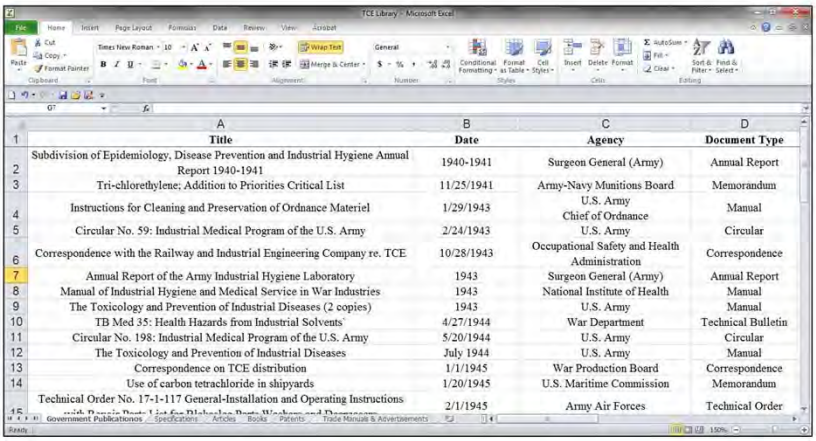
History Associates is a historical consulting firm headquartered just outside of Washington, D.C. We currently have about 20 historians on staff working on a wide array of projects—from developing smart phone apps for Civil War battlefields,, to helping to design museum exhibits, to assisting attorneys in a wide range of historical research projects.

Since our founding in 1981, History Associates has worked on over a thousand litigation matters covering a range of subjects… everything from determining the historical contents of a septic tank cleaner to work on Superfund megasites.

If pressed, though, to describe a "typical" project, I would say that we are often retained to document what may have happened in the past to cause contamination at a site and who might be responsible for cleanup costs.

Often, our work involves research into TCE-related issues stemming from historical operations at government facilities and industrial sites.

History Associates' TCE Library



	A	B	C	D
1	**Title**	**Date**	**Agency**	**Document Type**
2	Subdivision of Epidemiology, Disease Prevention and Industrial Hygiene Annual Report 1940-1941	1940-1941	Surgeon General (Army)	Annual Report
3	Tri-chlorethylene; Addition to Priorities Critical List	11/25/1941	Army-Navy Munitions Board	Memorandum
4	Instructions for Cleaning and Preservation of Ordnance Materiel	1/29/1943	U.S. Army Chief of Ordnance	Manual
5	Circular No. 59: Industrial Medical Program of the U.S. Army	2/24/1943	U.S. Army	Circular
6	Correspondence with the Railway and Industrial Engineering Company re. TCE	10/28/1943	Occupational Safety and Health Administration	Correspondence
7	Annual Report of the Army Industrial Hygiene Laboratory	1943	Surgeon General (Army)	Annual Report
8	Manual of Industrial Hygiene and Medical Service in War Industries	1943	National Institute of Health	Manual
9	The Toxicology and Prevention of Industrial Diseases (2 copies)	1943	U.S. Army	Manual
10	TB Med 35: Health Hazards from Industrial Solvents	4/27/1944	War Department	Technical Bulletin
11	Circular No. 198: Industrial Medical Program of the U.S. Army	5/20/1944	U.S. Army	Circular
12	The Toxicology and Prevention of Industrial Diseases	July 1944	U.S. Army	Manual
13	Correspondence on TCE distribution	1/1/1945	War Production Board	Correspondence
14	Use of carbon tetrachloride in shipyards	1/20/1945	U.S. Maritime Commission	Memorandum
15	Technical Order No. 17-1-117 General-Installation and Operating Instructions	2/1/1945	Army Air Forces	Technical Order

2

Over the course of our history, we have worked on dozens of TCE-related matters and have collected a wide range of records relating to TCE, including records documenting the use of TCE at specific sites.

Recently, we have started work on a broad project to synthesize our corporate knowledge of the history of TCE and to conduct new research into (1) TCE's historical uses (particularly by defense contractors during World War II and the Cold War), (2) the nature and extent of the federal government's historical control and allocation of TCE, (3) the historical manufacturers of TCE and vapor degreasers, and (4) TCE's known occupational health hazards.

As one part of our project, we have gathered our "in-house" TCE-related records into a growing library, which is subdivided by Government Publications, Specifications, Articles, Books, Patents, and Trade Manuals and Advertisements.

This slide shows part of our in-house collection of TCE-related Government Publications.

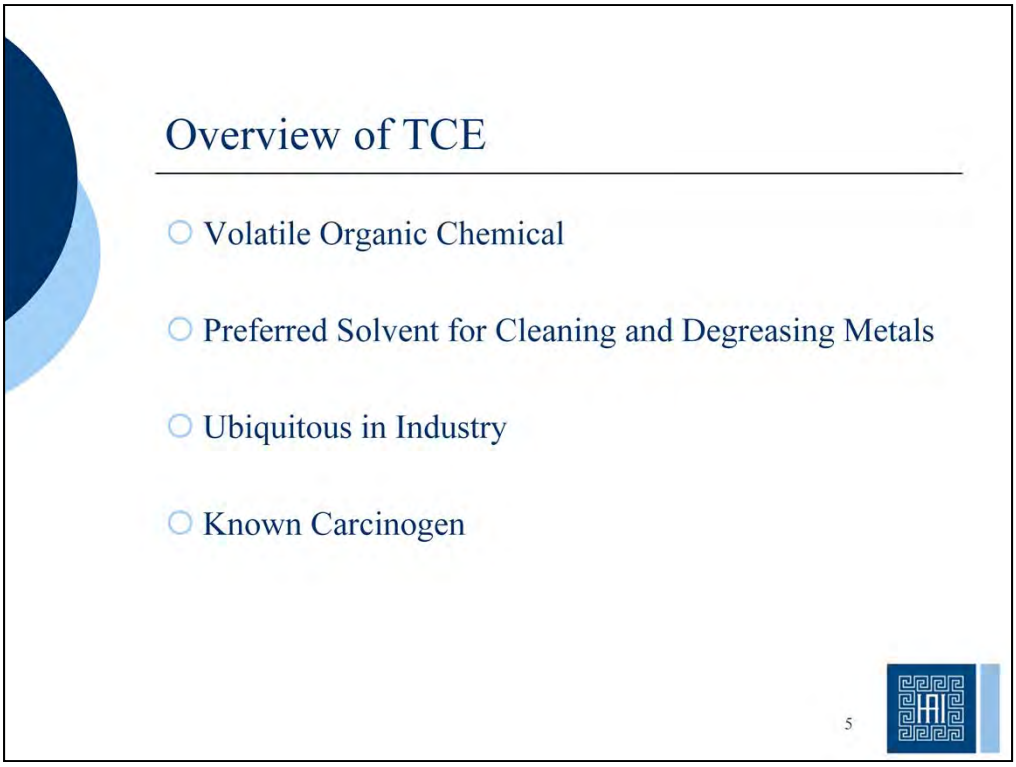
TCE records can be found at various federal records repositories, most notably the National Archives and Library of Congress…though we have also found TCE records at the other repositories listed on this slide.

I want to comment briefly on the value of doing research at the Library of Congress, which contains one of the world's largest collections of historical trade literature.

Thus, the Library of Congress maintains copies of many obscure industrial journals that touch upon TCE-related issues, including such veritable page-turners as *Metal Finishing, National Safety News, Products Finishing,* and *Safety Engineering.*

Presentation Outline

- Overview of TCE
- Historical Uses of TCE
- Metal Cleaning and Vapor Degreasing
- TCE during World War II
- Known Occupational Health Hazards of TCE Use
- Rule 66 and the Substitution of other Solvents for TCE



TCE is a colorless, sweet-smelling volatile organic chemical with a low boiling point and a high vapor pressure, which means that it boils quickly and releases a large volume of solvent vapors.

TCE was first prepared in Germany in 1864, but little attention was given to it in this country until the 1920s and 1930s, when, due to its efficiency and cost, it became the preferred solvent for cleaning metals. Indeed, for most of the 20th century, almost all heavy industries in the United States used TCE, including the electronics, defense, chemical, railroad, automotive, shipping, and dry-cleaning industries.

TCE's use, though, declined during the 1970s, as several scientific reports, including major reports by the National Cancer Institute, linked TCE to cancer in mice.

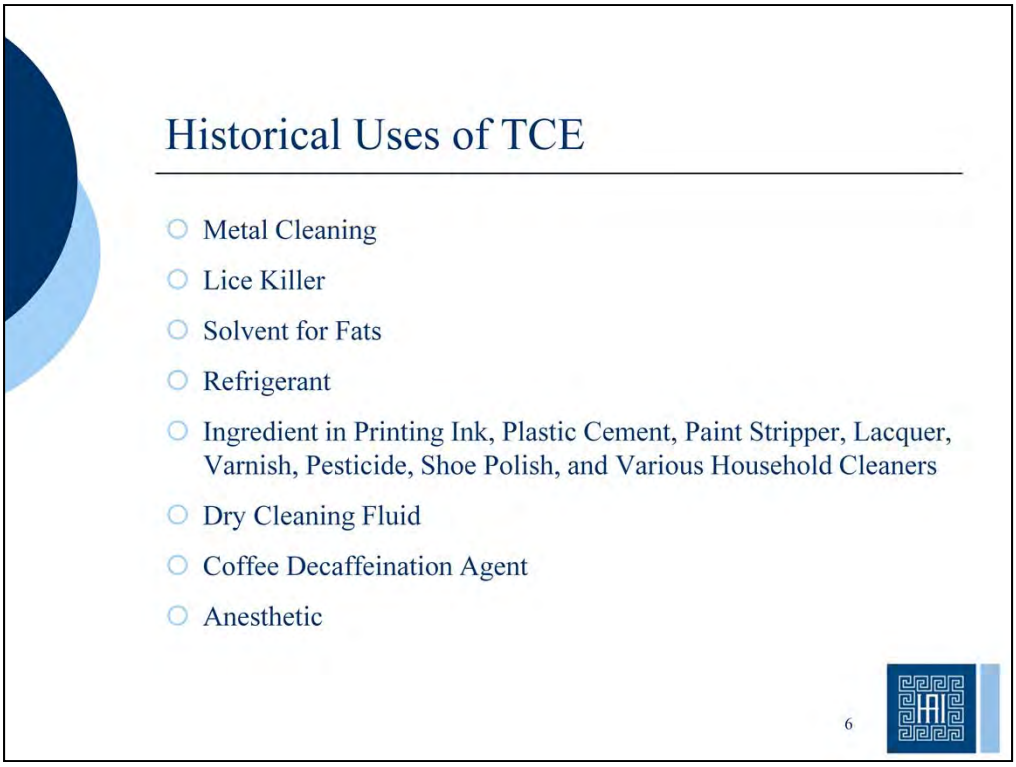
As significantly, TCE began to be detected in groundwater supplies, perhaps most famously in Woburn, Massachusetts. The Woburn case, of course, formed the basis for Jonathan Harr's 1996 bestselling book, *A Civil Action*, and the subsequent movie adaptation starring John Travolta and Robert Duvall.

Today, EPA classifies TCE as a known carcinogen and TCE exposure during pregnancy has been linked to higher miscarriage rates and increased risk of childhood developmental disabilities.

Due to its ubiquitous use, TCE has been detected at over 800 Superfund sites across the country. Historically, the remediation focus at many of these sites has been soil and groundwater issues stemming from the use of TCE. More recently, of course, vapor intrusion issues stemming from TCE (and other chemicals) have come to the fore.

Because of TCE's past and likely future prominence at so many contaminated sites, both in terms of groundwater contamination and vapor intrusion issues, the need to understand the history of TCE (both broadly and at particular sites) is perhaps more acute than ever.

And, as this is fundamentally a *historical* question, I would encourage you to turn to professional historians to help you with these matters



This slide lists some of the historical uses of TCE. Even though TCE was used for a wide variety of purposes, it is important to note that its leading use (by far) was in metal cleaning.

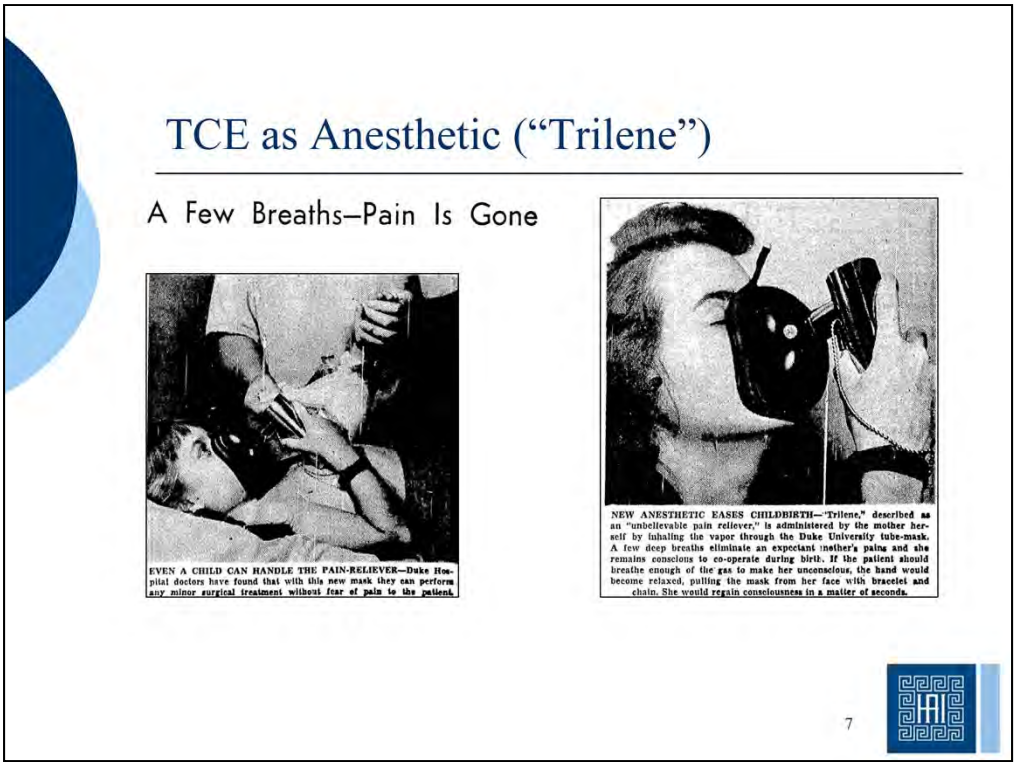
Indeed, in the early 1950s more than 90% of the TCE manufactured in this country was used in metal cleaning.

Nevertheless, it is interesting to note briefly some of the other historical uses of TCE, especially the final three listed on this slide.

Although tetrachloroethylene (PCE) was historically the most common dry-cleaning solvent in this country, TCE was also used in this capacity in the first half of the 20th century, as dry cleaners looked for replacements for petroleum-based cleaners, which were highly flammable and left an odor on the clothes.

TCE was also commonly used to decaffeinate coffee—a practice that continued through the mid-1970s.

Finally, TCE was also used as an anesthetic for minor surgical procedures, including bone setting, dental work…and (perhaps most disturbingly) even in childbirth.



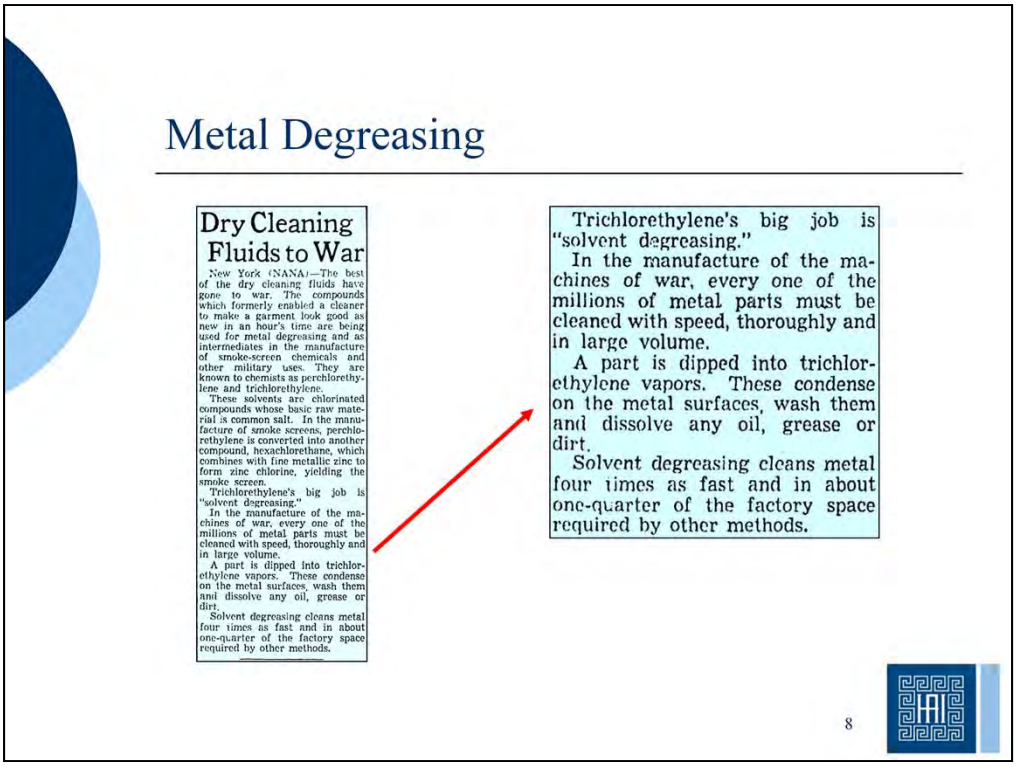
As part of our ongoing TCE research project, we are searching old newspaper articles. During this research, we recently came across this September 1952 article from the *Greensboro Daily News* that discusses the benefits of "Trilene," which was a highly purified form of TCE.

As you can see from the pictures that accompanied this article, Trilene was a *self-administered,* TCE-containing anesthetic. Moreover, it was marketed to expectant mothers.

According to the article, Trilene was considered "extremely safe in every regard" and it was especially useful in rural obstetrical practice, where it was considered the "optimal analgesic agent for use in home obstetrics."

Basically, expectant mothers could inhale Trilene themselves during the early stages of delivery and self-medicate their pain before the doctor arrived to deliver the baby.

Luckily, newer anesthetics came on the market in the late-1950s, leading to the abandonment of Trilene as an obstetrical anesthetic.



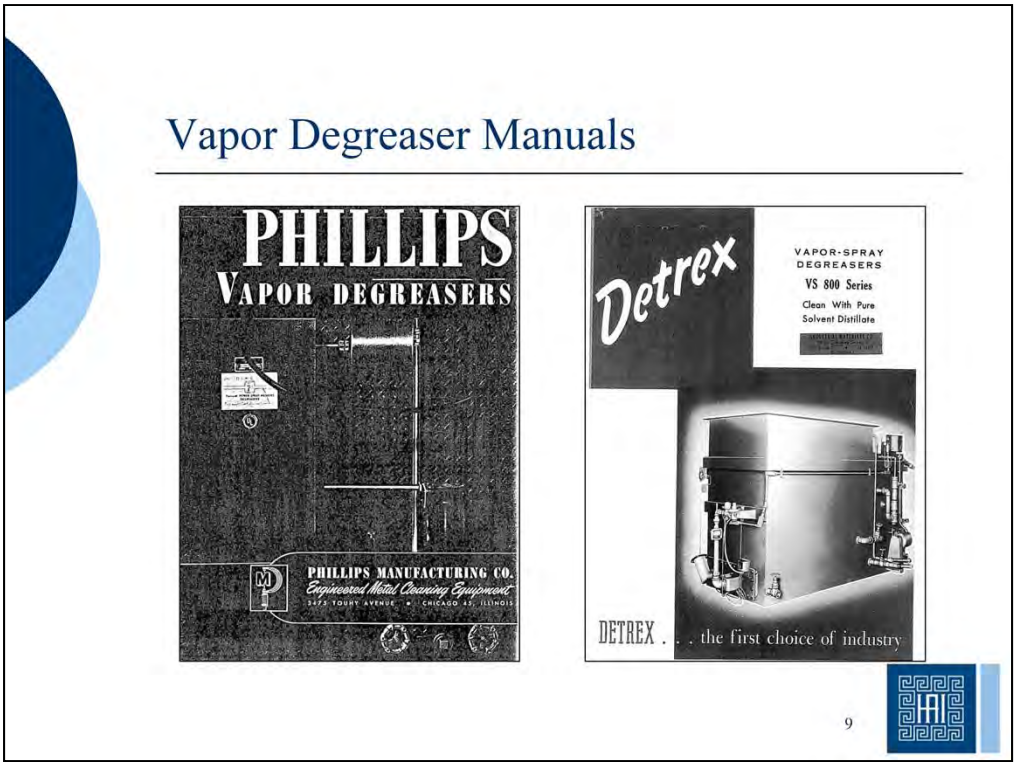
Through the early 1970s, though, almost all the TCE produced in this country was used for metal cleaning, and more particular in a process known as vapor degreasing.

Before manufacturers could paint, finish, weld, plate, or galvanize metals…they first required a chemically clean surface, meaning a surface free from oil, grease, and dirt. This metal cleaning was accomplished through the use of degreasing solvents such as TCE and most commonly through a process known as vapor degreasing.

In vapor degreasing, the metal to be cleaned is lowered into the vapors of a boiling solvent. Because the surface of the metal is colder than the vapor, the chemically pure solvent vapors condensed upon the metal, stripping away grease, oil, and dirt. The advantages of vapor degreasing were its simplicity, low cost, and the ability to distill and reuse the solvent.

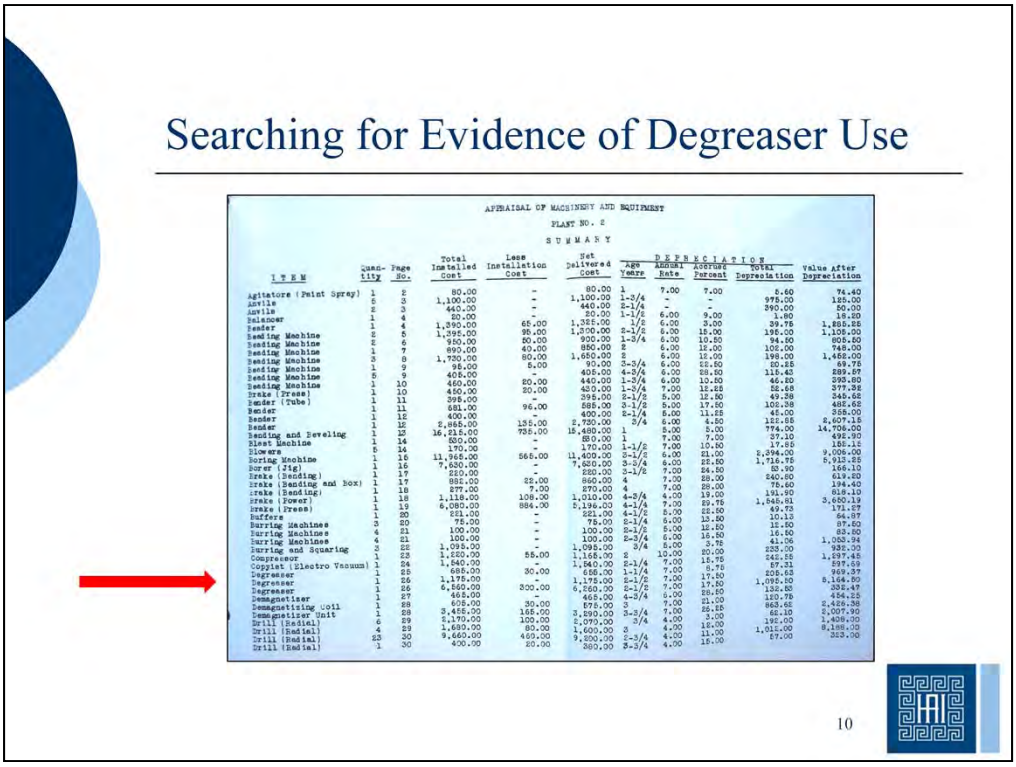
Vapor degreasing became especially prominent with the onset of World War II. As described by this January 1944 article from the *Omaha World-Herald*: "In the manufacture of the machines of war, every one of the millions of metal parts must be cleaned with speed, thoroughly, and in large volume. A part is dipped into trichloroethylene vapors. These condense on the metal surfaces, wash them and dissolve any oil, grease, or dirt. Solvent degreasing cleans metal four times as fast and in about one-quarter of the factory space required by other methods."

While manufacturers tried various solvents in vapor degreasers, by World War II (and throughout the 1950s and 1960s), TCE was widely accepted as the solvent of choice. For the most part, then, when you see a reference to a vapor degreaser in the historical record, it is a safe assumption that the vapor degreaser used TCE.



During World War II, vapor degreasers were a ubiquitous sight at industrial plants across the country.

Indeed, according to a 1944 handbook issued by Phillips Manufacturing Company (who, along with Detrex, was one of the leading wartime manufacturers of vapor degreasers), in November 1943 there were between 25,000 and 30,000 operating vapor degreasers in the United States.



Perhaps because of their ubiquity, it can sometimes be difficult to document the use of vapor degreasers at specific industrial sites. One place where this information can commonly be found, though, is within lists of government-owned surplus property at the end of World War II.

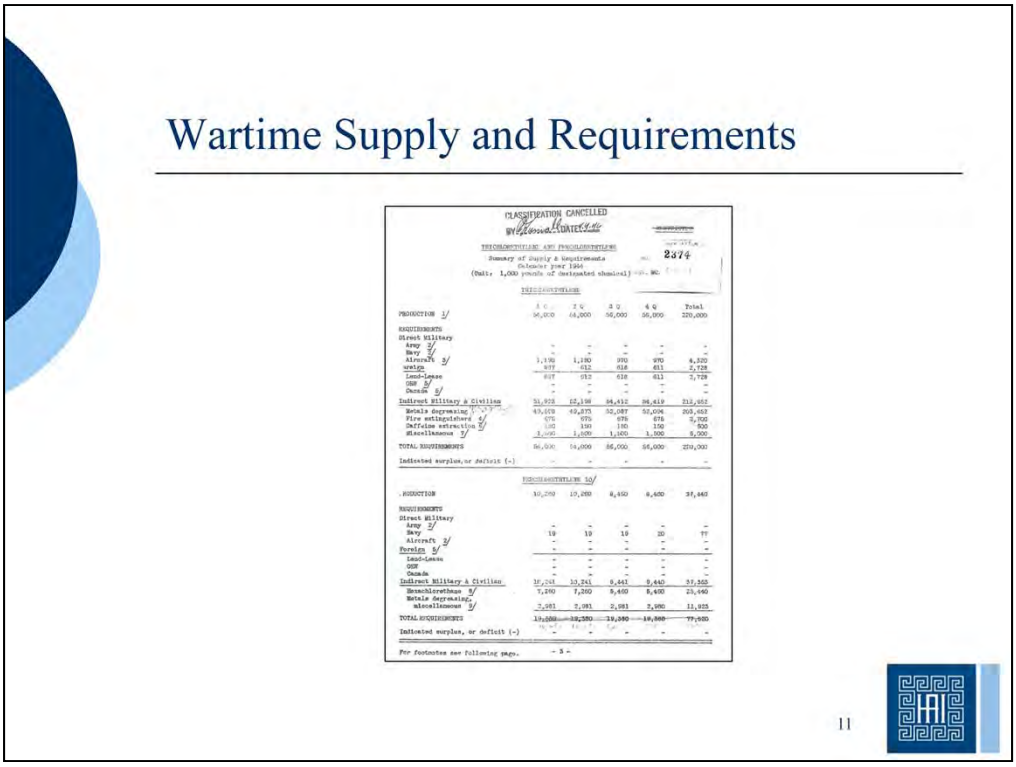
During World War II the federal government purchased equipment, tools, and in some cases built entire plants for private industries to use in support of the war effort. After the war, the government had to dispose of all this surplus property.

In doing so, the government first conducted complete appraisals of its government-owned property at private industrial facilities and created exhaustive lists of such property, down to individual hammers and drills.

These lists can be used to document the presence of ***government-owned*** vapor degreasers at specific wartime sites.

This is the case in this excerpt from a machinery and equipment list from an East Coast aviation manufacturing facility, which documents the presence of three government-owned degreasers at the facility.

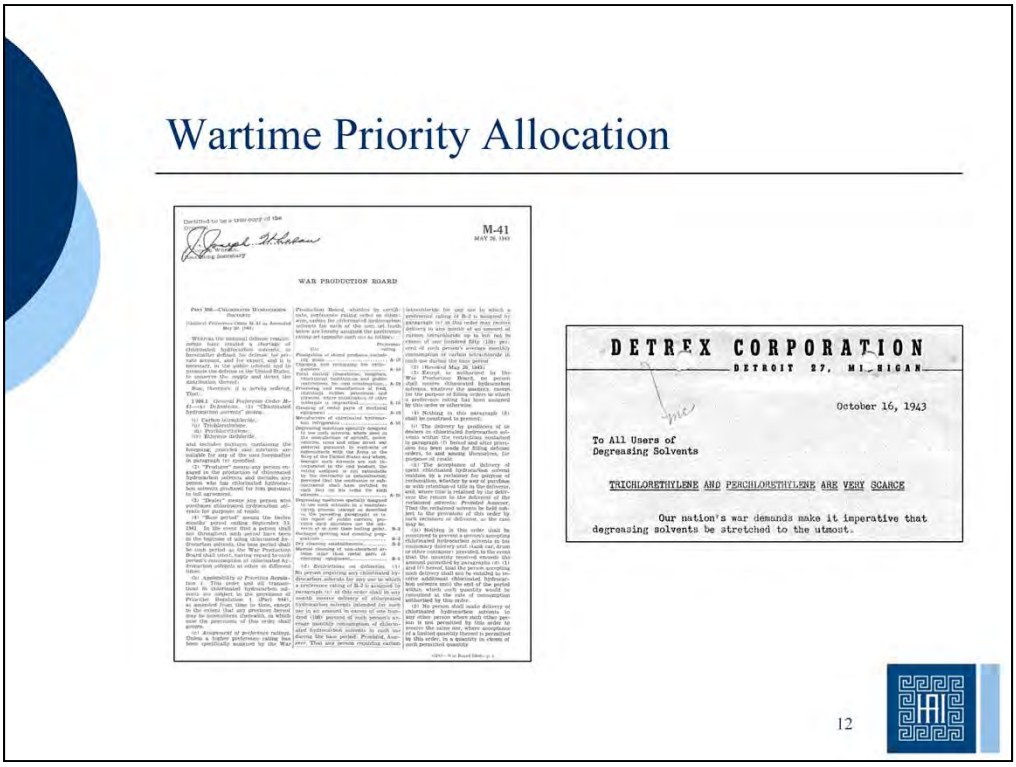
Parenthetically, through other research, we were able to identify the make/model of these degreasers and situate them in specific buildings at this aviation manufacturing facility



My next set of slides present some records from our TCE Library that document the use of TCE during World War II and the government's wartime control of TCE.

First, a sense of how much TCE the country used during the war.

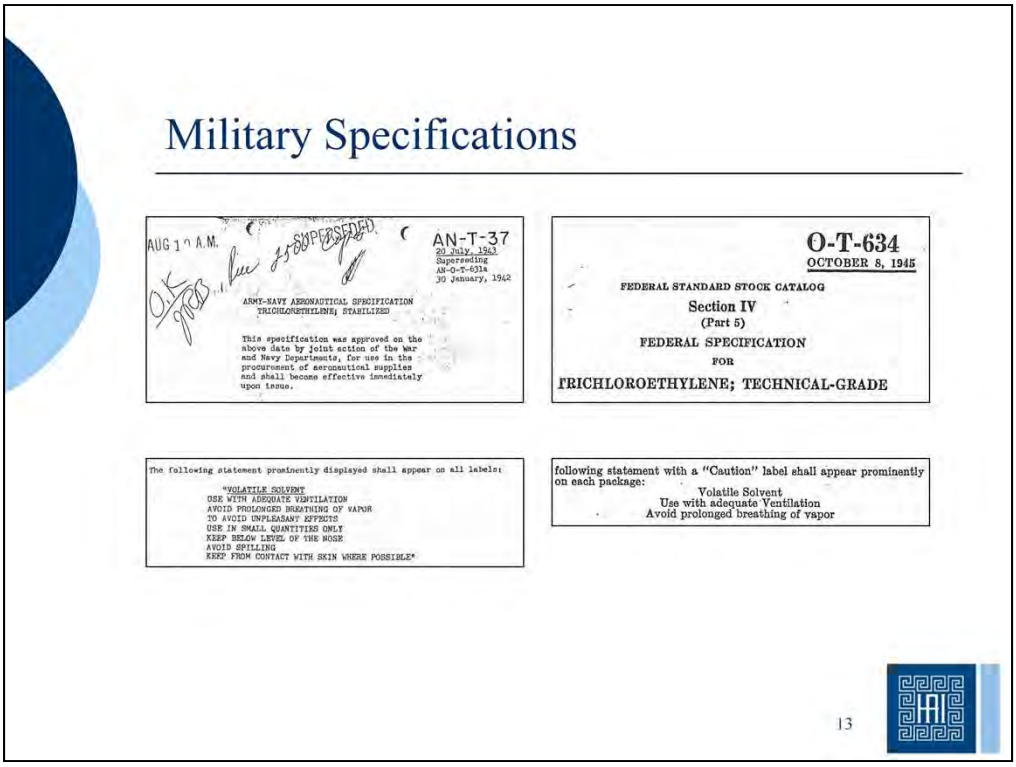
This slide shows the government's estimate that in 1944 the country would use 220 million pounds of TCE, 92% of which was (not surprisingly) used in metals degreasing operations, mainly for indirect military and civilian use (that is, defense contractor use).



Given the importance of metal degreasing (and, by extension, TCE) to the war effort, it is perhaps not surprising that the federal government closely monitored both the production of TCE and its end uses during the war.

This slide shows a copy of the War Production Board's May 1943 order concerning the preferential allocation of TCE and other solvents to specific end uses (including in degreasing machines used by Army and Navy contractors to manufacture aircraft, motor vehicles, arms, and other war material).

The slide also shows a portion of an October 1943 Detrex letter regarding concerns over the availability of TCE and PCE. These concerns came to fruition in February 1944 when the federal government directed TCE manufacturers to *only* deliver TCE to approved end users.

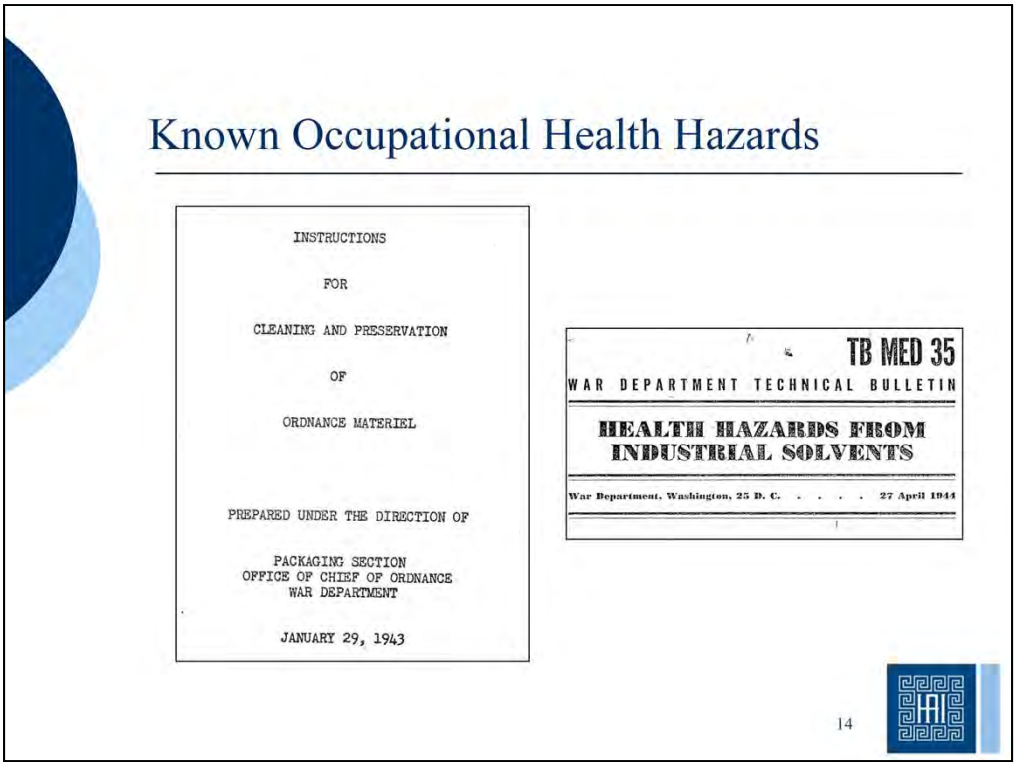


Dating back to the 1930s, the government issued specifications concerning requirements for TCE supplied for government use (e.g., its acceptable water content, acidity, etc.).

While most of the substance of these specifications is not of particular interest, I have excerpted on this slide the "warning information" specified to appear on all TCE containers furnished to the government, which state that TCE was to be used with adequate ventilation and that users should avoid prolonged breathing of TCE vapors.

As this slide suggests, our preliminary research indicates that there was no wartime cognizance of the harm TCE could cause to groundwater supplies. Instead, the extent of known historical occupational health hazards regarding TCE was confined to inhalation concerns.

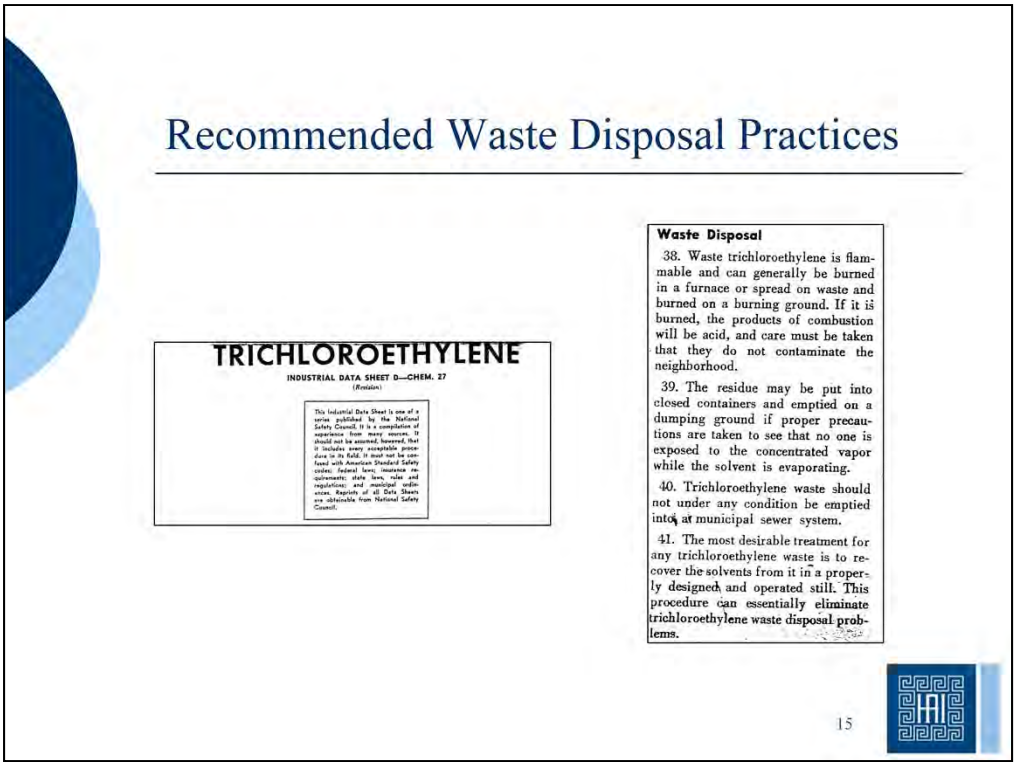
In some instances, government specifications and manuals also call for the use of TCE in specific settings (for example in the cleaning of certain aircraft parts and engines). These equipment/parts specifications can be particularly important as contractors *had* to adhere to them, or risk breaching the terms of their contracts.



Our research has also yielded copies of various military guidance publications that discuss the potential occupational health hazards of TCE and other industrial solvents. As with the military specifications, these publications report on the potential vapor inhalation issues with TCE.

For example, in April 1944, the War Department (via the Army Surgeon General) issued a technical bulletin titled *Health Hazards from Industrial Solvents*. In it, the Surgeon General recommended various preventive measures against illnesses stemming from industrial solvents, including avoiding direct inhalation of solvent fumes through the use of local exhaust ventilation or respirators.

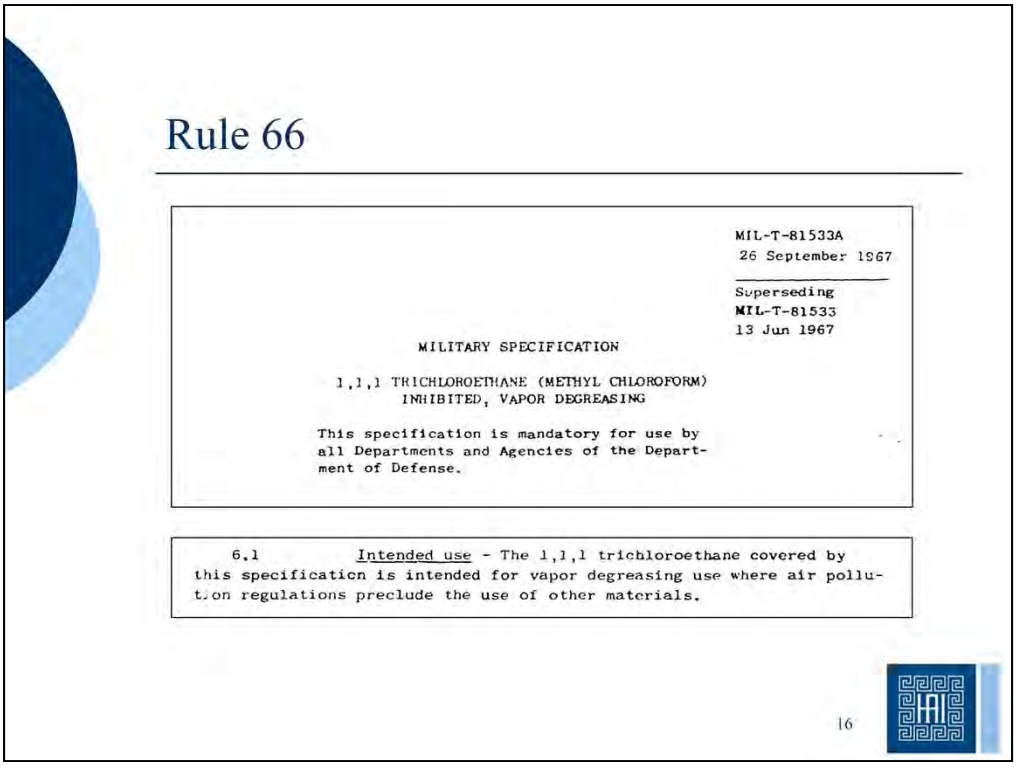
These warnings against TCE vapor inhalation mirror those found in Detrex manuals for its vapor degreasers, which recommend that vapor degreasers be installed in well-ventilated areas, due to concerns over the potential health effects of excess inhalation of TCE fumes.



To date, our research has yielded relatively little on the all-important topic of contemporary TCE waste disposal practices.

However, what we have found suggests that it was common practice to take waste solvent to a (well-ventilated) dumping area, dump it, and let the solvent evaporate (thus mitigating potential vapor inhalation hazards).

For example, in 1948 the *National Safety News* issued a guidance document stating that "Waste trichloroethylene is flammable and generally can be burned in a furnace or spread on waste and burned on a burning ground…. The residue may be put into closed containers and emptied on a dumping ground if proper precautions are taken to see that no one is exposed to the concentrated vapor while the solvent is evaporating."



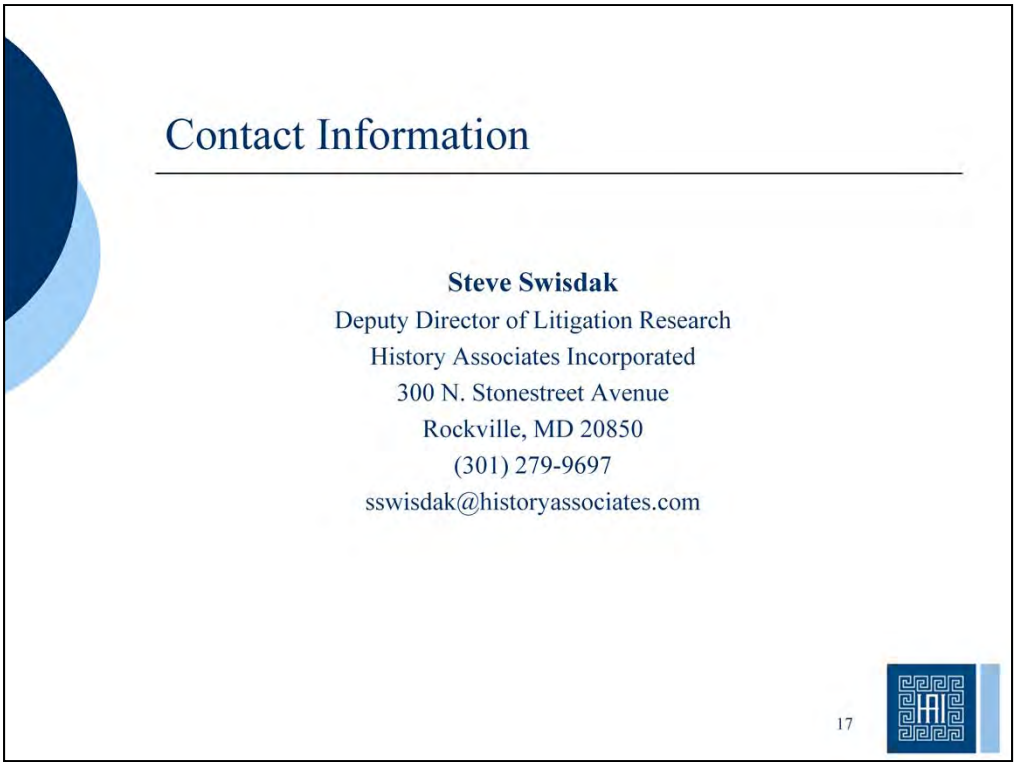
TCE's use began to decline nationwide in the mid-1970s following scientific reports linking it to cancer. In point of fact, though, in Southern California this decline began in the late-1960s with the enactment of smog-controlling regulations by the Los Angeles County Air Pollution Control District (APCD).

After years of debating how to reduce smog and air pollution, in July 1966 the Los Angeles County APCD passed Rule 66, which mandated that industries cut solvent air emissions by 85% or to not more than 40 pounds per day. However, following negotiations with various industry groups, APCD exempted many chlorinated solvents from the requirements of Rule 66, *though not TCE*. Thus, in order to abide by Rule 66, industries either had to install expensive vapor control equipment or switch to other solvents. Industries chose to switch to other solvents, particularly TCA.

Evidence of this shift can be found by comparing two editions of APCD's *Air Pollution Engineering Manual*. The 1967 edition noted that TCE accounted for an estimated 90% of all vapor degreasing solvent used in Los Angeles County. By contrast, the 1973 version of the same manual noted that "Because of Rule 66, an estimated 90 percent of the solvent used in Los Angeles County is divided equally between" PCE and TCA. "In other localities that do not have air pollution control laws restricting organic solvent emissions, an estimated 90 percent of the solvent used for degreasing is [TCE]…. Because vapor control [equipment] is expensive, all large degreasers in Los Angeles County now use [PCE] or [TCA]."

Industry was not alone in responding to Rule 66. As mentioned earlier, many military publications specified the use of TCE. To respond to Rule 66's effective banning of TCE in Los Angeles County (which was home to many large DoD contractors, including major aerospace companies), in September 1967 the Department of Defense issued a specification for TCA, which explicitly states that TCA was "intended for vapor degreasing use where air pollution regulations preclude the use of other materials."

In summary, Rule 66 profoundly altered the behavior of solvent users and suppliers in Los Angeles County, as it effectively pushed industry towards the use of replacement solvents such as TCA and PCE. Rule 66-type legislation eventually spread to other states, as by the mid-1970s, more than a dozen states had similar legislation. Thus, when coupled with the scientific reports linking TCE to cancer, TCE use in the United States by the 1980s was a fraction of what it was in the 1960s.



Steve Swisdak is a senior historian and deputy director of litigation research at History Associates Incorporated, a consulting firm that specializes in historical research and analysis in support of litigation. Mr. Swisdak has conducted research on behalf of History Associates' clients into myriad historical topics, including PRP identification for natural resource damages matters; past uses of private and public industrial facilities; and, historical common knowledge of the toxicity of various products.

Mr. Swisdak has provided expert reports, affidavits, and depositions on several litigation research projects and has served as an expert witness at trial. He has also published articles and lectured frequently on the use of historical research in legal matters, discussing such topics as "Researching Past Uses of New York Industrial Sites," "The Value of Historical Research to In-House Counsel," and, "Digging Deeper: Uncovering the Hidden Potential of Historical State and Local Records."

Mr. Swisdak earned his Master's degree from Johns Hopkins University and his Bachelor's degree (*summa cum laude*) from St. Mary's College of Maryland.