Environmental Cleanup Update

150 Sohier Road Property, Beverly MA | **FALL 2023**

Varian Begins New Phase of Environmental Cleanup

In the past two years, environmental investigations and clean-up of the former Varian site have progressed rapidly. Prior investigations and treatment have been conducted at the site since the 1990s. These efforts were renewed and enhanced starting in 2021. Since then, the Varian project team has worked with the community and the Massachusetts Department of Environmental Protection (MassDEP) to conduct additional investigations of indoor air, surface water and sediment, groundwater, soil, and bedrock. An updated risk assessment has been completed based on the additional data.

The risk assessment concluded that ***site contaminants pose no significant risk for local residents and current workers at the former Varian property***, with the existing soil vapor treatment systems operating on the property.

While there is currently no indication of significant risk, additional treatment is required under state cleanup laws to ***prevent potential future risk and to limit the future migration of contaminants***. In 2022 and 2023, the project team identified and selected updated treatment alternatives for six areas, prepared detailed implementation plans, and has begun installing these systems.

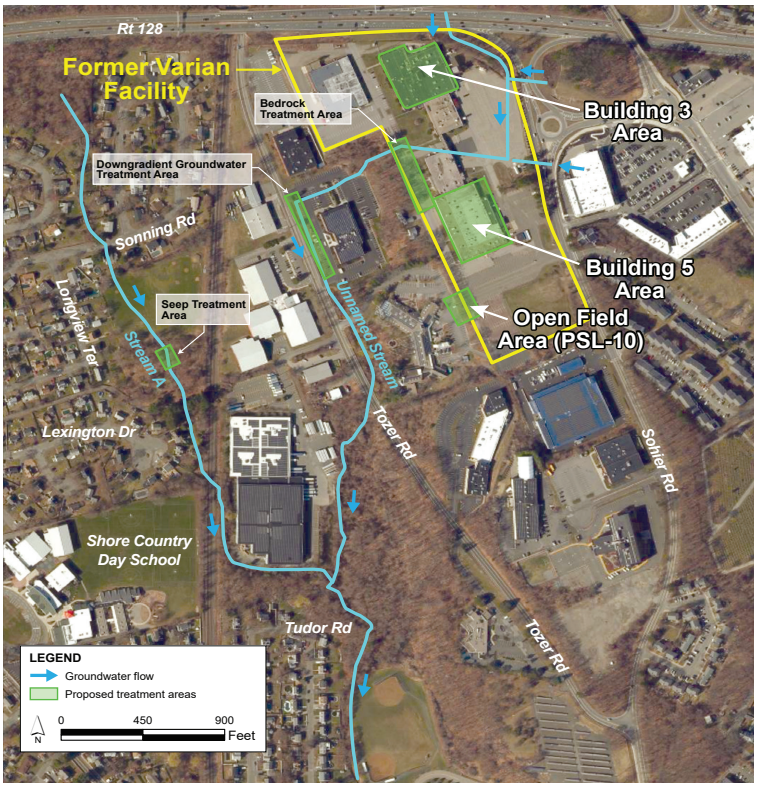


Figure 1 Site map and selected treatment areas

Environmental cleanup is focused on six project areas (**Figure 1**):

- Building 3 Source Area
- Tozer Road
- Stream A Seep
- Building 5 Source Area
- Bedrock near Buildings 3 and 5
- PSL-10 (Open Field) Source Area

The following pages describe the cleanup at each project area.

Site History and Overview

The former Varian Facility, located at 150 Sohier Road, is currently owned by another firm and operated as an active manufacturing facility for microwave and radar products.

The 150 Sohier Road property has been used as an industrial facility since the early 1950s. Industrial solvents were released to the environment due to the chemical handling and disposal practices that were common at the time, before more strict environmental regulations were enacted. These solvents, used primarily for surface treatment, cleaning, and degreasing operations, included trichloroethene (TCE), perchloroethene (PCE), and 1,1,1-trichloroethane (TCA). Releases of these solvents occurred in three main areas: the Building 3 area, the Building 5 area, and an open field known as potential source location (PSL) 10.

TCE, PCE, and TCA are heavier than water and have limited ability to dissolve in water. They also tend to evaporate easily and are referred to as volatile organic compounds or VOCs.

Varian, with support from Jacobs Solutions, is investigating and cleaning up the site in accordance with Massachusetts regulations, known as the Massachusetts Contingency Plan (MCP). The site is listed by MassDEP as Site Number 3-0485. Site reports and other documentation can be found under "Supporting Documents" in MassDEP's data portal at *https://eeaonline.eea.state.ma.us/portal#!/wastesite/3-0000485*.

Treatment Area	Selected Cleanup
Building 3 Source Area	Thermal Treatment, Bioremediation
Tozer Road Groundwater	Permeable Reactive and Adsorptive Barrier
Stream A Seep	Permeable Adsorptive Barrier
Building 5 Source Area	Bioremediation
Bedrock Near Buildings 3 and 5	Chemical Oxidation
PSL-10 Source Area	Soil Excavation with Permeable Treatment Zone

Building 3 Source Area – Thermal Treatment and Bioremediation

Groundwater below Building 3 will be treated using ***thermal treatment***, followed by a ***bioremediation*** polish and continued operation of the ***soil vapor extraction system***.

Thermal treatment involves installing heating elements into the ground below Building 3 and heating the groundwater to boiling. The heating elements are similar to the ones in a toaster, only larger. Heating the groundwater causes the volatile compounds to become vapors, which are captured by extraction wells that suck the vapors and some water to the surface for treatment using activated carbon. The activated carbon filters out the contaminants (in much the same way a household water filter does) and the clean vapors and water are released to the environment. The carbon containing the captured contaminants is recycled at a licensed off-site facility (**Figure 2**).

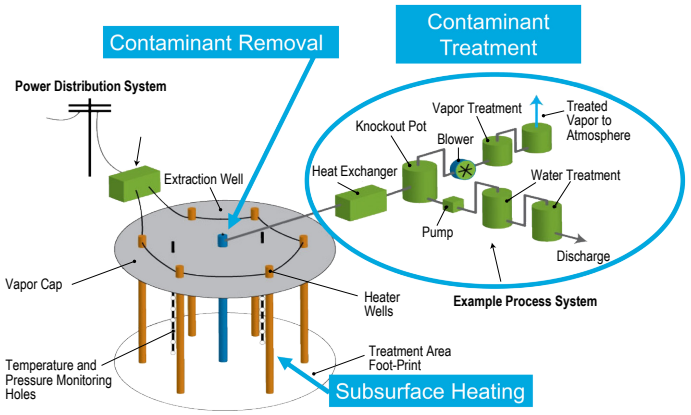


Figure 2 Diagram of a thermal treatment system

Following thermal treatment, ***bioremediation*** will continue to reduce contaminant concentrations by taking advantage of the increased temperature underground. The warm groundwater that remains after thermal treatment provides an excellent environment for microbial growth. Certain microbes "eat" contaminants like TCE and PCE. Bioremediation involves stimulating microbial growth by injecting amendments (such as vegetable oil or molasses) that the microbes use to grow and multiply, so they can consume more contaminants.

Throughout the treatment at the Building 3 source area, the ***soil vapor extraction*** system will continue to operate to protect site workers by preventing contaminant vapors from entering the building. This system, in operation since 2009, draws vapors by vacuum from the soil below the building and treats them using activated carbon.

Tozer Road Groundwater – Permeable Reactive and Adsorptive Barrier

A ***permeable reactive and adsorptive barrier*** will be installed along Tozer Road. Tozer Road is "downgradient" or downhill from the former Varian facility. The Tozer Road barrier will allow groundwater to pass but will act as a "catcher's mitt" to capture and treat groundwater contaminants that may move away from the Building 3 thermal treatment zone and other source areas.

A permeable barrier involves injecting treatment media (such as "colloidal activated carbon") and reactive material (such as "zero-valent iron"). Groundwater containing volatile compounds flows through the zone around the injection wells. The volatile compounds attach to the activated carbon or react chemically with the iron, and treated groundwater flows out the other side (**Figure 3**).

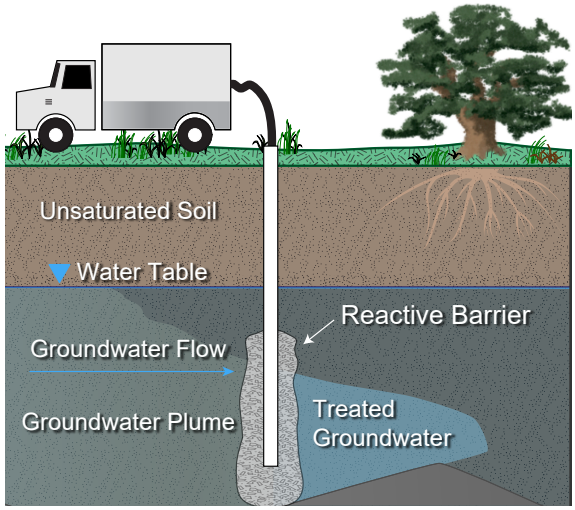


Figure 3 Diagram of a reactive and/or adsorptive permeable barrier

Concentrations of volatile compounds in groundwater along Tozer Road are significantly lower than those found in the Building 3 source area. The thermal treatment system at Building 3 will be designed to remove volatile compounds and the Tozer Road permeable barrier will be implemented as an additional protective measure to limit the compounds' ability to migrate away from Building 3 and other source areas on the property.

Stream A Seep – Permeable Adsorptive Barrier

At two seep areas along Stream A, a ***permeable adsorptive barrier*** was installed in October 2023 to capture volatile compounds in seepage water before it discharges to the stream. A reactive core mat containing granular activated carbon filters volatile compounds like a water filter does, with these compounds sticking to the carbon as the groundwater passes through the mat. The mat is covered with stone to prevent access or damage (**Figure 4**).

The conservative risk assessment indicated that there is no significant risk to people or pets from contact with water from the stream. The seep treatment is being conducted as an additional protective measure.

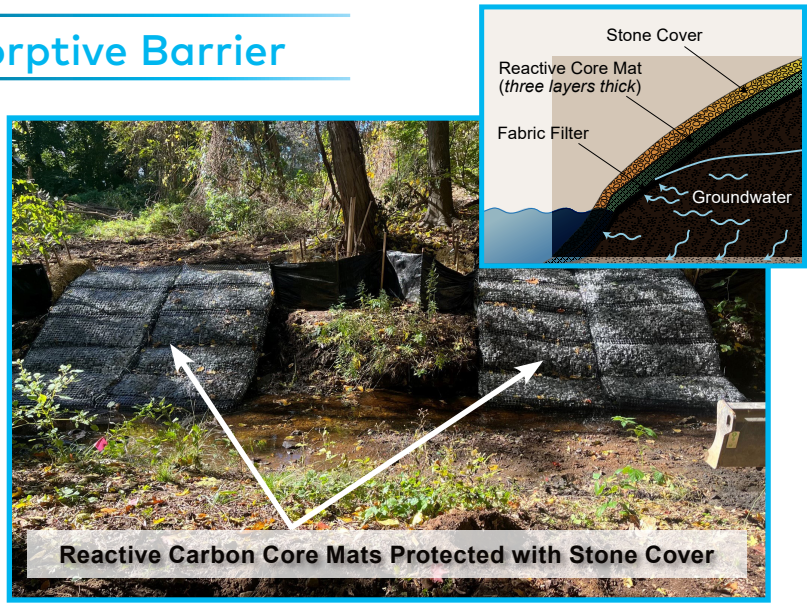


Figure 4 Reactive core mat installed at Stream A seeps

Building 5 Source Area – Bioremediation

The selected treatment technology for groundwater in the Building 5 area is ***bioremediation*** and continued operation of the ***soil vapor extraction system***.

Concentrations of volatile compounds in groundwater beneath Building 5 are significantly lower than beneath Building 3. Bioremediation has previously been successful where applied in the Building 5 area, and thermal treatment is less appropriate for areas with lower concentrations. Therefore, bioremediation will be expanded to new locations beneath the building and will use new application methods, such as high pressure or pulsed injections to address the deep groundwater. During the bioremediation treatment in the Building 5 source area, the ***soil vapor extraction system*** will continue to operate to protect current workers.

Bedrock Near Buildings 3 and 5 – Chemical Oxidation

A limited bedrock treatment area has been identified along the western boundary of the property between the Building 3 and Building 5 source areas. In that area, ***chemical oxidation*** will be implemented to treat elevated concentrations of volatile compounds in bedrock fractures.

Chemical oxidation involves injecting oxygen-containing chemicals (known as "oxidants", such as permanganate) to produce a chemical reaction that breaks down volatile compounds. Using chemical oxidation to treat volatile compounds in bedrock fractures can be challenging; it involves reaching and destroying these compounds in place within the fractures. Therefore, pre-design investigations will be conducted to identify injection sites. In addition, new application methods will be used to help the oxidants reach the volatile compounds in bedrock (**Figure 5**).

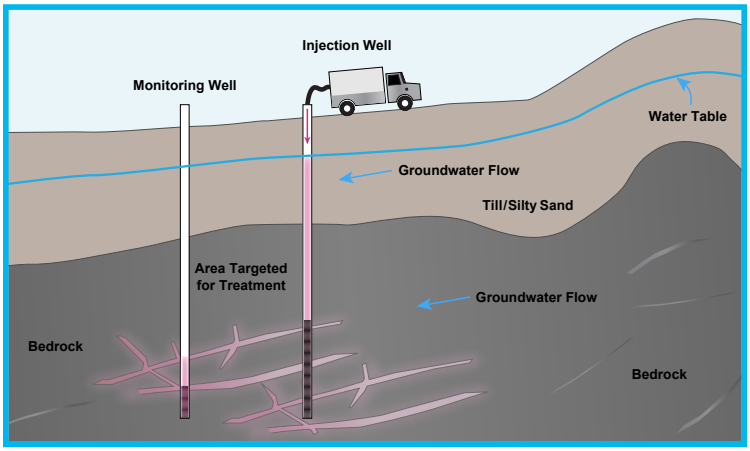


Figure 5 Diagram of chemical oxidation

PSL-10 Source Area – Soil Excavation with Permeable Treatment Zone

The selected treatment for the PSL-10 (Open Field) source area is a ***permeable treatment zone***. Soil excavation is also planned to supplement this treatment. Additional pre-design investigations were completed in August-September 2023 to evaluate the type of permeable treatment zone that should be implemented.

These investigations indicated that a relatively small shallow area of soil may be contributing volatile compounds to groundwater in this area. When shallow soil contributes volatile compounds to groundwater, then a simpler and more effective remedy may be to excavate the soil, and then backfill the excavated area with amendments that will enhance biological and chemical degradation. Using a solar-powered pumping system, groundwater is recirculated through this backfilled material to provide continued groundwater treatment. This permeable treatment area is commonly referred to as a "subgradient biogeochemical reactor" (**Figure 6**).

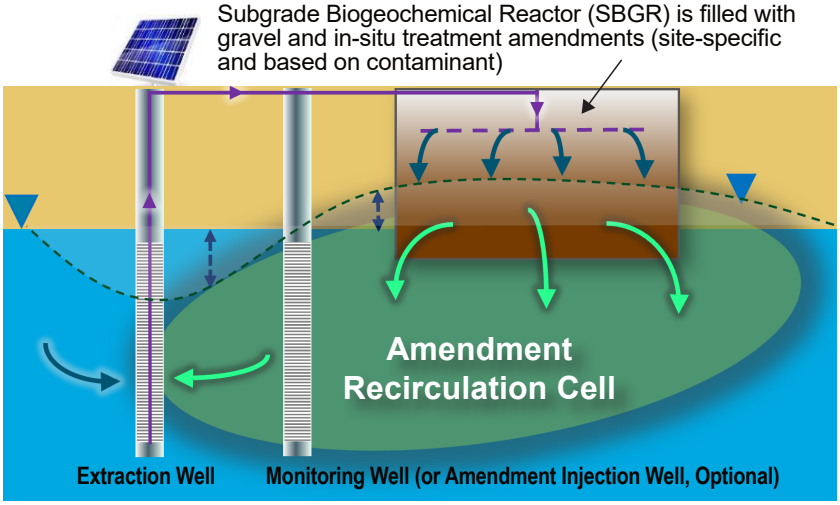
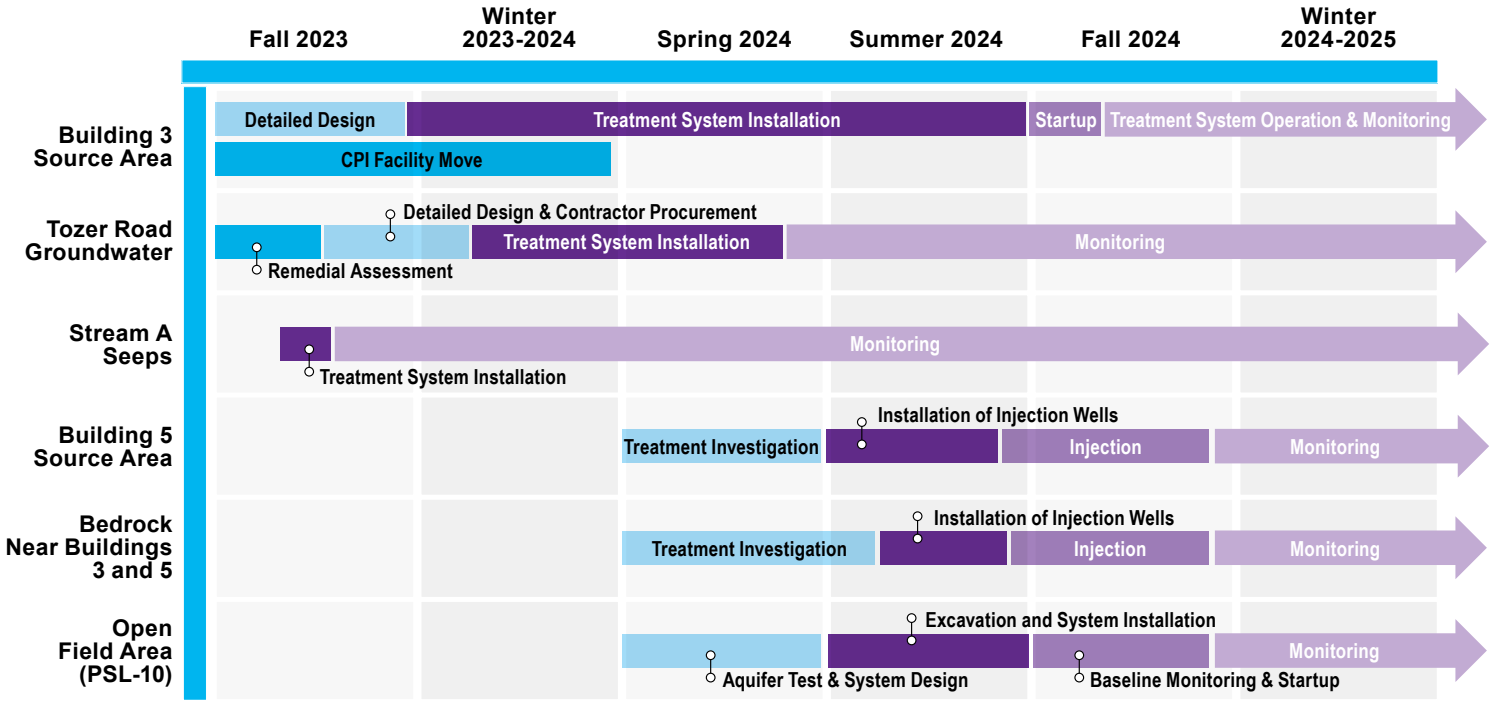


Figure 6 Diagram of a subgrade biogeochemical reactor

Anticipated Schedule



**NOTE: Estimated schedule, subject to change*

Varian is actively working with the community and MassDEP to achieve a permanent solution at the site.

For more information:

Visit the project website:
https://beverlysitecleanup.com/

Sign up for our mailing list:
https://beverlysitecleanup.com/more-information/

View recent site documents:
Beverly Public Library Reference Desk

Email questions:
beverlysitecleanup@jacobs.com

View all site documents on the MassDEP's website:
https://eeaonline.eea.state.ma.us/portal#!/wastesite/3-0000485