

# Dry-Cleaning Sites:

## Important Considerations for Environmental Due Diligence and Remediation

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**1. Was carbon tetrachloride and/or trichloroethylene ever used in dry cleaning?**

Carbon tetrachloride is one of the historical solvents used in the dry cleaning industry. Its use was limited to very early as a substitute for Stoddard Solvent. It's not a very common solvent. Trichloroethylene or TCE was not a common solvent used in the dry cleaning machines but used in the spotting agents. This is a common spotting agent used through the 2000s under a variety of trade names. TCE is also a degradation product of tetrachloroethylene (PCE) or Perc. TCE is generally a result of the degradation of PCE and not because TCE was used as the primary dry cleaning solvent.

**2. How likely is it that a plume from a historic dry cleaner exists below the cleaner, that ceased operation before environmental regulation?**

I'm going to give you my own statistic on this. It is near 100%. If there was a perc dry cleaner, and again talking specifically about perc dry cleaners, I've looked at over 500 dry cleaners, almost 600, and I've only found 2 that did not have contamination. One of them had a steel pan under the area not just the dry cleaning equipment, but the whole area including the spotting boards, waste management and solvent storage. No solvent related materials were managed outside the steel pan area. We also investigated two dry cleaners that were in operation for approximately 1 year with 5th generation equipment. One even had epoxy coating on the floor. Both dry cleaners had detectable levels of PCE in soil.

**3. Can you speak to the cookers and how they apply to permitted treatment of HW under RCRA?**

I want to make sure we understand what we are talking about. The solvent cooker or still is used to clean and remove dirt and waste products from the solvent. The solvent is "cooked" and what is left is a sludge material. This is the same process for both Perc and Stoddard Solvent equipment. The sludge or still bottoms are considered a hazardous waste for both Stoddard and Perc waste streams. Some people also refer to the evaporative cooker which was used to evaporate separator water from the dry cleaning equipment. The water from the evaporative cooker is basically converted into a vapor and discharged to the atmosphere. This is not considered a waste as it is still in process. However, if separator water is recovered, this water from a Perc machine is generally hazardous. The separator water from the Stoddard solvent may be hazardous depending on the concentration of Stoddard solvent in the water. The spent halogenated solvents are generally covered under RCRA F002 and the Stoddard Solvent is generally a D001 (Ignitable waste stream).

**4. Are PFAS chemicals in household laundry detergents?**

Based on the limited studies completed in the State of Florida that suggest PFAS compounds are found in some laundry detergents, it would not be a far reach to find these chemicals in some of the household laundry soaps.

### **5. What are the "green" dry cleaners using?**

Generally speaking, EPA is adopting a different language to discuss the use of alternative solvents. They refer to these products as "greener" or "safer" choice. Any solvent besides Perc or PCE is a safer/greener choice. Green Earth or Siloxane is advertised as a green solution. I would agree that this solvent is significant safer and greener than either PERC or Stoddard Solvent. The glycol and CO2 solvent are also significant greener. I think the term "green" has changed, that is why I want to be careful in answering this question any other way than these alternative solvents are much safer based on what we know today.

### **6. In my limited investigations of dry cleaners I've found more contamination outside by dumpsters rather than underneath equipment. Is that your experience?**

I don't know where in the country you are, I would say that is not an unexpected issue. We typically find wherever they are storing the waste, the dumpster apparently where you did the investigation is probably where they're dumping the waste. And even today, dry cleaning is such a low dollar industry dry cleaners are still illicitly getting rid of waste. The picture of a nice looking dry cleaner with the two machines in it, that's a high end dry cleaner and they'd be very cautious and have detailed records of their purchases and sales. I go to dry cleaners where they've never gotten rid of waste, and they say, they have super efficient equipment. So, they're dumping the waste somewhere. It is going somewhere and the dumpster is a likely spot for it to go.

### **7. How do laundry sites (1880-1920 on Fire Insurance Maps) compare to those dry cleaning facilities we commonly see post 1950s?**

In general, the early dry cleaners from the late 1800s to the early 1900s would have been using Stoddard solvent or some non-chlorinated solvent. Dry cleaners in the post 1950s were more likely to use PCE or Perc. As discussed during my presentation, 80 to 85 percent of the more modern age cleaners used PCE. That rate is quickly falling. Remember Stoddard Solvent was highly flammable and fire risk was high. Landlords preferred the use of PCE when it became available to reduce the fire risk. PCE or Perc dry cleaners drive the environmental costs for dry cleaners. We find it very rare that a Stoddard solvent cleaner requires some level of response action. The Stoddard solvent has many properties similar to gasoline and diesel. As we know, common petroleum gas station sites are generally significantly less costly than the dry cleaner sites.

### **8. Any chance you can touch upon how Stoddard solvents contain TPH in addition to VOCs?**

Stoddard Solvent is a middle distillate refined product from crude oil. It receives further processing to clean or purify the solvent. Some companies add stabilizers to reduce the flammability of the solvent. As a middle distillate, this would typically be detected in a Total Petroleum Hydrocarbon or TPH analysis.

**9. Is it appropriate to start analyzing samples for PFAS in addition to solvents given that waste solvents may contain PFAS that originated on the fabrics being laundered?**

I've seen some preliminary research is being conducted but I'm curious of the industry opinion on the matter. I think this is a conversation between you and your client. I think we will eventually learn the PFAS compounds are a concern at dry cleaners. This is an emerging contaminant. Many clients do not want to be at the forefront of the industry. I would also discuss this with your environmental regulatory to decide what is appropriate. Also, the standards are still in development. This also create a lot of uncertainty. I think you will need to balance these issues when deciding to or not to analyze for PFAS compounds.

**10. Are there environmental concerns or issues for long term sites that have use only petroleum based solvents (Stoddard), etc.?**

Generally speaking, Stoddard or petroleum based solvents are significantly less toxic, less mobile and highly volatile. These characteristics make this solvent a significantly lower concern. We have been involved with about 100 site that used Stoddard or petroleum based solvents. Only one of the site actually required some level of cleanup in the soil only. Generally speaking, the cleanup standards are much higher reducing the level of effort to achieve risk-based cleanup goals.

**11. Please discuss the best areas to sample and how inside a dry-cleaning shop.**

The best place to take the samples is behind the dry cleaning equipment. I received a number of calls after the session telling me other places to look, but the primary release point tends to be around the dry cleaning equipment. This is where most dry cleaners stored the waste products including spent filters and sludge from the dry cleaning machine. This picture was pretty common for dry cleaners. Some dry cleaners stored the wastes in the boiler room or outside the back door. Waste management areas are the second highest release point. Laundry sumps and floor drains are also a common source where dry cleaners discharged separator water. The dumpster was a common place in the pre 1990s. Dry cleaners were told to place their wastes in the dumpster. Lint traps become a secondary source as they are a low point in the sewer line. This is a common place for PCE to accumulate since the PCE is heavier than water. Lesser areas of concern include roof drains and storm drains.

**12. Why are boiler rooms a potential source area?**

The boiler room was a common place to store used filters and still bottoms. In addition, this was a common area to store the steam collection device. The boiler room was also a common floor drain to receive blowdown from the boiler itself. The dry cleaner would commonly discharge the separator water in this drain.

**13. Is there any way to determine a suspected drop-off/pickup only store versus a solvent user if A) the store is no longer there and no additional info can be found; and B) no ERIS database listing is identified. Is there a typical store size or adjacent facility types that could provide hints to this?**

First drop stations are typically smaller than stores with dry cleaning plants. However, I have seen dry cleaning plants converted into drop stations. Generally speaking, the dry cleaner tenants space is at least 30-feet wide by 70-feet deep or bigger depending on the size of the cleaners and the amount of equipment maintained. Most dry cleaning plants are bigger. I would not get too comfortable with size of the tenant space being the determining factor. Strip centers have a tendency to subdivide or join tenants spaces to accommodate future tenants. I would look for other evidence such as pipe racks and vents stacks through the roof. Unfortunately, there is no distinguishing size or characteristics that says this space was a drop station only. Most of the times you are going to recommend a Phase II. Another key aspect would be the presence of a large natural gas feed to source the boiler. This would be a good indicator that a dryer was present in the tenant space.

**14. What are the risks with the new Wet Cleaning Processes that are being used now?**

I wish that I knew the answer to that. I'm not as familiar with the actual soaps or surfactants that they're using in the process to be able to answer that question.

**15. Aren't the lint traps attached as part of the dry cleaning machine?**

The lint trap is a separator device in the sanitary sewer line design to recover clothing fibers. There is a trap on the dry cleaning machine. This trap is primarily designed to capture items such as buttons or items that become detached from the clothing. This is not really a lint trap. There is a lint filter in the dry cleaning equipment just as in the regulatory clothes drier you operate at home. The lint trap that I am referring to as a source is the lint trap that is included in the sanitary sewer line.

**16. Does PERC always break down through vinyl chloride during remediation process (for example through oxidation)?**

I am not clear about the question so I will try to answer. The chemical oxidation process would be a direct destruction of the compound itself. However, if you are referring to biological degradation through biological oxidation, yes, it can occur to some degree in this manner as well depending on the microbes that are present. The biological oxidation of the lesser chlorinated ethylene requires particular oxygenase enzymes that perform cometabolic chemistry on the carbon-carbon double bond. Generally, biological degradation is through reductive dichlorination. PCE predominantly degrades into trichlorethylene, the trichlorethylene degrades into cis- and trans-1,2-DCE, and then those compounds can degrade into vinyl chloride. And of course, vinyl chloride can break down into, ethane and ethene.

**17. Always sample inside the shop, or is outside okay?**

I prefer inside the shop if at all possible. Outside is a last resort due to access limitations or we are trying to look for gross contamination. Try to sample next to the dry cleaning equipment as first choice.

**18. Did some dry cleaners transition from petroleum to perc and therefore have both types of contaminants?**

If so, were petroleum products stored in USTs? Both PERC and Stoddard solvents were historically stored in transfer machines. Yes, dry cleaners have changed from one dry cleaning solvent to another. More recently, the dry cleaners have been changing from PERC to Stoddard.

**19. When you state Stoddard solvents, is that synonymous with "mineral spirits" that were stored in historical USTs?**

These are very similar products. They are both produced through the refinery distillation process. However, the Stoddard Solvent goes through additional refining and purification to be used as a dry cleaning solvent.

**20. Can you fingerprint to find out the difference between PERC and TCE used in either dry cleaner and metal plating operations? Are all such products the same?**

This is a very good question. Fingerprinting PCE versus TCE is very difficult. PCE degrades into TCE. The amount and nature of the degradation (aerobic versus anaerobic).

**21. Are all dry cleaners considered RECs? In what case, would a dry cleaner not become a REC (not counting dry cleaning drop off only)?**

Yes, all dry cleaners should be considered a REC. The potential risk of the REC varies. PERC or PCE cleaners are typically considered high risk while Stoddard Solvent would be considered a low risk. Again, the number of times a site requires some level of response action changes drastically between PERC and Stoddard. It is rare (only 1 in 100 dry cleaners using Stoddard required some level of active response action. 99 out of 100 PERC cleaners required some level of response action.

**22. As the generations of machines progressed, was it possible for a dry cleaner to switch from one product to another without retrofitting the machines or was a certain generation of machine only for one product?**

No, the machine had to be retrofitted. PCE is a dense non-aqueous phase liquid and Stoddard solvent is a light non-aqueous phase liquid. Therefore, at a minimum, the separation equipment had to be changed. I think there are some other modifications that are needed as well. I have heard of PERC machines being converted to Stoddard solvent machines.

**23. How far do these plumes typically spread?**

PCE plumes can be extremely long depending up on the nature of the release and the transmissive unit. I have seen PCE/TCE plumes that are between 1,000 to 2,000 feet long. Generally, the plumes are less than 1,000 feet in lower permeable units.

**24. What is the attenuation period for Stoddard solvent? Is this a consideration for due diligence?**

Stoddard solvent is very similar to fuel related products like mineral spirits or diesel fuels. Yes, they have significantly shorter attenuation period. Also, Stoddard solvent is very volatile and has a high evaporation rate. Both of these factors affect the significance of the business regarding due diligence.

**25. What are the constituents of concern (regulated substances) associated with organic cleaners?**

Not sure I understand this question. I assume you are talking about the "green" solvents. There are some discussion papers out there regarding potential environmental concerns associated with the various greener solvents. If you are investigating one of these sites, you may want to look into these papers. In general, there are not specific issues based on current knowledge of these products.

**26. Are they not listed wastes because of the mixture rule?**

Spent PCE or Halogenated solvents are a list waste. The mixture rule is how a specific waste stream could become a hazardous waste because spent PCE solvent was mixed in or derived from the Spent Halogenated solvents. This is a bigger topic than my answer here. But yes, mixture rule can make a waste stream hazardous due to the presence of one or more other hazardous wastes.

**27. Do drop off dry cleaner facilities have any contaminations?**

Drop off stations can have contamination. While not common, these stations may have conducted some level of onsite spotting using PCE or TCE spotting agents. Some dry cleaner drop stations actually conducted wet laundry services. Need to research to make sure it was a drop station only for the collection and distribution of clothes and no cleaning services were conducted onsite..

**28. Any insight into how liability typically falls between a property owner and a dry cleaning operator when a tenant's mismanagement of waste results in remediation work being needed?**

This is a CERCLA liability question. Because of CERCLA liability, the landowner is also responsible since they profited from the dry cleaner and had a responsibility to ensure that their tenants are operating within the environmental laws. Unfortunately, many times the dry cleaner goes away either due to closure or bankruptcy. Then the landowner is left with 100 percent of the bill. Sometimes, insurance policies are available to cover the costs depending on when the release occurred; however, this is a very complex process to determine eligibility and coverage.

**29. How often do you find the soil and/or groundwater at a downgradient property adversely affected by a dry cleaner?**

Very often. Depending on the size of the property, this is a very likely possibility.

**30. In your experience, what have you found to be a typical range in size of contaminant plumes, both migrating up-gradient (given that DNAPL may not flow in the direction of shallow groundwater) and down-gradient?**

There are so many factors that can affect plume size at dry cleaners that this question is relatively unanswerable. Discharges to sanitary sewer, placement of wastes in dumpsters, dumping the separator water out on the ground or into storm sewer systems can all contribute to groundwater contamination and create odd shaped plumes. These release points could make the plume appear to migrate significantly upgradient from the dry cleaning equipment. I strongly recommend that you look at the buried utilities including storm and sanitary sewers. Now to answer your original question. Yes, the plume can migrate in the opposite direction of groundwater flow due to a number of different fate and transport factors. We have found groundwater contamination 100 feet upgradient of the suspected release point. Sometimes it is not always clear the mechanism by which it migrated that far. Likely a combination of factors including complex subsurface lithology.

**31. When reviewing Fire Insurance Maps during Phase I assessments, besides a property labeled as a dry cleaner, are there any map features that could indicate the property is utilized as a dry cleaner?**

Typically the map says cleaners, dry cleaners, laundry, Chinese Laundry or clothes washing. The later two are not necessarily dry cleaners. I have also found that they will sometimes identify the solvent tanks or boilers.

**32. Do property owners typically take on any special insurance provisions to cover dry-cleaning operations?**

Sometimes. However, this insurance is very expensive and not always available.

**33. Do you ever sample the air inside the dc shop?**

Yes, however, the air inside the dry cleaner shop is governed by a different regulations (OSHA). This becomes a work safety issue. If the dry cleaner is not operating any longer, we can use indoor air samples to look at potential residual contamination within the shop or whether mass transport into the indoor air space is a real potential concern. We typically try to do sub slab sampling as these samples look specifically at mass transport in the subsurface. These samples look at the potential for contaminant mass to accumulate at levels that can create an indoor air issue.

**34. Is it common to find PCE in groundwater with no source area identified in soil? Site has been a "green cleaner" the past 8 years but historically used PCE. Will it migrate through soils into a shallow water table quickly?**

Yes, the PCE degradation is generally slow. The compounds degrade into other compounds including vinyl chloride. The soil sources are general small and may not be found. I would estimate that approximately 15 to 20 percent of our site have a very minor to no soil source. Yes, PCE moves very quickly through the soil column. We had a PCE release site where within 24 hours the PCE had impacted at least 10-feet of the soil and within 48 hours had impacted shallow groundwater in a silty clay environment. This same property is why PCE is such a good dry cleaning solvent.



## COMMENTS

**1. We switched to sub slab and deep soil vapor samples for initial Phase II ESA activities at known and suspected dry cleaner sites.**

I agree that these methods are good methods, especially if you do not know where the dry cleaning equipment was located. However, I would still recommend soil samples at known (not suspect) areas of the site. This would include the dry cleaning equipment, the waste management areas and the sanitary sewer collection/discharge points. Both samples provide valuable risk assessment type information. However, the soil and groundwater samples are more useful in quantifying risk. If the location of the equipment is suspect or not known, the vapor samples provide a good indicator of historical releases.

**2. We have found lots of issues just out the back door, where it seems like waste is thrown out the door just like mop water....**

I agree. It is where they dumped the separator water which would contain small droplets of solvents. This is also where they would drain the filters and sometimes store the waste products. Humans are lazy, the shortest walk is the best.



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