is not binding on the Department.

2.0 LEGAL REQUIREMENTS

2.1 TO WHOM IT APPLIES

The information offered in this guidance document applies to owners and/or operators of properties where there has been a known or suspected release of dry cleaning chemicals to the environment from current or past dry cleaning operations. This document does not address normal day-to-day operations at dry cleaning facilities or how to ensure that these operations are performed in compliance with various environmental laws and regulations. The Department has another guidance document titled "*Pressing Concerns – A Complete Guidebook to Environmental Compliance For Colorado Dry Cleaners*" dated December 2002, that was created to specifically address those topics.

Perchloroethylene (also known as tetrachloroethylene, perc, PCE) is an organic compound that is part of a class of chemicals called chlorinated hydrocarbon solvents. PCE is a liquid at room temperature, but readily evaporates into the air and thus is also called a volatile organic compound (VOC). The chemical properties of PCE are such that in liquid form it can readily migrate through unsealed concrete floors and concrete or asphalt parking lots. Thus, even if spills or leaks of the liquid PCE appear to be "captured or contained" by a hard surface, the chemical is actually moving into, and rather quickly through, the hard floor or pavement and entering the environment. The same properties that allow PCE to migrate through concrete floors also allow PCE to migrate rapidly through soil and rock once it is in the natural environment.

There are two primary human health risk concerns associated with the release of PCE to the environment:

1) PCE readily dissolves in ground water and can move rapidly away from the original spill area. The presence of PCE in ground water creates a risk to human health, even at very low concentrations, if the contaminated ground water is used as a source of drinking water. The State of Colorado also has ground water quality regulations that make it illegal to introduce chemical contamination into the ground water.

2) PCE evaporates readily from contaminated soil and ground water and can easily migrate up through the soil to the air, even if the contamination is located many feet below the ground surface. If there are buildings above the area of contamination, the PCE can migrate into the indoor air of the buildings. The PCE in indoor air creates a health risk even at very low concentrations when breathed by humans.

2.2 DRY CLEANING SOLVENT AS A LISTED HAZARDOUS WASTE

Under the law known as the Colorado Hazardous Waste Act [Colorado Revised Statutes (C.R.S.) 25-15-301 – 316] and its implementing Colorado Hazardous Waste Regulations, PCE that is used as a cleaning agent by dry cleaning shops is classified as a listed hazardous waste (F002) when it becomes spent or is disposed of. The Colorado Code of Regulations (CCR) section 6-1007-3, parts 99, 100, and 260 – 279 cover the disposal of hazardous waste and define disposal as "the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters." This definition applies to both used PCE that has become spent and must be disposed of, as well as unused product that may have unintentionally been spilled or leaked into the environment, the act of disposal resulting in it becoming spent and a waste by virtue of it no longer being available for its intended use. Dry cleaning facilities where hazardous waste has been released into the environment after November 19, 1980, even as a result of unintentional leakage, are considered to be unpermitted (and thus illegal) disposal facilities subject to the cleanup requirements of the hazardous waste regulations. Under these circumstances, the Department has the authority to require the cleanup of releases into the environment caused by improper disposal of hazardous waste.

If a dry cleaning facility can demonstrate that the release of dry cleaning solvent occurred prior to November 19, 1980, then that release is not subject to the cleanup requirements of the Colorado Hazardous Waste Regulations. A convincing demonstration can usually only be made for former dry cleaning shops that closed, or ceased chemical handling operations prior to the November 19, 1980 cut-off date. Owners/operators of pre-1980 sites should be aware however, that any contaminated soil and ground water that is removed from the ground or is in someway managed during remediation of these pre-1980 facilities is considered newly generated waste and is a listed hazardous waste if it contains PCE and/or its degradation products.

The Colorado Hazardous Waste Regulations and all of the guidance documents referenced in this document are available on the Departments Hazardous Materials and Waste Management Division's (the Division's) website at www.cdphe.state.co.us/hm/hmhom.asp

2.3 ADMINISTRATIVE MECHANISMS FOR INVESTIGATION AND CLEANUP

Notification Requirement

The Colorado Water Quality Control Act specifies that the Department's Water Quality Control Division must be notified of accidental discharges to the waters of the state. In particular, in Title 25, Article 8, Part 6 (C.R.S. 25-8-601) of the Colorado Revised Statutes, requires that "Any person engaged in any operation or activity which results in a spill or discharge of oil or other substance which may cause pollution of the waters of the state contrary to the provisions of this article, as soon as he has knowledge thereof, shall notify the division of such discharge." If the owner/operator of a dry cleaning facility believes that a release of dry cleaning solvent has occurred that has, or may, impact the ground water beneath the facility, the owner/operator should contact the Water Quality Control Division immediately by calling 303-692-3500, followed by written notification within five days of the discovery (5 CCR 1002-61, Section 61.8(5)(d)). The Hazardous Materials and Waste Management Division should also be notified of the discovery so that discussions may commence on the characterization and cleanup of the release.

Emergency releases (e.g., a ruptured 55-gallon drum resulting in a sudden release of solvent) should also be reported to the Department's toll-free 24-hour environmental emergency spill reporting telephone number (1-877-518-5608). A more complete discussion of all reporting requirements for chemical spills and releases in Colorado is contained within Attachment 1 to this document.

What to Do and Who to Contact

Despite the notification requirement in the water quality control law, most potential releases of dry cleaning solvents from current or former dry cleaning facilities come to the attention of the Department as a result of real estate and/or business transactions involving commercial or industrial properties. As a rule, money-lending institutions such as banks and investment companies require an environmental assessment to be performed prior to loaning money for transactions involving commercial or industrial properties. For properties where the results of the environmental assessment indicate that there is known, or high potential for, chemical contamination to exist, the lending institution will not typically provide a loan unless the parties in the transaction provide some type of documentation from a regulatory agency that the chemical contamination is being, or has been appropriately addressed. Once it has been established that the Department's input is required for a current or former dry cleaning facility, the owner/ operator can use the following information to determine how to proceed.

Post November 19, 1980 Release Sites

The Department's preferred regulatory mechanism for achieving an enforceable oversight role for the investigation and cleanup of un-permitted hazardous waste disposal sites that have resulted from post November 19, 1980 releases of dry cleaning solvents is the Corrective Action Plan. The requirements for a Corrective Action Plan are specified in the Colorado Hazardous Waste Regulations under 6 CCR 1007-3, Section 100.26 and described in the Department's Guidance Document titled "*RCRA Integrated Corrective Action Plan Application Guidance Document and Checklist*, First Edition, January 2000" (http://www.cdphe.state.co.us/hm/icapapp.pdf).

The application for a Corrective Action Plan should include a brief description of the history of the dry cleaning facility, the physical setting of the property, the site characterization activities and environmental data collected to date and any data regarding the type and extent of contamination identified to date. The Corrective Action Plan should then provide one of the following:

1) a detailed report of investigation activities that have been performed to fully define the vertical and horizontal extent of the release of dry cleaning solvents to soil, ground water and/or indoor air and either a remediation plan, or a request for no-further-action; or

2) a detailed work plan that describes a phased approach for investigating the full vertical and horizontal extent of soil and ground water contamination caused by the release of dry cleaning solvents and a commitment to perform the cleanup actions necessary to protect human health and the environment and/or meet state ground water standards.

Owner/operators of dry cleaning facilities where there has been a known or suspected release of dry cleaning chemicals to the environment since November 19, 1980 who wish to prepare and submit a Corrective Action Plan should contact the Department's Hazardous Waste Corrective Action Unit.

The Department will use its best efforts to review the initial application and any subsequent reports within 60 days of receipt and spend no more than 40 hours reviewing a document. Additional time may be required to review more complex plans and reports. The Corrective Action Plan regulations allow the Department to charge facility owner/operators for time spent by professional staff reviewing documents. Please check with the Department to get the most current hourly charge used to calculate review and activity fees.

If for some reason, the owner/operator of an un-permitted hazardous waste disposal facility cannot develop, or properly implement, a Corrective Action Plan within an acceptable timeframe, the Colorado Hazardous Waste Regulations allow the Department to compel the cleanup of the site by issuing a unilateral enforcement order to the owner and/or operator of the dry cleaning facility. The terms of these orders are not negotiable, include very specific performance requirements and may specify monetary penalties for violations of the order requirements.

Pre-November 19, 1980 Release Sites

There is no formal regulatory mechanism to enforce remediation of sites where the release of contamination predates the effective date of the hazardous waste regulations (unless information is available indicating that there is an imminent and substantial risk to human health and the environment, in which case the Department may choose to either issue an emergency order or refer the matter to the U.S.

Environmental Protection Agency). Owners/operators of dry cleaning facilities where there was a known or suspected release of dry cleaning chemicals to the environment prior to November 19, 1980 should submit a site characterization report and cleanup plan to the Voluntary Cleanup Program. The authority for the Voluntary Cleanup Program is derived from the State of Colorado Voluntary Cleanup and Redevelopment Act passed in 1994. The details of how to address known or potential releases of dry cleaning fluid at a pre-1980 site, and ultimately obtaining a no action determination letter, are provided in the Department's guidance document titled "*Voluntary Cleanup Roadmap, A How-To Guide*, dated October 2001.

The information required for a Voluntary Cleanup Program application is very similar to that of the Corrective Action Plan described above. The application must be accompanied by a check for $2,000, payable to the Colorado Department of Public Health and Environment. The Department then bills against the fee at the current hourly rate for professional staff. If there is money left at the end of the review, it will be refunded to the applicant. The application will be reviewed within 45 days of its receipt, with the possibility that the Division may request an extension.

Don't Hesitate to Involve the Department

The overall goal of the Department's Hazardous Materials and Waste Management Division is the protection of human health and the environment in the State of Colorado. Corrective Action Plans allow a facility to investigate, and if necessary, remediate contamination originating from their facility without the use of a formal enforcement mechanism. It is always in the Department's best interest to work with the owner/operator of a facility to investigate and cleanup releases as expeditiously and cooperatively as possible. Enforcement actions are generally reserved for recalcitrant or non-compliant facilities. The expenditure of professional staff effort and legal support required to conduct enforcement actions is far greater than could ever be made up by assessment of penalties. The personnel who oversee the Voluntary Cleanup Program have no enforcement or penalty assessment mechanisms at their disposal to require cleanup of facilities where releases of dry cleaning solvents occurred prior to November 1980. However, as mentioned earlier, lending institutions generally require acceptance of the remediation by an appropriate state agency before financing and property transfer can occur.

The successful implementation of a Corrective Action Plan or Voluntary Cleanup Plan requires open and productive communication between the owner/operator and the Department. When the owner/operator of a dry cleaning facility determines that input from the Department is necessary to continue forward with a project, a start-up meeting or teleconference should be scheduled with Department personnel. An initial call to the Compliance Assistance and Technical Support line at (303) 692-3320 can help establish which program should oversee the cleanup effort and establish a time and place for a start-up meeting. The purpose of the start-up meeting is to review the site background information and any existing data to determine the appropriate regulatory mechanism to use for the site and decide on the next step in the process. If possible, the start-up meeting can also be used to establish performance goals and cleanup standards that will apply. Additional formal, or informal, meetings or teleconference calls should occur throughout the project to help keep the project moving rapidly to completion while assuring the Department that the site cleanup is proceeding in a manner consistent with statutory and regulatory requirements and is protective of human health and the environment.

It is best for all parties concerned if the Department is engaged in a collaborative or consultative role, rather than an enforcement role made necessary by a recalcitrant facility or issues of non-compliance.

What to Do When Multiple Parties are Involved

In those cases where the dry cleaning facility is, or was, operated by one party ("the operator") and the property is owned by another ("the owner"), it is imperative that the two parties communicate and coordinate with one another early in the cleanup process since the actions of one will influence the other. For example, the property owner may have a different cleanup objective in mind (unrestricted use) from the business operator (commercial/industrial use), a situation that must be rectified before a final remedy can be proposed. Communication between the parties is also necessary to allocate liability based upon some degree of involvement. Oftentimes the responsible party will take the lead in remediating the release, in which case the other party should be kept informed of all aspects of the cleanup process, since both the owner and operator share responsibility in the cleanup of the site. The Department will not serve as an arbiter of who is the most responsible for the release and remediation of PCE. If the owner or operator are not able to propose a characterization and remediation plan in a timely manner, or are otherwise unable to coordinate among themselves, the Department will issue unilateral orders to both.

3.0 WASTE GENERATION AND WASTE MANAGEMENT AT DRY CLEANING FACILITIES

A variety of wastes are generated during the dry cleaning process involving chlorinated solvents. Those waste streams containing PCE are listed hazardous wastes (F002). The discussion of waste generation and waste management activities provided in this section is intended to help identify likely areas where releases of PCE may have been, or continue to be, sources of soil and ground water contamination at dry cleaning sites.

Waste Water

There are several different waste water streams generated during dry cleaning operations that likely contain levels of dissolved PCE since the water has come in contact with dry cleaning solvents. The waste water with the highest concentrations of PCE is the separator water generated during solvent distillation and solvent recovery processes. The separator water is saturated with solvent and at room temperature may contain approximately 150 mg/L (milligrams per liter, or parts per million) of PCE. Note that not all dry cleaning facilities recycle their PCE, but if they do, the collection container is generally located behind the dry cleaning machine. The Department expects the environmental investigation of the site will include soil borings through the floor of the dry cleaning facility in close proximity to the current, and any previous, locations of the dry cleaning machine.

The waste water generated during dry cleaning operations becomes a major concern if the building housing the dry cleaner is not connected to a public sewer system that flows to a publicly owned treatment works (POTW or waste water treatment plant). As a result, the Department expects that all environmental evaluations of dry cleaning facilities include a discussion of historic and current waste water disposal methods, especially dry cleaning facilities in rural areas that are less likely to be connected to a public sewer. If it is determined that the dry cleaning facility is not, or was not a some point in its history, connected to a waste water treatment plant, then the Department expects the environmental investigation of the site to include soil borings, with the collection of soil samples for chemical analysis, from the vicinity of septic tanks and leachfields, cesspools, or surface impoundments that may have been used for the disposal of dry cleaning wastewater.

Spent Filter Cartridges

The spent solvent filter cartridges that are used in the dry cleaning machines can contain up to one gallon of residual solvent. Some of this solvent can be recovered if the filters are allowed to drain back into the dry cleaning machine after they are changed. The major concern with these cartridges is that they were often allowed to drain inside, or outside the service door of the dry cleaning facility prior to disposal in a trash dumpster. The assumption used to be that the liquid PCE that drained from the cartridges would just evaporate away since the chemical is so volatile. However, a large percentage of the solvent may have migrated to the soil beneath these drainage areas due to the propensity of PCE to flow right through asphalt and concrete. As a result, the soil in these areas can be highly contaminated with PCE and can be a major source of ground water contamination unless remediated. The Department expects the environmental investigation of the site to include soil borings, with the collection of soil samples for chemical analysis, from the vicinity of the service door(s) of the dry cleaning facility and from the vicinity of the trash dumpsters for the facility.

Solvent Delivery/Storage/Transfer

Although much of the dry cleaning solvent being used today is delivered via closed-loop systems, in the past, the PCE was likely to have been delivered in bulk quantities and stored on-site in tanks or containers. Even minor spills or leaks that may have occurred during the product transfer or storage could have resulted in significant quantities of PCE being released over time. The Department expects the environmental investigation of former dry cleaning facilities, or existing dry cleaning facilities that have been in operation for a long-time, to include the collection of soil samples in the former PCE storage container/tank areas.

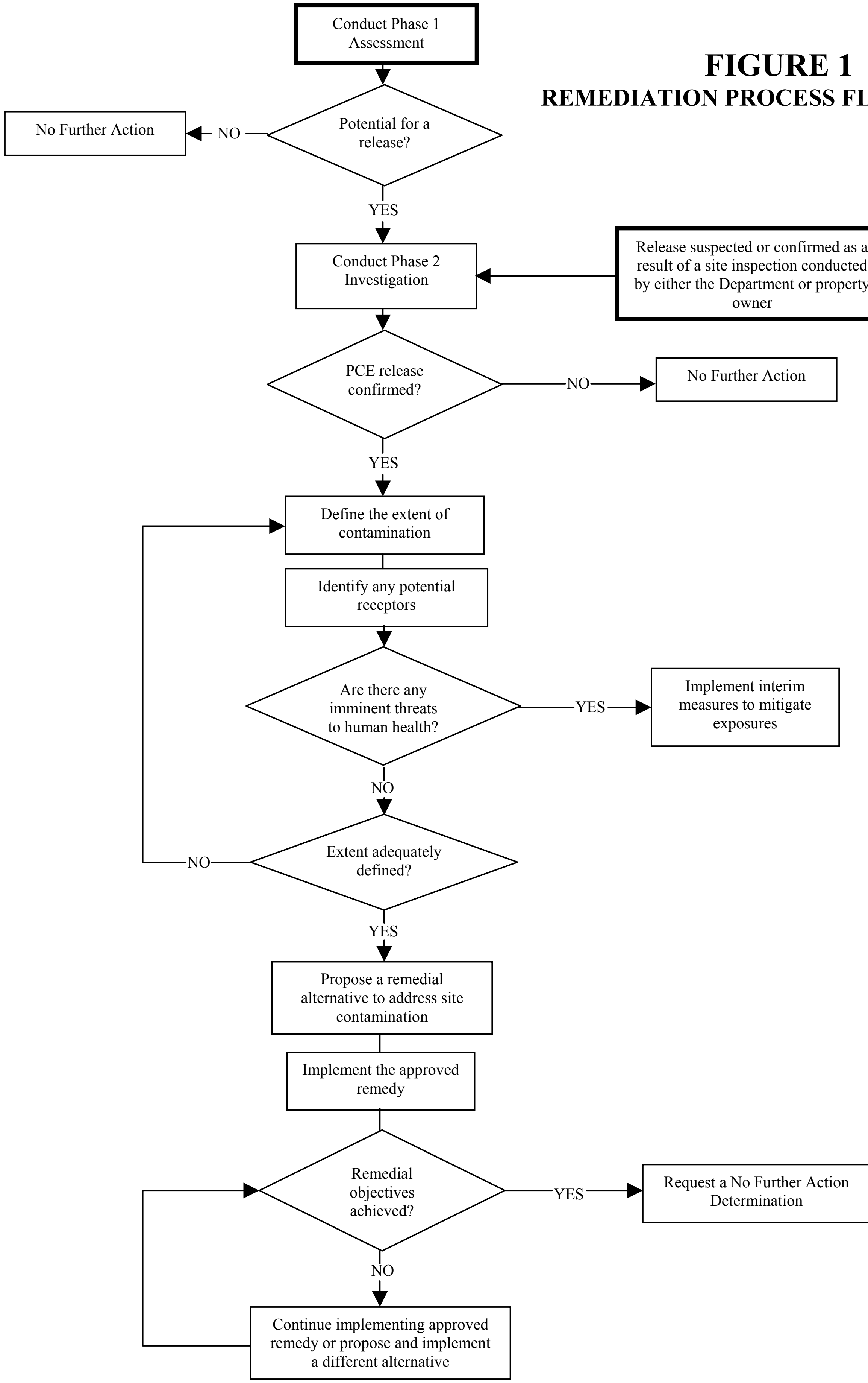
At most currently operating dry cleaning facilities, dry cleaning solvent is stored in tanks located at the base of the dry cleaning machine so that leaks during storage would be difficult to distinguish from operational releases. Operational related releases can occur as the result of equipment failure, including leaking gaskets, seals, valves, ruptured hoses, failed couplings, and equipment corrosion. Spills and leaks can also be associated with dry cleaning machine/equipment maintenance including filter changes, still cleanouts, servicing of the solvent pump and button trap cleanouts. As a result, the Department expects the environmental investigation of dry cleaning facilities to include soil borings, with the collection of soil samples, from locations as close to the dry cleaning machines as possible.

4.0 THE SITE INVESTIGATION

This section has been prepared to help the environmental consultants who perform site investigations focus on the collection of data that the Department believes is crucial for understanding the nature and extent of releases of dry cleaning fluids. It is also intended to help the owner/operator gain a general understanding of why some of these activities are required and how they will be performed. A flowchart depicting an outline of the site investigation and remediation process is provided in Figure 1.

The Department is aware that there are numerous guidance documents available that describe the techniques and equipment that may be used to conduct a site investigation program. The Department's preference is that proven and professionally accepted techniques be used (ASTM or EPA approved methods) so that the acceptability of the data will not be questioned. If alternate sampling techniques are better suited for site-specific circumstances, it is strongly recommended that Department approval for their use be obtained prior to conducting the field investigation. Sampling methods employed should be described in sufficient detail in all work plans or reports so that the quality of the data may be evaluated. For sites being characterized using a phased approach, the alternative is to seek approval for a standard set of sampling procedures that will be employed throughout the characterization effort.

FIGURE 1
REMEDIATION PROCESS FLOWCHART



4.1 PRELIMINARY ASSESSMENT OR PHASE I REAL ESTATE ASSESSMENT

A preliminary assessment of a dry cleaning facility involves an in-office review of available information and a site reconnaissance to identify potential contaminant source areas, the environmental conditions in the surrounding area and potential receptors if releases of dry cleaning solvent have occurred.

The office review activities should include the review of: all previous investigation reports for the facility, records of regulatory inspections, historical aerial photographs and topographical maps, facility as-built drawings, reports from assessment/remedial work at nearby sites, and data from the State of Colorado State Engineers Office regarding the locations of nearby potable/public supply wells. The office review can also include telephone, or in-person interviews with the business owner/operator and/or the real property owner to obtain information on facility operations and waste management practices.
The outcome of the office review should be a collection of general information regarding the facility. This includes dates of operation and whether the dry cleaning shop has ever switched locations within the same shopping center. If the shopping center has been in existence for a long period of time, it is possible that more than one dry cleaning business has operated on the property so historic tenant lists should be checked if available.

The assessment should document available information regarding historical operations and waste management practices, including the types of equipment used, wastes that are/were generated (contact water, filters, distillation residues etc.) and how the wastes were stored and managed. Information should also be compiled regarding other businesses that operated within the dry cleaning shop space, or nearby spaces to establish whether there may be other sources of chemical releases to the environment. Note that chlorinated solvents that are the same, or similar, to dry cleaning solvent have been used in a wide variety of businesses such as the printing and publishing industry and automobile repair facilities.

A site reconnaissance is absolutely necessary prior to starting any soil boring and sampling program. The intent of the site reconnaissance is to determine:

- the current location of dry cleaning equipment, evaluate current waste management practices and note any visible signs of chemical spills or leaks.
- where wastes are/were stored and where the facilities dumpsters are located.
- if the facility is, or ever was served by a septic tank/drainfield and where these components are located.
- if there are floor drains present.
- whether there are expansion joints and/or cracks in the facility floor slab located near solvent storage, solvent transfer, solvent use, or waste storage areas.

During the site reconnaissance, a facility layout diagram should be prepared that identifies the location of all of the features noted above, plus information regarding the exterior of the building such as land slopes, drainage features and potential drilling locations.

4.2 SITE INVESTIGATION OR PHASE II REAL ESTATE ASSESSMENT

Is a soil boring and sampling program necessary?

The short answer to this question is yes. While direct visual evidence of poor product/waste solvent management practices and/or release of dry cleaning solvent can often be noted during the site reconnaissance, it is very difficult to use visual evidence to demonstrate that a release has not occurred during dry cleaning operations. As a result, a soil boring and sampling investigation is usually warranted and requested at dry cleaning facilities. A ground water investigation may not always be required if a thorough soil investigation shows that the release of dry cleaning solvent has not reached ground water. However, soil characteristics underlying the site may be such that identifying the source will be very difficult and costly (e.g., highly permeable soil through which liquids will travel downward with little to no lateral diffusion), potentially requiring many boreholes to locate a source that may be very small in size. In certain situations, samples obtained from ground water monitoring wells provide a better indication of the presence and magnitude of a release, because the ground water often spreads the contamination over a larger area and consequently makes it easier to find. Unless a large number of samples are involved, the absence of soil contamination (or the detection of low concentrations) may not necessarily mean that a release has not occurred; however, sample results from just a single downgradient ground water monitoring well may be a better indicator of a release than all those soil samples combined. Ideally, a sampling program for dry cleaning facilities should include an appropriate number and combination of targeted soil and ground water samples (located in, immediately adjacent to or downgradient of the suspected source areas).

Although the focus of this guidance document is on the characterization and remediation of PCE, the site history should be reviewed to determine whether or not other types of dry cleaning chemicals were employed. Older facilities may have used petroleum-based solvents or other chlorinated hydrocarbons in their dry cleaning machines, the release of which should also be investigated and remediated (e.g., mineral spirits, carbon tetrachloride). Similarly, the modern alternatives to PCE solvent, if used at a site under investigation should also be looked at when evaluating whether dry cleaning activities may have impacted either soil and/or ground water. The test methods used to analyze samples should be capable of detecting all possible chemicals of concern that may have been released at the site.

Planning an Initial Site Investigation for Sites With No Known Releases

An initial site investigation at a dry cleaning facility to determine whether releases of dry cleaning solvent have occurred need not be an expensive, complicated activity. If the preliminary assessment does not yield evidence of a release, the Department's expectation is for a soil boring and sampling program to focus on those areas of the facility where releases are most likely to have occurred.

Prior to coring through floors and drilling into the subsurface, care should be taken to identify the location of utilities that may be beneath the floor of the facility and beneath the ground outside of the building. The State of Colorado operates a Buried Cable Location Service that when notified at (800) 922-1987, will facilitate the marking of the location of major underground utilities from the street to the on-site buildings. However, they will not routinely mark utilities inside of buildings, or utility lines that are owned by the property owner.

Places to Look Inside the Dry Cleaning Shop

The collection of soil samples from directly beneath the floor at several locations inside the dry cleaning space will greatly enhance the Department's confidence in the results of the site assessment program. However, we are aware that use of a drilling, or direct push, rig inside of the dry cleaning space may not always be feasible, particularly if the tenant space is occupied and easy access to suspect source areas is no longer available. In this case, the coring of a hole through the concrete floor with a portable drill or hammer, and the collection of soil samples using a hand auger, will be acceptable. If neither of these techniques is possible, the collection of soil samples using a drilling rig located as close as possible to the current and/or former dry cleaning space as possible may suffice.

<u>Dry Cleaning Machine</u> - If feasible, one soil boring should be conducted at both the front and back of the dry cleaning machine. Look for discolored and/or peeling floor tiles near the solvent use, solvent storage

and waste storage areas. If expansion joints or cracks (pathways for solvent migration) in the floor slab are located near the dry cleaning machine, the soil borings should be focused in these areas. A soil sample for quantitative chemical analysis for VOCs should be collected from directly beneath the facility floor slab (and under any gravel layer beneath the slab). Additional soil samples should be collected at approximately 5-foot intervals until the water table, or competent bedrock, is reached. These soil samples should be screened using the field screening techniques and the sample interval with either visible contamination or the highest field screening values should be submitted for quantitative chemical analysis. The last soil sample should be collected from the interface with the water table/bedrock and this sample should be submitted for quantitative chemical analysis for VOCs.

If dry cleaning is no longer performed at the facility and the former locations of the dry cleaning equipment in the building are unknown, look for cut off lag bolts protruding from the concrete floor slab. The machines were anchored to the floor with these bolts. Sometimes the bolts have been removed and their former locations are marked by concrete or mortar patches. Sometimes the floor in a former dry cleaning facility is covered with carpet or floor tile and the former location of the dry cleaning machine is unknown. As a general rule, in strip shopping centers, the dry cleaning machine is most often, though not always, located in the rear portion of the dry cleaning facility.

<u>Floor Drains</u> - One soil boring should also be placed near floor drains closest to the dry cleaning machine. If solvent wastes were discharged down floor drains plumbed with PVC piping, PCE can soften and even dissolve the PVC. The elbow joints of drain lines are particularly susceptible to dissolution. Floor drains are commonly located in the boiler room at dry cleaning facilities. Since PCE vapors are denser than air, the vapors tend to settle to the floor, particularly after the dry cleaning plant has been shut down for the day. These vapors will migrate to low spots along the facility floor and floor drains, floor expansion joints and cracks in the floor slab are prime entry point for these vapors. Problem areas also include the piping beyond the drain, including the sanitary sewer line itself. Cracks and joints in the piping have the potential to leak PCE-bearing liquids disposed of down these conduits, potentially contributing to ground water contamination beneath or outside the building. Soil samples should be collected as described above.

Places to Look Outside the Dry Cleaning Shop

<u>Service Door</u> - At least one soil boring should be located in the area outside the service door since it may have been used as a discharge area for waste water, the storage of spent cartridge filters, and/or the storage of both drummed unused or waste solvent. If there are several doors at the facility, conduct the soil boring at the door located nearest the dry cleaning machine/distillation unit. A soil sample for quantitative chemical analysis for VOCs should be collected from directly beneath the facility pavement (and under any gravel layer beneath the pavement). Additional soil samples should be collected at approximately 5-foot intervals until the water table, or competent bedrock, is reached. These soil samples should be screened using the field screening techniques and the sample interval with visible contamination or the highest field screening values should be submitted for quantitative chemical analysis. The last soil sample should be collected from the interface with the water table/bedrock and this sample should be submitted for quantitative chemical analysis for VOCs.

<u>Septic Tank/Drainfield</u> - As stated earlier, the discharge of dry cleaning related waste water to a septic tank/drainfield system can be a significant source area for soil and ground water contamination. If the dry cleaning shop was, or is, serviced by a septic tank/drainfield, the owner/operator should work with Department personnel to plan the investigation of the system because of the complexity of the task. Generally speaking, the Department will want at least one soil boring near the septic tank that extends below the bottom of the tank. If the location of the leachfield is known, several soil borings should be conducted within the leachfield itself (if the system is no longer in operation), or around the perimeter of

the leachfield (if the system is still in use). If there is no information available regarding the location or design of the system, great care should be taken to avoid damaging the leach field if it is still in use. Soil samples should be collected from the approximate depth of the leachfield lines and submitted for quantitative chemical analysis for VOCs. Soil samples should also be collected at regular intervals to the water table or competent bedrock, whichever comes first and samples submitted for quantitative chemical analysis for VOCs based on the field screening results.

Dumpsters/Trash Cans – One soil boring should be placed close to the current location of the dumpster or trash cans closest to the dry cleaning shop. Again, a soil sample should be collected from directly beneath the pavement and submitted for quantitative chemical analysis for VOCs. Soil samples should also be collected at regular intervals to the water table or competent bedrock. Another soil boring should be conducted in any other location where waste containers were staged in the past.

Determine the Nature and Extent of Contamination

If a release of dry cleaning solvents to soil or ground water is confirmed during the initial site assessment, the owner/operator must conduct an investigation to determine exactly what contaminants are present, where they are located, and at what concentrations. The main objective is to establish the full vertical and horizontal extent of contamination in all environmental media (soil and ground water at a minimum). The follow-on investigation must also collect adequate data to identify potential human and ecological receptors and whether the release has resulted in an unacceptable risk to the receptors. If field portable analytical instruments capable of provided quantifiable data for VOCs in soil and ground water are used, the investigation to define the full extent of contamination can be performed immediately after the preliminary investigation.

A sufficient number of representative samples must be collected and analyzed to adequately determine the horizontal and vertical extent of contamination in all environmental media. The Department does not generally require a specific number of samples, but rather leaves that determination up to the judgment of the environmental professionals conducting the assessment. The site sampling and analysis plan should explain the rationale behind each sample location as well as justification for eliminating assessment of any suspected source areas.

When investigating potential source areas and defining the horizontal and vertical limits of contamination, environmental sampling should be conducted in a manner that has a high probability of identifying contamination present onsite and offsite as a result of a release or releases from the facility. A single site investigation plan should be developed that includes a decision tree that defines a process for characterizing the site from its beginning to the end, thereby eliminating the need for multiple interim reports and work plans. This approach naturally requires detailed pre-planning that identifies the necessary steps and decisions that need to be made to fully complete the characterization work.

If sufficient quantities of PCE have been released, there is a potential that this solvent will move through both the soil column and ground water to collect as a free phase atop some confining layer in the subsurface. Similarly, elevated concentrations of PCE dissolved in ground water has the potential to stratify in the subsurface, causing the more dense PCE plume to settle deeper in the water-bearing aquifer. The presence of non-aqueous phase liquids may be confirmed through contaminant concentrations in ground water, visual examination of samples and/or the analysis of samples from shallow soil borings. These behavioral characteristics of PCE add to the challenge of investigating releases associated with dry cleaners. One should be cautious drilling within source areas to avoid the possibility of creating preferential pathways for contamination to migrate to deeper depth intervals. Unless these non-aqueous phase and high concentration dissolved phase areas of contamination are located, they may continue to degrade water quality for an indefinite period, potentially wasting time and money trying to cleanup dissolved phase ground water contamination.

Dry cleaning facilities are typically located amidst other shops in strip malls or shopping centers. Depending on site characteristics, the contamination may have migrated through the soil beneath these adjoining tenant spaces, requiring that samples be collected from these areas in order to define the extent of the contamination. Recognizing that sampling activities can be very disruptive to business activities in these adjoining areas, there may be circumstances where the delineation of contamination can be deferred to a later date in the corrective action process: this delineation may occur through the collection of confirmation samples after the remedy has been implemented (e.g., soil vapor extraction) and cleanup is believed to be complete.

When evaluating ground water, at least one upgradient ground water sample should be collected to define background water quality. A sufficient number of monitoring points should be used to convincingly define the downgradient extent of contamination. Many more monitoring points may be necessary, both horizontally and vertically, depending on specific conditions. Some situations where more data are needed include sites: a) with complex subsurface conditions (e.g., multiple water-bearing zones, fractured bedrock, complex fluvial deposits, etc.), b) where free-phase or stratified contamination may be present (e.g., dense non-aqueous phase contamination, vertically stratified dissolved phase contamination, etc.), or c) where the direction of ground water flow is uncertain or variable.

PCE and its degradation products are very volatile and therefore capable of migrating from soil or ground water into the vapor phase, which in turn can migrate upwards through soil pore spaces and enter overlying buildings where they may accumulate at concentrations that can pose a danger to the building occupants. If testing reveals that solvent vapors are migrating from a subsurface source into overlying structures, the party performing the site investigation will also be required to characterize the magnitude and extent of this vapor phase contamination. Testing should continue until solvent vapors are no longer measured at concentrations that exceed specified risk levels.

The extent of contamination in soil is defined when one of the following conditions is met:

- For each individual constituent, the contamination is defined down to a concentration that poses an excess cancer risk equal to or less than 1×10^{-6} and/or a Hazard Index of less than one using a residential exposure scenario (unrestricted use).

- For each individual constituent, the contamination is defined down to a concentration that poses an excess cancer risk equal to or less than 1×10^{-6} and/or a Hazard Index of less than one using a site-specific exposure scenario (e.g., industrial exposure scenario, a restricted use). This would be allowed only if a) soil contamination at and beyond the facility boundary does not exceed an unrestricted use concentration, b) there is little to no possibility that the soil contamination will in the future migrate offsite at concentrations in excess of unrestricted use concentrations, and c) an effective and enforceable environmental covenant is placed on the affected property for as long as necessary to restrict activities to those used in calculating the site-specific soil concentration.

- The contamination is defined down to a concentration that is protective of ground water quality. Contamination should not be left behind that has the potential to leach out of the soil and degrade ground water quality underlying the site to the degree that State standards are exceeded. For PCE and its degradation products, which are mobile constituents and have very low ground water standards, the protection of this resource will in almost all cases drive the cleanup at dry cleaning facilities.

Soil concentrations calculated for each of these three categories are listed in Table 2.

Extent of contamination in ground water is considered defined when contaminant levels are:

- at or below established State ground water standards (5 CCR 1002-41, Regulation 41), or
- at or below a risk-based concentration that is determined to be protective of human health and the environment for those constituents that do not have an established State ground water standard. The facility should seek the Department's approval to use a risk-based concentration before proceeding with the investigation.

And:

- at or below a concentration that is protective of other potential exposure pathways (e.g., off-gassing of vapors and their collection in indoor air; discharge to surface water).

The physical and geochemical characteristics of subsurface materials, including the local hydrology and geology, should be defined so that the fate and transport of the contamination will be understood. This information is used in conjunction with other site setting information in evaluating contaminant migration pathways, establishing potential exposure scenarios and evaluating possible remedial alternatives.

An evaluation of the hydrogeologic setting is based on the specific geologic formations and lithology affecting ground water flow beneath the facility and the characteristics of impacted aquifers. Information such as lithologic characteristics of the soil and bedrock, permeability of the formation, depth to ground water, thickness of the saturated interval(s), areal extent of the aquifer(s), hydraulic conductivity of the aquifer(s), and an interpretation of the hydraulic interconnectivity between saturated zones is needed to evaluate the horizontal and vertical extent of contamination and help determine contaminant migration characteristics. The type and amount of information gathered is dependent largely on the complexity of the subsurface environment, and, secondarily, on what is needed to help select a remedial alternative for the affected media.

Ground water level contour maps are required for each saturated zone to determine local ground water flow patterns. Care should be taken to ensure that potential man-made influences on ground water flow, such as french drains, unlined ponds, septic systems, storm water outfalls, permitted waste water discharge outfalls or ground water production wells are reflected in the ground water level contour maps. At this stage of the site investigation, data should also be collected for the purpose of evaluating viable remedial alternatives. Oftentimes the nature of the contamination and our experience dealing with similar situations elsewhere might point to one or more potential remedies (presumptive remedies). Instead of waiting for the completion of the field characterization effort, the facility will benefit from collecting additional data during the investigation phase that can be used for the purpose of evaluating and possibly selecting one or more remedies that might be applied to the site. Doing so early in the process has the potential to save considerable time (shaving months, possibly years off the cleanup process) and money (eliminating the need for multiple sampling efforts). A few examples include:

- conducting pumping tests to evaluate aquifer characteristics and determine their influence on pump-and-treat or other in-situ treatment technologies.
- characterizing soil properties to evaluate the possible use of soil vapor extraction or other infiltration treatment technologies;
- characterizing the basic geochemical characteristics of the formation to evaluate the behavior and ability of injected chemicals to treat contamination;
- characterizing microbiological populations or collecting general water quality data to evaluate the possibility of using enhanced monitored natural attenuation.

Vapor Intrusion Pathway

PCE, classified by the U.S. Environmental Protection agency as a probable human carcinogen, readily evaporates off of soil and ground water, becoming a gas that can easily migrate up through rock fractures or soil pore spaces, even if the contamination is located many feet below the ground surface. If there are buildings above the area of contamination, PCE vapors can migrate into overlying buildings and pose a health risk even at very low concentrations when breathed by humans. The vapor concentrations may be elevated to the extent that it presents a health risk, but low enough that the building occupants would be unaware that they are being exposed.

Dry cleaning facilities are typically located within or near residential communities, contamination from which has the potential to migrate beneath adjoining properties and pose an indoor air threat if concentrations are high enough. For example, PCE vapors derived from contamination that has migrated laterally through soil beneath a building has the potential to enter and collect within adjoining tenant spaces at concentrations that may pose a risk to the occupants. Similarly, ground water contamination that has traveled off-site and beneath single or multi-family dwellings may be capable of generating soil vapors that enter the home at measurable concentrations. Therefore whenever PCE contamination is determined to have migrated beneath nearby buildings, the expectation is that the vapor intrusion pathway will be evaluated to some degree, ranging from comparing ground water sample results against screening concentrations all the way to gathering indoor air quality data from potentially impacted buildings. These indoor air and ground water screening concentrations are listed in Table 1.

Since PCE is a widely used solvent that is found in some household products (e.g., glues) and home activities (e.g., dry cleaned clothing), there is a high probability that low concentrations of PCE vapor is present in most homes that is not attributable to environmental contamination. This “background” level of contamination will make it somewhat difficult to interpret indoor air test results collected from homes above ground water contamination coming from a dry cleaning facility. Although ground water screening numbers are provided in Table 1, the specific characteristics of a site, everything from depth to ground water to what types of buildings are located above the contamination, should be reviewed before a decision is made to enter a property for the purpose of collecting indoor air data. Once a decision is made to sample indoor air, it is important that a comprehensive chemical survey be conducted within the building as close to or on the day the indoor air samples are to be collected. The purpose of the survey is to determine if there are any activities, products or chemicals kept in the building that may interfere with the proposed testing, making it difficult to distinguish the source of measured contamination (subsurface contamination vs. household products). The resulting air quality data must be carefully reviewed with the Department to avoid triggering a costly investigation based on a false positive attributable to background sources of contamination.

Because of the technical challenges posed by this exposure pathway, please consult with the Department and any available guidance documents it may have prepared on the subject before proceeding with the design and implementation of an indoor air-monitoring program.

4.3 SAMPLING AND ANALYSIS

General Sampling and Analytical Methods

The sampling and analysis plan should describe in sufficient detail the field and analytical procedures that will be used to determine the concentration of constituents in representative samples of potentially affected environmental media. The sampling and analysis plan often includes provisions for both qualitative and quantitative analyses. Qualitative methods are used to process large volumes of media cheaply and quickly, and are often called “screening” methods. Qualitative methods are used to

Table 1 - Air And Ground Water Screening Concentrations

Volatile organic chemicals have a high vapor pressure (molecular weight < 200 g/mol and Henry's Law Constant > 10^{-5} atm m^3/ mol) and easily form a gas at normal temperature and pressure. This definition applies to a large number of organic compounds, many of which are human-made chemicals. From this long list of chemicals, the Department has chosen those typically found at dry cleaner release sites that can be analyzed using the TO-15 low resolution SCAN method.

Target indoor air concentrations for those chemicals not included on this list may be found in EPA Region 3's risk based concentration table (http://www.epa.gov/reg3hwmd/risk/human/rbc/rbc1004.pdf). Ground water screening concentrations for those chemicals not included on this list may be found in Table 2c of EPA's November 2002 "Draft Guidance For Evaluating The Vapor Intrusion To Indoor Air Pathway From Groundwater And Soils" (http://www.epa.gov/correctiveaction/eis/vapor.htm). Consult with Department staff before basing any decisions on the need for further work using concentrations found in either of EPA's tables.

Chemical Abstracts No.	Chemical Name (IUPAC)	Risk Basis C=Cancer NC=Noncancer	Remediation Goal Indoor Air Concentration[1] ($R=10^{-6}$, HI=1) µg/m^3	Remediation Goal Ground Water Screening Concentration[2] µg/Liter	Action Level Indoor Air Concentration[1] µg/m^3	Action Level Ground Water Screening Concentration[2] µg/Liter	CGWS µg/Liter
75-35-4	1,1-dichloroethene	NC	5	7	5	7	7
156-59-2	Cis-1,2-dichloroethene	NC	37	210	37	210	70
156-60-5	Trans-1,2-dichloroethene	NC	62	1800	62	1800	100
127-18-4	Tetrachloroethene	C	0.31[3]	5	15.5[3]	20	5
79001-6	Trichloroethene	C	0.016[4]	5[5]	0.8[4]	5[5]	5
75-01-4	Vinyl chloride	C	0.072	2	0.72	20	2

IUPAC – International Union of Pure and Applied Chemistry
CGWS – Colorado Ground Water Standards, as found in Regulation #41 (5 CCR 1002-41)

[1] The screening values are derived from a variety of sources and are based on a residential exposure scenario. Parties using this table should periodically check these sources to verify that the posted values are still in use.

[2] With few exceptions, the ground water screening concentrations are derived from EPA's November 2002 "Draft Guidance For Evaluating The Vapor Intrusion To Indoor Air Pathway From Groundwater And Soils". Except for those values based on Maximum Contaminant Levels, the screening numbers assume water/vapor equilibrium and an attenuation coefficient of 1000. The action level screening concentrations were extrapolated from the USEPA value.

[3] The value listed for tetrachloroethene's indoor air screening concentration uses an EPA approved CalEPA inhalation slope factor. The action level is based on a $5x10^{-5}$ risk to account for background contributions in indoor and ambient air and analytical reporting limit constraints.

[4] Consult the Department's August 20, 2004 "Policy On An Interim Risk Evaluation And Management Approach For TCE" for an explanation of the Department's selection of the screening level and action level for trichloroethene (http://www.cdphe.state.co.us/hm/tcepolicy.pdf). The action level listed is the lower end of a range provided in that policy.

[5] EPA's target ground water concentration for trichloroethene is the MCL, which is equivalent to a 10^{-4} risk value. Use of this concentration as a screening value is consistent with the Department's August 20, 2004 "Policy On An Interim Risk Evaluation And Management Approach For TCE", in which $5x10^{-5}$ and $1x10^{-4}$ risk values are used as interim action levels.

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determine if a chemical or constituent is likely to be present, but can't definitively be used to determine what the concentration level is for that constituent. Examples include photoionization detector (PID) and flame ionization detector (FID) meters, Geo-probe samples, and geophysical data. Quantitative analytical methods are used to measure attributes of representative samples and provide reproducible results with known accuracy and precision and are required to demonstrate the absence of contaminants in a sample. All samples for quantitative analysis should be prepared and analyzed in strict accordance with the methods described in EPA's Test Methods for Evaluating Solid Waste (SW- 846). If there is a planned variation from the established methods, the proposed variation must be described in the site characterization work plan or report so that their influence on the sampling data may be evaluated. Approval from the Department is strongly recommended prior to use of an alternate method.

Some things to consider when planning the sampling and analysis program include the following:

- ensure that samples are collected using equipment and methods that will either minimize or eliminate the loss of constituents that may be present.
- volatile constituents should be sampled from areas that have not been disturbed (e.g., from the excavation sidewall, not the soil pile that has accumulated below) using techniques that minimize disturbance or exposure of the sample (e.g., using equipment and a method that does not result in the vigorous agitation of a soil or water sample; containerizing a sample immediately, not waiting until after the soil core has been logged or screened).
- if field screening techniques are employed, samples retrieved from the subsurface should be split into two aliquots: screening tests are performed on one of the split samples, while the other is immediately containerized and reserved for laboratory analysis. At no time should a screened sample be sent to the laboratory for analysis, because the volatile constituents have been lost through the screening process.
- tests performed on materials that may contain volatile constituents should only be conducted on grab samples: the act of compositing a sample results in the loss of these constituents.
- in those cases where the collection of composite samples has been approved by the Department, ensure that a statistically valid number of individual samples are used (e.g., 5 or 6 individual samples maximum, not 30, per composite) and have been collected from an appropriately sized area (e.g., one sample per 20, not 200, cubic yards).
- samples must be containerized, preserved and analyzed within holding times in strict accordance with Department and EPA approved guidelines.

All sample results received by the Department will be critically reviewed to ensure that they are representative and reliable so that subsequent decisions will be made based on our confidence of the data. It is therefore important that work plans or reports clearly describe the sampling equipment, methods and preservation techniques employed to characterize a site. Reports should also include all quality assurance/quality control data that may have been generated for a particular data set, not just the summary tables, so that data quality may be evaluated.

Field Assessment Technologies To Speed the Site Investigation Process

When conducting site investigation activities to delineate the extent of contamination or to otherwise evaluate contaminant levels, it is useful to have a means of checking for the presence of a contaminant while performing the sampling activities. There are a number of technologies that have recently been developed that can greatly increase the amount and quality of the information that can be collected directly in the field during environmental site investigations. These technologies are constantly being enhanced while new ones continue to be developed, so please be sure to check and see whether other methods are available besides the few listed here. The following are a few examples of assessment technologies that have been utilized in dry cleaning site characterization work. A more detailed description of these technologies can be found at http://www.epa.gov/tio/char.htm.

Mobile Laboratories
The iterative process practiced in conducting site assessments in the past involved multiple mobilizations that generated multiple reports and work plans requiring multiple reviews. Long delays occurred in the cycle. Mobile laboratories offer an alternative to the older process. Coupled with direct push sampling, mobile laboratories offer an efficient means to provide accurate real-time data that allows field personnel to adjust the scope of work during the assessment and therefore minimize the number of mobilizations needed to complete a site assessment. Mobile laboratories can also be utilized effectively during remedial excavations. Onsite analysis allows excavations to be completed in one mobilization.

Mobile laboratories offer quantitative, laboratory-grade, gas chromatograph or gas chromatograph/mass spectrometer detectors. For the investigation of dry cleaning facilities, the Department will also allow the used of an abbreviated analytical suite to reduce sample run times. For a PCE dry cleaning site this would include tetrachloroethene, trichloroethene, cis 1,2-dichloroethene, trans 1,2-dichloroethene, 1,1-dichlroethene and vinyl chloride. Analysis for the benzene, toluene, ethylbenzene, xylene (BTEX) suite and naphthalene should also be performed at older facilities that may have used petroleum hydrocarbon based dry cleaning solvents.

Color-Tec Screening
Color-Tec is a screening method used to determine if ground water, soil, sediment or surface water samples contain PCE or its breakdown products. This screening method uses colorimetric tubes and their reaction to chlorinated ethenes to give an immediate visible sign of its presence. This indication is partially quantitative but for delineation purposes, the indication of the presence of the contaminant is sufficient to delineate the approximate extent of contamination at a site. The colorimetric tubes can be used to prescreen samples and determine which samples should be analyzed by the laboratory. This method reduces delays associated with waiting for the laboratory analysis to determine where the next samples will be collected. The Color-Tec method can also be used independently of the mobile laboratory to delineate contamination at a site. In utilizing this method, duplicates of approximately 20 to 25% of the samples are sent to a laboratory for analysis.

If the Color-Tec method is utilized to analyze samples from newly installed monitor wells and chlorinated solvents are detected in a sample from a lateral or compliance monitor well, then an additional well can be installed while the drilling rig is still in the field, saving the costs associated with an additional mobilization.

For additional information on the Color-Tec screening method refer to a paper entitled *Ecology & Environment's Color-Tec Screening Method for Detection of Chlorinated Solvents in Ground water and Soil Samples* at the State Coalition for the Remediation of Drycleaners website: http://www.drycleancoalition.org/download/Color_tec_2005.pdf

Direct Push-Installed Monitor Wells (Microwells)
A significant portion of the costs of site assessment work is associated with monitor well installation and managing investigation-derived wastes (drill cuttings, well development water, purge water and decontamination water). As noted in Sections 2.2 and 7.0, most investigation-derived wastes generated during dry cleaning site investigations are classified as listed hazardous waste and disposal can be expensive. Waste minimization should be an integral part of any site investigation. Use of microwells as permanent monitor wells in dry cleaning site investigations can result in significant cost savings in both the investigations and subsequent ground water monitoring.

Microwells are small diameter (inner casing diameters of one-half, three quarters, or one inch) PVC monitor wells. These wells are generally installed utilizing direct push technology. If direct push sampling techniques are employed in conjunction with on-site sample analysis (utilizing a mobile laboratory, portable gas chromatograph or Color- Tec screening), microwells can be installed upon completion of contaminant plume delineation saving time and the expense of an additional mobilization. Additionally, no drill cuttings are generated during installation and wastewater generated through well development and purging is minimized. Minimal purge water is generated during future ground water monitoring events. A considerable cost savings can be realized in the installation of compliance monitor well clusters by installing multiple microwells in a single borehole rather than installing a cluster of monitor wells by conventional means.

Membrane Interface Probe

The membrane interface probe (MIP) is a device used to detect VOCs in the subsurface. The probe is advanced using direct push technology and is used in conjunction with a soil conductivity device, which is used to characterize the subsurface lithologies. The Membrane Interface Probe contains a fluorocarbon membrane mounted on the direct push drive point. The membrane is heated (100˚- 120˚C) and VOCs partition from the soil, soil gas or ground water across the membrane where they are transported to the surface by a carrier gas. At the surface the vapors are analyzed in a truck-mounted laboratory using one or more detectors. A good choice of detectors for dry cleaning work would be an electron capture device (ECD) for the chlorinated solvents.

The Membrane Interface Probe provides continuous profiling offering real-time data. It is effective in both the saturated and unsaturated zones and in clays. While the anticipated practical quantitation limit of the Probe of 100 ug/l is twenty times higher than the state ground water standards for most chlorinated solvents, the Membrane Interface Probe can be a highly effective tool in site characterization work at contaminated dry cleaning sites. The primary application is to provide a picture of the distribution of contaminants in source areas. At highly contaminated sites where remediation is anticipated, a day or two of Membrane Interface Probe work performed in the contaminant source area will provide valuable information concerning where the predominant portion of the contaminant mass is located and how it occurs in the soil and ground water. These data will prove to be invaluable in remedial design, particularly where in-situ remediation is being considered. The Membrane Interface Probe work will also aid in choosing strategic locations and screen intervals for monitor wells to evaluate the performance of the remedial system and for injection wells, if applicable.

Passive Diffusion Bag Samplers (PDB)

Passive Diffusion Bag samplers are low-density polyethylene bags filled with de-ionized water that allow passive diffusion of VOCs from the ground water into the bags until constituent concentrations reach equilibrium. The samplers are placed at target intervals within a monitoring well to allow representative samples to be collected from specific depth intervals to check for vertical stratification of contaminants. The bag length can vary; however, the typical sampler is approximately two feet long. The monitoring wells are not purged prior to collection of the sample; therefore the investigation-derived wastewater is limited to the remaining water from the bag. Multiple samplers are placed in a monitoring well to vertically delineate the screened interval. Periodic monitoring typically targets the vertical interval with the highest concentration as a worst-case scenario. The samplers are commonly left in place for a minimum of two weeks, retrieved, and shipped to the laboratory for analysis. Use of Passive Diffusion Bag samplers for ground water monitoring at sites with deep wells can result in considerable cost savings with regard to labor and minimization of investigation-derived wastes.

Soil Gas Surveys

Soil gas surveys can be a useful means of identifying contaminant source areas. The primary applications for soil gas surveys are at dry cleaning sites where the building that housed the dry cleaning facility has been razed and the location of the traditional contaminant source areas (dry cleaning machine, distillation unit, solvent storage and waste storage areas) is unknown, and possibly in identifying the location of a wastewater leachfield. There are two types of soil gas surveys – passive and active. Passive soil gas surveys utilize a sorbent material (granular activated carbon or zeolites) contained in a sampling chamber. The sampling chamber is placed in a shallow borehole, which is sealed at the surface, and the sampling chamber is left in the ground for a period of time varying from one day to two weeks. The sampling chamber is then retrieved, sealed and sent to a laboratory for analysis. Passive soil gas surveys can be successfully conducted in lower permeability soils. The drawbacks to passive soil gas sampling are that two site mobilizations are required and there is a waiting period for laboratory analysis.

Active soil gas surveys collect soil gas from a hollow probe driven into the ground. These samples can be analyzed on site utilizing a portable gas chromatograph or mobile laboratory or, the sample can be sent to a fixed laboratory. A qualitative evaluation can be obtained by utilizing colorimetric tubes. Active soil gas data analyzed in the field is real-time data and the scope of the survey can be adjusted to pinpoint "hot spots" and collect additional data during one mobilization. Active soil gas surveys are not suitable for low permeability soils or very shallow water tables.

5.0 EVALUATING RISK AND DETERMINING IF A REMEDY IS REQUIRED

Once the nature and extent of the release to the environment has been fully characterized, a risk evaluation is performed to determine whether the release presents an unacceptable current, or potential future, risk to human health and the environment. For most dry cleaning facilities, where the releases have impacted relatively small areas, the risk evaluation will consist of a simple comparison of the levels of contamination found in the environmental media (e.g., soil and ground water) to generic soil remediation objectives and/or State Ground Water Standards published by the Department. Remediation to mitigate the actual or potential threat to human health and the environment will almost always be required if the published soil remediation objectives and/or promulgated State Ground Water Standards are exceeded at any location on, or off, the facility property. Please note that facility owner/operators always have the option of performing a site-specific risk evaluation to determine whether remedial activities will be required as discussed below.

5.1 SOIL CONTAMINATION

Generic Soil Remediation Objectives

In Table 2, the Department has established ground water protection and human health risk-based concentrations for chemicals in soil using conservative assumptions on the nature of the contamination and risk. These soil remediation objective concentrations have been developed for a variety of land uses (residential, commercial, industrial) and the protection of ground water quality. Generally, remediation to mitigate the actual or potential threat to human health and the environment will be required if the soil remediation objectives for one or more constituents are exceeded. Failure to cleanup a site to the most stringent of these soil concentrations requires the placement of institutional controls (i.e., an environmental covenant) on the property as described below.

The generic soil remediation objectives also include soil concentrations that are protective of ground water for those contaminants, such as PCE, that have a high potential to leach from soil and degrade the ground water quality beneath a site. The soil concentrations that are protective of ground water may be used as both screening criteria and cleanup numbers. For example, the soil concentrations protective of ground water can help determine whether ground water monitoring is needed at a site, or can be used to support a no-further-action determination if all soil concentrations are below both the ground water protection and the human health soil remediation objectives. Consideration of the potential for contaminants to transfer from one media, where it may not pose a risk, to another, where it may pose a risk ensures current as well as future protection of human health and the environment.

The generic soil remediation objectives can also be used to determine whether soil remediation activities are complete. The Department approves the use of these generic soil remediation objectives, allowing quick cleanup to known acceptable levels. The advantage of using these generic numbers is that the time and cost of additional study associated with performing a site-specific risk assessment is eliminated and cleanup can proceed quickly. If there is a relatively small release to soil, the generic soil cleanup levels can be used to cleanup and verify remediation of the release, allowing the entire process to be quickly completed.

Site-Specific Soil Exposure Risk Assessment

Every facility has the option of conducting a detailed risk evaluation using site-specific information regarding potential exposures in an effort to calculate safe, protective soil objectives unique to that site. Risk evaluation input parameters that are typically modified using site-specific data include frequency of human exposure to the contamination, exposure duration, and assumptions of potential pathways (ingestion, inhalation, dermal contact) by which a human can be exposed to the contamination. The site-specific risk evaluation may also include the use of complex chemical fate-and-transport models and probabilistic evaluations of possible exposures and risk. The use of institutional controls (i.e., an environmental covenant) to prevent exposures to contamination may also be factored into a risk evaluation and subsequent decision to remediate or not. Facilities should work closely with Department personnel in the planning stages of a site-specific risk evaluation to reduce the potential for disagreements with the outcome of the evaluation.

Table 2 - Soil Remediation Objectives

(June 2004 Version)

Chemical	CAS	Residential/ Unrestricted Landuse		Commercial Landuse		Industrial Landuse		Ground Water Protection Levels[1]		State Ground Water Standard
		(mg/kg)	Notes	(mg/kg)	Notes	(mg/kg)	Notes	(mg/kg)	Notes	(µg/L)
1,1-Dichloroethene	75-35-4	0.07	c	0.37	c	0.33	c	12.0		7
Cis-1,2-Dichloroethene	156-59-2	611	nc	1,000	nc,ucl	1,000	nc,ucl	1,3		70
Trans-1,2-Dichloroethene	156-60-5	1,000	nc,ucl	1,000	nc,ucl	1,000	nc,ucl	5.4		100
Tetrachloroethene	127-18-4	5.18	c	36.0	c	19.0	c	1.88		5
Trichloroethene	79-01-6	4.54	c	24.3	c	21.4	c	0.68		5
Vinyl Chloride	75-01-4	0.16	c	2.27	c	1.24	c	7.0		0.023 to 2[2]

[1] The model used to calculate soil concentrations protective of ground water makes certain assumptions regarding the extent of contamination: 10 meter by 10 meter square area of contamination; 1 meter thick layer of contamination sandwiched between 1 meter thick layer of clean soil, above and below; the contaminant layer is located 1 meter above the water table. Site-specific factors that deviate from these conditions may influence, up or down, the soil concentration that is protective of ground water.

[2] The higher of the two values listed in the range is the remediation goal for releases that occurred prior to September 14, 2004 while the lower, health-based value is the remediation goal for releases determined to have occurred after that date.

c Cancer
nc Non-cancer
ucl Upper concentration limit

5.2 GROUND WATER CONTAMINATION

The Department's Water Quality Control Commission promulgates the Basic Standards for Ground Water in Regulation 41 (5 CCR 1002-41) for a long list of organic and inorganic chemicals. Table A of Regulation 41 includes ground water standards for all of the hazardous constituents associated with dry cleaning operations (summarized in Table 2). The ground water standards apply to all ground waters of the state, without regard to current or potential future use of the ground water as a source for agricultural, industrial or human consumption purposes. The initial point of compliance for achievement of the State ground water standards is typically the facility property boundary, which means that active remediation is normally required to address existing on-site contamination and to prevent further off-site migration of contaminated ground water. The decision to require active ground water remediation will also consider the potential for the transfer of contaminants in the ground water to soil gas and then indoor air of buildings above the contaminant plume. The final point of compliance for State ground water standards is achievement of the standards throughout the contamination plume, both on-site and off-site. Regulation 41 contains provisions for petitioning the Water Quality Control Commission to allow site-specific ground water standard(s) and/or point of compliance if a facility so desires.

6.0 SITE REMEDIATION

If the results of the risk evaluation indicate that the release from the dry cleaning facility represents an unacceptable risk to human health and the environment, a decision must be made regarding the type of remedy that is required and how fast the remedy must be implemented. The level of effort necessary for the remediation and the speed at which a remedy is implemented is dependant on the location of the contamination and the magnitude of risk created by the contaminated environmental media.

6.1 DEALING WITH IMMINENT THREATS TO HUMAN HEALTH

Releases of contamination that pose an actual or imminent threat to human health and the environment must be dealt with immediately. For example, if soil and/or ground water contamination is detected beyond the property boundary in an area where the ground water is used as a source of drinking water, or where the ground water contamination is impacting indoor air, the Department typically requires implementation of an "interim measure" to quickly reduce the human exposure to the contamination. Interim measures could include the installation of whole-house water treatment systems or provision of bottled water for ground water users to ensure that they are not exposed to contaminated water from impacted wells or construction of a subsurface soil vapor extraction system beneath a home to reduce the concentrations of VOCs entering the home.

An interim measure may also be required on site to quickly stop further releases of constituents and/or to prevent the further spread of contamination while long-term final corrective measures for the site are being evaluated. For soil contamination, this could be accomplished by excavating and removing highly contaminated soil to reduce the spread of contaminants. For ground water contamination, this could be accomplished by installing a physical (sheet pile wall) or hydraulic (ground water pump and treat system) barrier in the source area or along the property boundary to halt the migration of highly contaminated ground water.

Other benefits for implementing an interim measure early in the corrective action process include: it can reduce the quantity of environmental media that may need to be remediated; it can reduce the amount of time needed to remediate the release; it can reduce the overall cost of the remediation effort; it may reduce the concern the Department and public may have with regard to the release; and it may limit the scope of the regulatory impact.

6.2 LONG-TERM REMEDIATION GOALS

Soil Remediation Goals

The owner/operator of a dry cleaning facility with releases to the environment should strive to remediate the surface and subsurface soil at their site to levels that do not pose a risk to ground water and human health, using a residential/unrestricted use exposure scenario, thus allowing unrestricted use of the property both now and in the future (i.e., clean closure). The soil beneath the dry cleaning facility can be cleaned up to the generic ground water protection and residential scenario soil remediation objectives listed in Table 2, or site-specific unrestricted use soil cleanup values developed by the owner/operator. Achieving this goal would allow the facility owner/operator to "walk away" from the site following closure and would provide the greatest amount of protection to all prospective users or residents. No land use restrictions would be necessary if a facility has been cleaned-up to such a standard.

Contamination that has impacted the soil on property that the facility operator does not own (rental property) or that has migrated beyond the facility boundaries brings into play an entirely different set of considerations and legal obligations, and may reduce the remedial options available to the party responsible for the release. This contamination must either be a) remediated using conservative remediation objectives that result in clean closure and unrestricted use of the impacted property or b) remediated to the extent requested by the property owner. The facility owner/operator may not impose restrictions on the current or future use of properties it does not own, unless that property owner agrees to 1) the cleanup performance standards, 2) the remedial alternative that will achieve these performance standards, and 3) the imposition and maintenance of institutional controls to limit future land use or development if something other than clean closure is proposed.

Ground water Remediation Goals

The owner/operator of a dry cleaning facility with releases to ground water will be required to remediate the ground water beneath the site to achieve the established State ground water standards (5 CCR 1002-41, Regulation 41), or achieve a risk-based concentration that is determined to be protective of human health and the environment for those constituents that do not have an established State ground water standard.

The final point of compliance for State ground water standards is achievement of the standards throughout the ground water contamination plume, both on-site and off-site. Interim cleanup goals may involve halting the continued migration of contaminated ground water beyond the facility boundary, perhaps utilizing institutional controls (i.e., an environmental covenant) to prohibit use or disturbance of ground water until the final, long-term cleanup goals are achieved.

6.3 POTENTIAL REMEDIES FOR DRY CLEANER RELEASES

The evaluation and selection of a preferred remedy for the release of dry cleaning fluid should be a collaborative process wherein the Department and the facility, and/or its agents, collectively decide upon the objectives of the cleanup effort and the best methods to achieve them. The facility has knowledge of what the future plans are for the property and what it is capable of achieving with its available resources. The Department has knowledge of what regulatory requirements must be met and how best to go about achieving them in an efficient and effective manner. A considerable amount of knowledge and experience regarding remedial alternatives exists between the facility, their consultants and the Department. It is recommended that technical meetings be held with all parties so that this pool of knowledge can be harnessed to craft a site-specific remedy that satisfies the needs of everyone involved. The goal of these meetings is to decide upon a remedial alternative that can subsequently be developed into a work plan that is approved with minimal modification and delay, and that will hopefully achieve the remediation objectives without having to implement multiple, costly remedial alternatives. Our desire is to cleanup the site as quickly as possible using the most cost-effective means.

Non-technical factors must also be considered when evaluating and selecting remedies. These include: problems with gaining on- and off-site access from uncooperative tenants, landowners, or independent third parties; physical access to implement the remedy with respect to space limitations, and the location of structures, utilities and streets; local, state and federal permitting requirements (e.g. Underground Injection Control, National Pollutant Discharge Elimination System (NPDES), etc.); and aesthetics and noise pollution concerns.

Many remedial alternatives are available to select from, several of which may need to be implemented at a single site to address different contaminated media (soil, ground water, indoor air). Although the following sections discuss a number of remedial alternatives presently in use, new technologies are continually being developed and should be considered at the time the choice of remedies is being evaluated. The selection of the preferred remedial alternative, using either proven or innovative technologies, will be dictated by a variety of factors, including its chance of success, cost and length of time needed to achieve the remediation goals.

Soil Remediation

Soil remediation is vital to site cleanup because chlorinated dry cleaning solvents in the unsaturated soil beneath a facility can remain a significant source of ground water contamination for many years after the initial release. Removal and/or treatment of the source area greatly enhance the efforts to cleanup ground water contamination since the source is no longer contributing to the ground water plume. Soil remediation techniques are classified as either in-situ (in the ground) or ex-situ (out of ground).

Ex-situ soil remediation typically involves simple excavation of the contaminated soil for direct off-site disposal or above ground treatment with off-site disposal of the treated soil or it reuse as fill material in the original excavation. Excavation of contaminated soil is typically the simplest and most cost-effective remedial alternative for small areas where the contamination is not too deep. The major factors to consider when evaluating soil excavation as a remedy is the potential for disrupting tenant activities, damage to buildings and infrastructure, and worker health and safety. Also, excavation of PCE contaminated soil will result in the generation of a hazardous waste, triggering special waste management requirements (e.g., storage in tanks and containers). The outcome of this technique is more assured when compared to other remedial alternatives that are dependent upon the many uncertainties associated with the physical, chemical, and/or biological properties of the affected media to achieve success.

A very common technique for in-situ soil remediation is soil vapor extraction which involves the installation of a series of “wells” in the contaminated soil above the water table and placing a negative pressure on wells in the vadose zone to pull contaminated soil vapors from the subsurface soils. The vapor extraction wells are typically connected via a header system to collect the contaminated vapors for discharge to the atmosphere, with or without first being treated to remove the PCE, depending on the quantity emitted. Soil vapor extraction is not very effective in low permeability soils such as silts and clays.

A relatively new technique for conducting in-situ soil remediation is the direct injection of treatment materials into the subsurface to accomplish biological and/or chemical treatment of contaminated soil in both the saturated and unsaturated zones. In many areas of the state, the subsurface soil contains natural microorganisms that can effectively degrade chlorinated solvents through a process called reductive dechlorination. In each reductive dechlorination step, a hydrogen molecule replaces a chloride molecule and the solvent is eventually reduced to a relatively innocuous constituent called ethene. Enhanced bioremediation is the use of various products injected into the subsurface to optimize the growth of microorganisms, and thus enhance the degradation of PCE. The injected products are generally intended to either provide additional food sources for the microorganisms to increase the population and/or materials that will ferment in the ground and generate large volumes of hydrogen that help ensure the reductive dechlorination process continues all the way to ethene. The biology/chemistry of these reactions is well understood and can often result in a very rapid decrease in contaminant concentrations in soil.

In-situ chemical oxidation is the injection of chemicals into the subsurface that are intended to directly break down the contaminants via chemical reaction and convert them to harmless byproducts. The most common products used during chemical oxidation projects are: Fenton's Reagent, hydrogen peroxide, ozone, potassium permanganate and sodium permanganate. A key design consideration for chemical oxidation is that the reactions are exothermic and have the potential to give off large quantities of heat and generate unacceptable pressure levels.

The major issue in designing and implementing any in-situ remedy is the delivery of the treatment chemicals to the contamination in the subsurface. Oftentimes the high concentrations of PCE in the soil are sorbed to low permeability silts and clays that the injected chemicals cannot penetrate. This situation may require multiple injections of chemicals over a long period of time to ensure thorough treatment.

Ground Water Remediation

Traditionally, ground water remediation at dry cleaning facilities has been accomplished using a ground water pump and treat method. A series ground water extraction wells or an infiltration gallery is installed near the source area and/or along the facility property boundary and the contaminated ground water is pumped to the surface. The contaminated ground water is then treated in an air stripper and/or granular activated carbon vessel prior to discharge to the public sewer or surface water (via a discharge permit). Ground water pump and treat systems can be enhanced via multi-phase extraction where extraction systems are designed to remove soil vapor and water at the same time, attempting to enhance the removal of both media with one system. These remediation methods typically have a high initial capital expense to install and protect the equipment and are also very expensive to operate. The systems must often run for a long period of time and will not often result in complete elimination of the contamination.

There are currently a wide variety of innovative technologies being tested and used for remediating ground water. As noted above under the soil remediation discussion, in-situ techniques are proving very effective at remediating releases of dry cleaning fluids via enhanced bioremediation or direct chemical oxidation. Other innovative ground water remediation techniques include: air sparging, aquifer flushing and thermal treatment.

Bioremediation ground-water treatment systems enhance the existing in situ natural biological organisms by providing a food source or other key ingredients necessary for the organisms to thrive. Common products that are injected into an aquifer include: Hydrogen Release Compound® (HRC), dextrose, ethyl lactate, molasses, sodium lactate, cooking oil, ethanol and potassium lactate. Anaerobic bioremediation, specifically reductive dechlorination reducing PCE to ethane, is typically achieved by introducing oxygen scavengers to reduce the oxidation-reduction potential and the presence of oxygen within the subsurface. Once the aquifer is conditioned for treatment, the addition of foreign microbes may be required to completely reduce breakdown products to ethane at sites where minor microbial activity is present.

Chemical oxidation typically involves the injection of chemicals into the contaminated ground water to facilitate a reaction that converts the contaminant to harmless byproducts. A major consideration for chemical oxidation is the amount of oxidant that will be required to treat the contamination. The contaminant in the ground water will be competing for the oxidant with naturally occurring materials that also consume oxidants, such as iron, arsenic, methane and living and dead biological matter, so enough chemical must be injected to account for their presence. Multiple injections of oxidants will likely be required since the oxidants tend to decompose rapidly once in the environment. Chemicals in common use as oxidants include: Fenton's Reagent, hydrogen peroxide, ozone, potassium and sodium permanganate. The water chemistry should be well enough understood to predict whether the addition of chemical oxidants may negatively impact the local permeability of the aquifer.

Air sparging is the injection of air or other gases into the aquifer in an attempt to volatilize the contaminants, which then enter the unsaturated zone where they are captured via soil vapor extraction methods. The air sparging also introduces oxygen to the aquifer that can enhance bioremediation in the ground water, for those constituents that aerobically degrade.

Depending on site conditions, plume control may be achieved with the construction of a permeable reactive barrier using zero valent iron or another amendment. This may be accomplished using iron filings installed within a "funnel and gate" barrier wall, injecting iron filings into the formation through which water must pass via closely spaced wells, or injecting nanoparticle-sized iron which behaves more like an in-situ chemical amendment.

As discussed above under soil remediation, the major concern with in-situ techniques for ground water is the ability to actually deliver the treatment chemical to the contamination. Fracturing techniques may be used to alleviate the problem of low permeability, or "tight" soils or aquifer materials and increasing the radius of influence for treatment chemicals. Fracturing is accomplished by injecting pressurized air or liquid into the ground to force open existing fractures, or to create new fractures to increase permeability. The injected liquid can contain fine sand to ensure the new fractures remain propped open and can also include the treatment chemicals for enhanced bioremediation or chemical oxidation so that multiple steps are not required. Fracturing has been demonstrated to work above and below the water table and in both unconsolidated materials and bedrock.

Non-Aqueous Phase Liquid Remediation

At some dry cleaning sites, the volume of dry cleaning fluid released may have been so large that areas of pure product/waste could have accumulated in the soil and/or aquifer material beneath the facility. The areas of free phase liquid can exist as thick lenses or thin stringers in the soil or aquifer that can be very difficult to detect. As precipitation infiltrates through the soil, or ground water flows through the aquifer, the water dissolves this free phase contamination and continues to degrade ground water quality until it is depleted, removed, or isolated from the environment.

If these areas are accessible, the most effective remediation method is excavation of as much of the free phase liquid and highly contaminated soil and aquifer material as possible. However, since it is unlikely that all of the free phase contamination can be removed, other remediation techniques have been developed to address the issue.

In-situ flushing is the process of promoting movement of contaminants by displacing the contamination using a co-solvent or surfactant. The technology loosens the free phase liquid and allows it to be mobilized for recovery in pumping wells or dissolved in the surrounding ground water where it can be treated with the in-situ techniques described above.

Thermal treatment provides heat, via steam injection or electrical heating, to the impacted zones to turn the free phase liquid to vapor or a mobile liquid. The contaminant is then removed from the subsurface via vapor and/or ground water extraction wells.

6.4 ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS AND ENVIRONMENTAL COVENANTS

Alternatives to the above remediation goals exist if the property owner on which the dry cleaning facility is located is willing to accept a cleanup of the chemical release to a criteria less stringent than residential/unrestricted use and State Ground Water Standards. These alternatives are applicable only to contamination within the boundaries of the property directly controlled by the property owner on which the dry cleaning facility is located.

Engineering controls are man-made structures or systems designed to prevent the migration of, and exposure to contaminants of concern. Typically, engineered controls do not directly reduce the concentration of constituents of concern in an environmental media, although concentrations may be reduced over time through natural attenuation. They may be used for both short and/or long-term management of risk at the facility. Common types of engineering controls that may be applicable to releases of dry cleaning solvents include:

- caps designed to prevent the infiltration of precipitation and surface water into waste or contaminated media, thereby reducing the amount of subsurface soil contamination that might reach the ground water beneath the site. Caps can also reduce the vapor emissions from waste and contaminated media, which could minimize or prevent impacts via the inhalation pathway.
- hydraulic containment barriers that can consist of trenches, sumps, drains, and wells designed to reverse localized ground water flow gradients in such a manner as to reduce or prevent the continued migration of contaminated ground water.

The use of engineering controls requires development of a mechanism to guarantee that the engineered control is operated and maintained to ensure protectiveness over time. This can be accomplished by adequate design of operation, maintenance, and monitoring specifications, in addition to placing an institutional control on the property that requires current and future owners to maintain the protection offered by the engineered control.

Institutional controls are legal mechanisms that impose some restriction on land use to render actual and potential human exposure pathways incomplete. They can also obligate the facility owner to conduct certain activities to maintain protectiveness (e.g., maintain a cover or a hydraulic containment system). These restrictions may include zoning restrictions, structure-use restrictions, excavation restrictions, land-use restrictions and natural resource-use (e.g., ground water) restrictions. Depending on site-specific circumstances, institutional controls may be the only practical mechanism to afford an adequate level of long-term protection of human health by, for instance, eliminating pathways to contaminants.

Environmental covenants are enforceable agreements voluntarily initiated by the property owner, and once approved by the Department, are recorded with the property deed and run with the land in perpetuity, or until the conditions requiring the environmental covenant are resolved. The environmental covenant binds the owner of the land, all successors, and any persons using the land to comply with the use restrictions listed in the covenant to maintain the required level of protection. It may only be terminated with the approval of the Department. The environmental covenant provides the Department with an enforceable mechanism to insure that engineering/institutional controls that are part of environmental remediation projects are properly implemented and maintained, so that implemented remedies continue to be protective of human health and the environment. For example, an environmental covenant may specify that the extraction of the shallow ground water beneath a property for human consumption is prohibited. Once the levels of contamination fell below specified levels, the owner could apply to the Department for modification or termination of the environmental covenant. More detailed information on environmental covenants can be found at http://www.cdphe.state.co.us/hm/envcovenants.asp.

For those corrective actions performed under the jurisdiction of the Colorado Hazardous Waste Act, an environmental covenant is required for any environmental remediation project where the cleanup does not allow for unrestricted land use or where an engineered structure must be maintained. Cleanups completed under the oversight of the Department's Voluntary Cleanup and Redevelopment Act are not required to employ an environmental covenant for remedial decisions that don't achieve unrestricted use: the voluntary cleanup application and the Department's approval of that document will specify what those future use restrictions will be, the violation of which will void the Department's approval of the cleanup. However, parties may choose to prepare an environmental covenant for sites remediated under the Voluntary Cleanup Program if this mechanism will ensure the safe long-term use of the property and protection of its occupants, and possibly reduce any future liability the owners may have.

Only the owner of the property can encumber a property with an environmental covenant, which is why they usually cannot be used to address off-site contamination. Consequently, off-site releases will need to be remediated to applicable standards.

6.5 MONITORING REQUIREMENTS

Once approved by the Department, the facility owner/operator will implement the selected remedial alternative and collect necessary information to demonstrate that it has achieved, or is achieving, the desired remedial goal. This information may include:

- confirmatory soil sampling to show the source area excavation and/or treatment was successful;
- periodic monitoring to demonstrate compliance with permit requirements (e.g. NPDES discharge and air emissions sampling); and
- periodic monitoring (ground water level, ground water quality, soil vapor, indoor air, etc.) to verify that the selected remedial alternative is operating as necessary to remediate the contamination and eventually demonstrate that the cleanup objectives have been achieved and that no further action is required.

Confirmatory soil sampling involves the collection of a statistically valid number of samples from the floor and sidewalls of a source area excavation, or from multiple depths within a bulk volume of treated soil, to demonstrate that the source area was successfully removed, or treated.

For dry cleaning facilities that implement remedial technologies requiring a long period of time to completely remediate the release of dry cleaning fluid, the periodic long-term monitoring program should consist of quarterly or semi-annual sampling of key points in the system. These may include: the source area vapor extraction well with the highest contaminant concentration; source area ground water wells with the highest concentrations; property boundary monitoring wells; and ground water plume boundary wells. The long-term monitoring plan should include criteria, or triggers for deciding when to stop the remedial activities to either begin post-remediation confirmation monitoring or decide that a different remedial alternative is necessary to achieve the remediation goals. The post-remediation confirmation monitoring should consist of a minimum of four sampling events collected over the course of a year from key monitoring points to demonstrate that contaminant concentrations will not rebound after active treatment has stopped.

Data collected during the confirmation sampling and/or performance monitoring phase of the cleanup will ultimately be incorporated into a completion report that will be the basis for requesting that the corrective action process be terminated. Collecting adequate data demonstrating that the cleanup objectives have been met will ensure that the Department approves the notice of completion in a timely manner.

6.6 HOW TO GET THAT NO FURTHER ACTION LETTER

Demonstrating one of the following completes the corrective action process for a dry cleaning facility:

1. The contamination has either been completely removed from the affected media or reduced to a level suitable for unrestricted use (i.e., suitable for residential use). All established standards and cleanup objectives have been achieved.
2. The contamination that may still be present in the environment (at concentrations that are not safe for all uses) has been adequately controlled and will not present an unacceptable risk to human health and the environment, based on the existing, and potentially future, land use. Under this category, ground water contamination must be stable or declining in concentration, and should be confined to the source area property, such that State ground water standards are met at the property boundary. This assumes that there are no continuing operation and monitoring requirements and that institutional controls, including an environmental covenant if necessary, are in place to ensure that human health and the environment continues to be protected, both now and in the future.

To complete the corrective action process under the hazardous waste program, a completion report summarizing the cleanup actions taken must be submitted to the Department for review and approval. The time frame for providing this report is usually established in an approved work plan or is determined when a specified performance or cleanup standard is achieved.

Once the completion report has been received, the Department will review it and make a determination on whether or not the information provided is adequate to demonstrate that the cleanup standards established for the facility have been met. If the Department determines that the facility has met those standards, the owner/operator will receive a no further action letter from the Department. A no further action letter is the written notice that states the Department will not require any further cleanup activities at the facility based on the information and reports provided. The letter will confirm that approved plans have been successfully implemented, that cleanup objectives have been met and that no further action is required with regard to the release.

Under the Voluntary Cleanup Program, a no action determination is made following receipt of the initial site investigation/cleanup application if either 1) evidence is provided that no releases of consequence attributable to the subject property have been identified or 2) the contamination has been successfully remediated, as documented in the application. Otherwise, the parties performing cleanup activities in accordance with a Department approved proposal must certify that the work has been completed and the remediation objectives met before a no action determination letter can be issued at the conclusion of the process.

7.0 CONTAMINATED MEDIA AND WASTE MANAGEMENT

The investigation and clean up of releases of cleaning solvent from dry cleaning facilities almost always involves the generation of materials known as remediation waste. The remediation waste can typically be grouped into two categories: (1) a contaminated environmental media (e.g., soil and ground water) that may contain a solid or hazardous waste and 2) a material that is known to meet the definition of solid waste under the Colorado Hazardous Waste Regulations, 6 CCR 1007-3 §261.2 (e.g., disposable sampling equipment).

As was discussed in Section 2.2 of this guidance, spent or discarded PCE, and environmental media contaminated with PCE, meet the definition of a hazardous waste. The Colorado Hazardous Waste Regulations (6 CCR 1007-3 §262.11) require that a waste determination be performed on remediation waste suspected of being contaminated with PCE. Consequently, the Department strongly recommends that facilities manage all of their remediation waste as if it were hazardous waste from the time it is first generated in order to ensure compliance with the Colorado Hazardous Waste Regulations in the event it subsequently does prove to be a hazardous waste, unless test results are available proving otherwise.

A more detailed discussion on the management of remediation waste can be found in Appendix 3 of the Department's *Corrective Action Guidance Document*, Version One, May 2002. The generation, handling and disposal of remediation wastes should be documented in site monitoring or completion reports to reassure the Department that these wastes have been properly managed in accordance with the applicable regulations.

Contaminated Environmental Media

Examples of environmental remediation waste include: soil that is removed from the ground during drilling activities or excavation of contaminated soil; and ground water extracted from a well during sampling or remedial pumping activities.

In general, the Department considers environmental media to be contaminated with a solid waste if it contains a hazardous constituent at a concentration above the analytical method detection limit. If the results of sample analysis show that the environmental media does not contain a solid waste, then there are no requirements for management or disposal of the material under the Colorado Hazardous Waste Act.

If the environmental medium does contain a solid waste, it will be classified as hazardous waste if it contains a listed hazardous waste, as defined under 6 CCR 1007-3 Part 261 Subpart D, and the constituent concentrations are at levels that may pose a risk to human health or the environment. Soil contaminated with PCE will be considered to "contain" F002 listed hazardous waste. Note that even if the PCE was released into the environment (disposal) prior to the 1980 effective date of the hazardous waste regulations, the RCRA hazardous waste listing for PCE will still apply if the remediation waste is determined to contain this dry cleaning solvent at the time it is subsequently "generated" (i.e., removed from the ground and subsequently managed: excavated, brought up as drill cuttings, pumped up from the aquifer below, etc.). Hence the need to properly manage PCE-bearing remediation waste that is generated at all dry cleaning facilities undergoing cleanup.

The simplest method for managing potentially contaminated environmental media that may be hazardous remediation waste is to containerize the waste as it is generated, store it temporarily in a generator storage area, make a proper waste determination, and then ship the waste off-site for treatment and/or disposal in accordance with its waste status. Under the Colorado Hazardous Waste Regulations, a generator may accumulate/store (6 CCR 1007-3 §262.34(a)) and treat (6 CCR 1007-3 §100.21(d)) hazardous waste on-site for 90 days or less without a permit provided the waste is in a closed container (e.g., 55-gallon drum, tank truck and/or roll-off dumpster). At the end of the 90-days, the generator must ship the waste off-site for treatment and/or disposal, unless it can be demonstrated through analytical testing that it no longer "contains" a hazardous waste. The alternative to managing contaminated environmental media in this fashion is to pre-characterize it before it is generated (e.g., using site characterization data to determine which areas to be excavated don't contain PCE at concentrations that would trigger special handling requirements; purge water from historically clean wells doesn't need to be managed as though it contains a hazardous waste).

Contaminated ground water from purging or pumping of wells may be disposed of in the sanitary sewer with prior approval from the receiving Publicly Owned Treatment Works (POTW or waste water treatment plant) responsible for treating the sanitary wastewater. The concentration of contaminants in the ground water must meet the wastewater treatment plant's pretreatment standards prior to discharge to the sewer. This may require on-site pre-treatment of the ground water using portable or fixed waste water treatment units. Contaminated ground water, regardless of whether it has been treated to remove the contaminants or not, may not be disposed of into storm sewers or surface waters of the State unless prior approval (a permit) to do so is received from the Department.

The Department has developed what is known as Contained-Out Determination Criteria to help ease the burden of disposal of environmental media that are contaminated ("contain") with relatively low concentrations of hazardous waste. This procedure is described in detail in Appendix 2 of the Department's *Corrective Action Guidance Document*, Version One, May 2002. Under the contained-out determination procedure, the Department considers that contaminated environmental media no longer contain a hazardous waste when 1) concentrations of hazardous constituents from listed hazardous wastes are below human health-based levels and 2) they are protective of water quality. Generally, contaminated environmental media that have met the contained-out criteria are not subject to RCRA hazardous waste requirements and may be disposed of as a solid waste. Contaminated environmental media that may initially fail to be eligible for a contained-out determination can be treated on-site to reduce contaminant levels (6 CCR 1007-3 §100.21(d)), after which test results may reveal that residual concentrations pose little risk, satisfying the contained-out determination criteria and allowing for its management as a solid waste. Experience indicates that little to no remediation waste generated at dry cleaning sites need be disposed of as a costly hazardous waste.

Solid Waste Remediation Waste

Examples of remediation waste that is a true solid waste (as opposed to soil, rock or ground water which by themselves cannot be classified as a solid waste) include: rubble such as concrete or asphalt pavement; building materials such as tile, carpeting or dry wall removed from around the dry cleaning unit; and disposable sampling equipment or personal protective equipment. These materials are also known as debris. Another example of a remediation waste that is a solid waste is decontamination water generated during an investigation. These types of solid waste are classified as listed hazardous waste if they have been mixed with, or are contaminated by listed hazardous waste such as PCE that has been released to the environment.

If this form of remediation waste is determined to be non-hazardous waste, then it must be managed as a solid waste in accordance with the guidelines and protocols specified in the Colorado Solid Waste Disposal Site and Facilities Act and the Colorado Solid Waste Regulations at 6 CCR 1007-2. Such a waste may be disposed of at the local landfill.

If the solid waste remediation waste is determined to be a hazardous waste, it is subject to all applicable storage and disposal requirements of the hazardous waste regulations. Such a classification will require that the waste be delivered to a permitted hazardous waste facility for treatment and/or disposal.

The "debris rule" contained in hazardous waste regulations allows exclusion of hazardous debris waste from the hazardous waste management and disposal requirements under specific conditions. The term "debris" is specifically defined in the Colorado Hazardous Waste Regulations, 6 CCR 1007-3, Part 268, Section 268.2(g) as "solid material exceeding a 60 mm particle size that is intended for disposal and that is: a manufactured object; or plant or animal matter; or natural geologic material". Examples of debris waste include: disposable personal protective equipment, disposable sampling equipment, and concrete or asphalt pavement rubble. If the debris has been treated using one of the technologies in 6 CCR 1007-3 Table 1 of §268.45 it is no longer subject to regulation as hazardous waste. For example, a key treatment technology listed in the §268.45 Table 1 is "High Pressure Steam and Water Sprays": the removal of listed hazardous constituents off the surfaces of debris using this techniques will allow this material to be disposed more cheaply as a solid waste. One of the other technologies listed in the table may need to be employed if the hazardous constituents permeate the debris to the extent that pressure washing is incapable of removing it. The exclusion for debris waste from hazardous waste requirements under 6 CCR 1007-3 §261.3(f)(2) allows the Director of the Hazardous Materials and Waste Management Division of the Department, considering the extent of contamination, to determine that a debris is no longer contaminated with hazardous waste and therefore, is no longer subject to regulation as hazardous waste.

As long as the remediation debris waste is physically cleaned such that there are only minor amounts of visible contamination on the disposable sampling equipment and personal protective equipment, the waste can be disposed of as solid waste because our expectation is that the debris would not be highly contaminated with hazardous constituents. The facility claiming this exclusion should keep records of the disposition of the wastes that include documentation that the debris was generally free of visible contamination.

It is important to remember when these exclusions are used that the debris is still a solid waste that must be managed in accordance with the guidelines and protocols specified in the Colorado Solid Waste Disposal Site and Facilities Act and the Colorado Solid Waste Regulations at 6 CCR 1007-2.

8.0 PUBLIC INVOLVEMENT PROCESS

For most dry cleaning facilities where releases of dry cleaning fluids have occurred, there is no formal requirement to notify or involve the public in the process. However, the Department will always notify the local health department and/or local government of activities occurring within their area of jurisdiction by providing them with copies of our correspondence or by contacting them directly in order to inform them of the situation. We strongly recommend that the facility owner/operator keep the local authorities informed of their activities by providing them with copies of documents that may be generated during the corrective action process. If the situation warrants it, the facility may also find it necessary to inform other local authorities (e.g., fire department, emergency responders, agencies responsible for issuing required permits, etc.) of planned activities that may require their involvement. This sharing of information will ensure that these agencies are informed of activities occurring within their community, thereby allowing them to participate in the corrective action process if they so desire, and respond directly to questions they may receive from the public.

Depending on circumstances, the facility owner/operator may be encouraged to voluntarily notify the public of its activities through newsletters, public meetings or information repositories, particularly if corrective action activities are conducted off site in, or adjacent to, residential areas. The Department may ask the facility owner/operator to notify the public, or may do so independently of the facility, in cases where there is a potential for the surrounding public to be exposed to contamination derived from the facility. A few examples include, but are not limited to: cases where private domestic use or irrigation wells may be located within the suspected path of the ground water plume, wherein an effort must be made to locate and perhaps sample registered and unregistered wells in the path of a contaminant plume; or when residential areas must be entered for the purpose of installing and sampling monitoring wells. Some level of public involvement may also be necessary if a party that has paid for cleanup wishes to pursue claims against other potentially responsible parties.

9.0 REFERENCES

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ATTACHMENT 1

REPORTING CHEMICAL SPILLS AND RELEASES IN COLORADO
A Guide to the Regulations

When a chemical spill or release occurs in Colorado, there are a number of reporting and notification requirements that must be followed by the agency or individual responsible for the spill. These requirements tend to be confusing, and regulations often overlap. This brochure briefly explains the major requirements.

GENERAL

For all hazardous substance incidents, the local emergency response agencies must be notified.

RELEASES FROM FIXED FACILITIES

The Superfund Amendments and Reauthorization Act (SARA) Title III, a federal law with which facilities must comply in Colorado, requires reporting releases from fixed facilities. Fixed facilities must immediately report any release that exceeds the reportable quantity for that specific chemical to the agencies listed below. Refer to the SARA Title III List of Lists, available from the Environmental Protection Agency (EPA), for the reportable quantity.

The party that owns the spilled material must immediately notify the following agencies or organizations:

1. National Response Center (NRC);
2. Colorado Emergency Planning Commission (CEPC), which is represented by the Colorado Department of Public Health and Environment (the State health department or the Department); and
3. Local Emergency Planning Committee (LEPC).

In addition to telephone notification, the responsible party must also send written notification describing the release and associated emergency response to both the CEPC (in this case, the Department) and the LEPC.

RELEASES FROM RCRA FACILITIES

Emergency releases from facilities permitted under the Resource Conservation and Recovery Act (RCRA) are reportable according to the permit requirements. The permit often requires reporting to the Department, even if the amount of the release is less than a reportable quantity under SARA Title III (6 CCR 1007-3 Part 264). Permitted facilities and large quantity generators (LQGs) of hazardous waste are required to have and implement a contingency plan that describes the actions facility personnel must take in response to fires, explosions, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, surface or ground water at the facility (6 CCR 1007-3 Sections 264.52/265.52). Whenever there is an imminent or actual emergency situation, appropriate State or local agencies, with designated response roles as described in the contingency plan, must be notified immediately. The National Response Center or government official designated as the regional on-scene coordinator must be notified immediately if the facility's emergency coordinator determines that the facility has had a release, fire, or explosion that could threaten human health or the environment outside the facility (6 CCR 1007-3 Sections 264.56/265.56). The State health department and the local authorities must be notified when the facility is back in compliance and ready to resume operations. In addition, the facility must send a written report to the Department within 15 days of any incident that requires implementation of the contingency plan. The contingency plan should include current contact information for notification and submittal of written reports.

Permitted facilities and large quantity generators that store hazardous waste in tanks must notify the Department within 24 hours of any release to the environment that is greater than one (1) pound and must submit a written report to the Department within 30 days of the release (6 CCR 1007-3 Section 264.196(d)/265.196(d)).

TRANSPORTATION ACCIDENTS

- Transportation accidents that result in a spill or release of a hazardous substance in excess of the reportable quantity (40 CFR Part 302.6) and transportation-related releases that cause injury or death, cause estimated property damage exceeding $50,000.
- Cause an evacuation of the general public lasting one or more hours.
- Closes or shuts down one or more major transportation arteries or facilities, or results in fire, breakage, spillage, or suspected contamination from radioactive or infectious substances must immediately be reported to the National Response Center.

Refer to the EPA SARA Title III List of Lists for those substances that have reportable quantities. In addition to the NRC being notified, the local emergency number (9-1-1) must be called and the State health department should be notified. Written notification of any transportation accident involving a release of hazardous materials must be provided to the U.S. Department of Transportation within 30 days (49 CFR Part 171.16).

Since hazardous waste is a subset of hazardous materials, transporters that have discharged hazardous waste must notify the National Response Center and provide a written report to the US Department of Transportation as noted in the above reporting requirements. In addition to these requirements, the transporter must give immediate notice to the nearest Colorado State Patrol office (8 CCR 1507-8 HMP 5) and the nearest law enforcement agency if the accident or spill involved a vehicle (42-20-113(3) CRS). Notification and a written report detailing the ultimate disposition of the discharge of hazardous waste must also be provided to the State health department (6 CCR 1007-2 Section 263.30). For simplicity, transporters may submit a duplicate copy of the US Department of Transportation report to the Department.

In the event of a spill or discharge of hazardous waste at a transfer facility, the transporter must notify the State health department within 24 hours if the spill exceeds 55 gallons or if there is a fire or explosion. Within 15 days of a reportable incident, the transporter must submit a written report of the incident to the Department, including the final disposition of the material (6 CCR 1007-2 Section 263.40). Releases of hazardous waste at a transfer facility may also require notification to the National Response Center and a written report to the U.S. Department of Transportation.

RELEASES TO WATER

A release of any chemical, oil, petroleum product, sewage, etc., which may enter waters of the State of Colorado (which include surface water, ground water and dry gullies or storm sewers leading to surface water) must be reported to the State health department immediately (25-8-601 CRS). Written notification to the Department must follow within five (5) days (5 CCR 1002-61, Section 61.8(5)(d)). Any accidental discharge to the sanitary sewer system must be reported immediately to the local sewer authority and the affected wastewater treatment plant.

Releases of petroleum products and certain hazardous substances listed under the Federal Clean Water Act (40 CFR Part 116) must be reported to the National Response Center as well as to the State health department as required under the Clean Water Act and the Oil Pollution Act.

RELEASES TO AIR

Any unpredictable failure of air pollution control or process equipment that results in the violation of emission control regulations should be reported the State health department by 10 a.m. of the following working day, followed by a written notice explaining the cause of the occurrence and describing action that has been or is being taken to correct the condition causing the violation and to prevent such excess emissions in the future (5 CCR 1001-2 Common Provisions Regulations Section II.E).

If emergency conditions cause excess emissions at a permitted facility, the owner/operator must provide notice to the Department no later than noon of the next working day following the emergency, and followed by written notice within one month of the time when emission limitations were exceeded due to the emergency (5 CCR 1001-5, Regulation 3 Part C, Section VII.C.4).

RELEASES FROM OIL AND GAS WELLS

All spills and releases of exploration and production waste or produced fluid exceeding five (5) barrels, including those contained within unlined berms, shall be reported in writing on the Oil and Gas Conservation Commission (OGCC or the Commission) Spill/Release Report Form-19 within 10 days of discovery of the spill. In addition, spills/releases that exceed twenty (20) barrels of exploration and production waste shall be verbally reported to the Commission within twenty-four (24) hours of discovery. Spills or releases of any size that impact or threaten to impact any waters of the state, residence or occupied structure, livestock or public byway, shall be verbally reported to the Commission as soon as practical after discovery (OGCC Rule 906). If the spill may reach waters of the state (which include surface water, ground water and dry gullies or storm sewers leading to surface water), it must also be reported immediately to the State health department (25-8-601 CRS).

RELEASES FROM STORAGE TANKS

Petroleum releases of 25 gallons or more (or that cause a sheen on nearby surface waters) from regulated aboveground and underground fuel storage tanks must be reported to the State Oil Inspector within 24 hours (after-hours contact the State health department's Emergency Spill Reporting Line). This includes spills from fuel pumps. Spills or releases of hazardous substances from regulated storage tanks in excess of the reportable quantity (40 CFR Part 302.6) must be reported to the National Response Center and the local fire authority immediately, and to the State Oil Inspector within 24 hours. (8-20.5-208 CRS and 7 CCR 1101-14 Article 4). Owners/operators of regulated storage tanks must contain and immediately clean up a spill or overfill of less than 25 gallons of petroleum and a spill or overfill of a hazardous substance that is less than the reportable quantity. If cleanup cannot be accomplished within 24 hours, the State Inspector of Oils must be notified immediately (7 CCR 1101-14 Article 4-4). The State health department should also be notified in the case of hazardous substance releases because cleanup activities may be covered by state solid or hazardous waste requirements (6 CCR 1007-2, 6 CCR 1007-3). Any release that has or may impact waters of the state (which include surface water, ground water and dry gullies or storm sewers leading to surface water), no matter how small, must be reported immediately to the State health department (25-8-601 CRS).

RELEASES FROM PIPELINES

Releases of 5 or more gallons of hazardous liquids or carbon dioxide from a pipeline that result in explosion or fire, cause injury or death, or cause estimated property damage (including cost of cleanup and recovery, value of lost product, and property damage) exceeding $50,000 must be reported immediately to the US Dept of Transportation Office of Pipeline Safety (49 CFR Part 195 Subpart B) and the National Response Center. Releases of 5 or more gallons of hazardous liquids or carbon dioxide from interstate pipelines that do not involve explosion or fire, injury or death, or property damage exceeding

$50,000 should be reported to the US Dept of Transportation Office of Pipeline Safety within 30 days after the incident.

Releases of natural gas from intrastate pipelines that cause injury or death, property damage in excess of $50,000 (including the cost of lost product), closure of a public road, or evacuation of 50 or more people must be reported immediately to the Colorado Public Utilities Commission, Pipeline Safety Group (4 CCR 723-11-2). Releases of natural gas or liquefied natural gas (LNG) from interstate pipelines that cause injury or death, property damage in excess of $50,000 (including the cost of lost product), or results in an emergency shutdown of the facility must be reported immediately to the National Response Center and the US Dept of Transportation Office of Pipeline Safety.

Releases of oil, petroleum products or other hazardous liquids from interstate and intrastate pipelines that have or may enter waters of the State of Colorado (which include surface water, ground water and dry gullies or storm sewers leading to surface water) must be reported to the State health department immediately (25-8-601 CRS). The Department should also be notified of releases to soil because cleanup activities may be covered by state solid or hazardous waste requirements (6 CCR 1007-2, 6 CCR 1007-3).

RADIOLOGICAL ACCIDENTS, INCIDENTS, AND EVENTS

The State health department must be notified of any condition that has caused or threatens to cause an event, which meets or exceeds the criteria specified in (6 CCR 1007-1) RH 4.51 and RH 4.52 of the State of Colorado *Rules and Regulations Pertaining to Radiation Control*. Reportable events include lost radioactive materials, lost radiation producing machines, over-exposures to persons, contamination events, and fires or explosions involving radioactive materials. Depending upon the severity of the event, notification may be required immediately, within 24 hours, or within 30 days. In most cases, a written follow-up report is also required. If you are unsure of the proper notification requirement, please contact the Department immediately. During normal business hours, the Radiation Management Unit is available to receive telephone notifications at (303) 692-3300. After hours contact the Department's Environmental Spill Reporting Line at 1-877- 518-5608.

NOTIFICATION NUMBERS

Colorado Department of Public Health and Environment
Toll-Free 24-hour Environmental Emergency Spill Reporting Line
1-877-518-5608

OTHER NUMBERS

National Response Center
1-800-424-8802 (24-hour)

Local Emergency Planning Committee
http://www.cdphe.state.co.us/el/sara/lepclist.html

Division of Oil & Public Safety-Storage Tanks
(303) 318-8547

Oil and Gas Conservation Commission
(303) 894-2100
(888) 235-1101 (24-hour)

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