



CORRECTIVE ACTION GUIDANCE

Vermont Agency of Natural Resources Waste Management Division

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INTRODUCTION

In the event of a release or discovery of a hazardous material in the environment, the Vermont Department of Environmental Conservation (DEC), Waste Management Division (WMD) requires immediate notification (10 V.S.A. § 6617) of this release and subsequent investigation, confirmation and reporting of site conditions. Depending upon the risk to human health and the environment posed by the release, corrective action (cleanup) may be necessary at the site. If corrective action is deemed necessary, a written document known as a corrective action plan (CAP) must be developed by the responsible party (RP) and approved by the WMD, Sites Management Section (SMS). A CAP should be prepared by a professional consultant experienced in the investigation and remediation of releases of hazardous materials.

The CAP is a justification for and comprehensive description of the proposed cleanup activities. The SMS will review the CAP to determine if the proposed activities will satisfy the corrective action requirements in state statute (see 10 V.S.A. § 6615) and regulations (Underground Storage Tank (UST) Regulations and Hazardous Waste Management Regulations). This document is intended to provide guidance to RPs and their consultants in preparing CAPs that will fully meet these requirements¹. In addition, this document establishes recommended guidelines for preparing CAPs that are not only complete, but also well organized and easy to understand and review. Effective communications between all parties involved is essential for a successful and cost efficient cleanup. The SMS believes that adherence to these guidelines will foster improved communications as well as more effective oversight and response from SMS Site Managers.

PRELIMINARY SITE INFORMATION

The CAP is one of several sequential documents or reports that the SMS may require responsible parties to prepare relative to a release or discovery of hazardous materials in the environment. Most are preliminary to the CAP and provide the underlying information base for choosing a corrective action.

Before it can be determined if corrective actions are needed to mitigate the effects of a release, initial steps must be taken to evaluate and document the specific conditions of the site. Upon discovery or confirmation of a release, RPs are required to immediately notify the SMS and take initial emergency abatement procedures, as stated in 10 V.S.A., Section 6617 (Notification) and in the UST Regulations and the Hazardous Waste Management Regulations.

¹This document is in no way intended to supersede the authority of the federal government or that of other state regulatory agencies.

Initial reporting should provide important basic information about the site and the specific nature of the release. Elements of initial reporting include :

- the site location, and the name of the site owner or owner's representative, if appropriate;
- the source, type, and estimated quantity of the materials released (if known);
- the use and approximate locations of water supplies and any buildings potentially impacted or threatened by the release;
- the results of any environmental sampling and subsequent analysis;
- any initial emergency abatement actions taken and the effectiveness of these actions; and,
- any other particularly relevant site information.

When site conditions warrant, the SMS will require responsible parties to perform a subsequent, more comprehensive, site investigation before deciding whether corrective action is necessary. The investigation should be designed to determine the following:

- Define the source(s), degree, and extent of the contamination.
- Define all possible pathways for contaminant migration.
- Present data that quantifies the amount of contaminants migrating along each pathway.
- Determine the fate of the contaminant(s) in the subsurface (adsorption, degradation, etc.).
- Define all relevant sensitive receptors or potential receptors.
- Determine the risk of contamination directly affecting receptors.
- Provide a preliminary recommendation, with justification, for the need to conduct remedial action or monitoring at the site.
- Identify possible remedial actions that may be appropriate to control, mitigate, and/or monitor the effects of the release.

Guidance for this type of an investigation can be found in the document, "Site Investigation

Guidance," which is available from the SMS upon request.

WHEN IS CORRECTIVE ACTION NECESSARY?

At any point in reviewing site information relative to a release of hazardous materials to the environment, the SMS may require responsible parties to perform corrective action at a site. Corrective action **must** be initiated if one of the following conditions exist:

- when free floating product exists on the water table in amounts that are feasible to recover;
- when dense non-aqueous phase liquid (DNAPL) is present either as residual phase DNAPL or as a pool of free product, and remediation is technically practicable;
- when a sensitive receptor ² is either directly affected or at risk of being affected by contamination at concentrations that pose an unacceptable health or environmental risk ³;
- when published soil standards or risk-based maximum soil concentration standards are exceeded and there is a direct contact threat to human health or the environment;
- when any state or federal statutory (e.g., Superfund or RCRA) authority or regulation requires corrective action;
- when groundwater contamination is migrating offsite at concentrations exceeding the Vermont Groundwater Enforcement Standards and the SMS determines that it is not being sufficiently remediated by natural attenuation processes; or,
- when required as part of a federally mandated cleanup at sites regulated under the Superfund or RCRA Corrective Action programs.

All corrective actions must be approved by the SMS before being implemented. As explained above, the CAP is the written instrument used to gain SMS approval. In cases of human health or environmental emergencies, verbal approval for actions may be granted by the SMS, but must be followed by a written CAP and formal SMS approval.

²Sensitive receptors include public and private water supplies; surface waters; wetlands; sensitive ecological areas; outdoor and indoor air; and enclosed spaces such as basements, sewers, and utility corridors.

³A qualitative risk assessment showing how and why the receptor(s) is at risk should be included with the CAP.

A RP may elect to remediate a site which does not meet the conditions stated above. However, RP-elected corrective action that involves remediating petroleum releases from leaking underground storage tank(s) will not be considered eligible for reimbursement from the Vermont Petroleum Cleanup Fund (PCF). Further information on this issue can be found in the document titled "Procedures for Reimbursement from the Petroleum Cleanup Fund," and is available from the SMS upon request.

THE CORRECTIVE ACTION FEASIBILITY INVESTIGATION

A Corrective Action Feasibility Investigation (CAFI) should be completed for all sites where corrective action is determined necessary. The intent of a CAFI is to determine what corrective action technology(ies) would be best suited to the conditions at a particular site. The CAFI can be used to evaluate an innovative yet unproven technology. Information derived from the CAFI can be used to justify the selection of an appropriate corrective action strategy. The CAFI also provides criteria for the actual design of systems and equipment to be used at the site. The results of a CAFI are often included as part of the site investigation report, and are incorporated into the CAP as identified below. However, they may also be provided to the SMS as a separate interim document.

EVALUATION OF CORRECTIVE ACTION TECHNOLOGIES

The CAFI is used to evaluate possible remedial alternatives when the Site Investigation or other information indicates that remedial action may be required at a site. The SMS expects the CAFI to include a general review of all appropriate remedial alternatives. In addition, a formal evaluation is required on one or more of the most appropriate remedial alternatives. The number of remedial alternatives evaluated shall depend upon the complexity of the site, number of contaminant releases, extent of the plume, persistence of the contaminant(s), existence of single or multiple phases of contaminant, and/or other factors as appropriate. The SMS may require further evaluation of remedial alternatives.

Natural attenuation of contamination is an acceptable remedial alternative to evaluate during the review of corrective action technologies. In some cases, it may be acceptable to allow contaminants to naturally attenuate if this does not pose an unacceptable risk to human health or the environment. In these cases, the SMS expects the documentation and evaluation of specific site information to support natural attenuation as a remedial option. This information includes documenting the process of natural attenuation through monitoring. For example, at sites with a gasoline release, the reduction of contamination may also be documented by evaluating specific geochemical and biological indicators. Additionally, natural attenuation can be supported using modeling and stoichiometric equations, when appropriate.

Some contaminants are very persistent and are difficult to remediate using presently available technologies. If the CAFI demonstrates that active remediation is not technically or economically feasible, or that it will not remediate a site any faster than natural attenuation, the SMS may allow long term monitoring of natural attenuation instead of active remediation as long as human health and the environment are protected. As part of this process, the SMS may require source reduction, engineering or institutional controls, groundwater reclassification, or a combination of these controls. Long term monitoring by itself will not be allowed if there is an unacceptable risk to human health and the environment. Also, corrective action may be required to prevent migration of the contamination. Natural attenuation can also be considered as an alternative to continuing active remediation, once the remedial goals of a project have been met, such as source area reduction or contaminant migration stabilization.

RISK ASSESSMENT

The SMS expects the evaluation of risk posed to human health and the environment from hazardous material releases at each hazardous waste site. The SMS relies on risk assessment methodologies that incorporate Environmental Protection Agency (EPA) and Vermont Department of Health (DOH) standard risk assessment approaches. Risk is a function of the compound's toxicity, the exposure dosage and the exposure pathway. Toxicity can be determined by referring to values provided by IRIS (a federal health database), or by reviewing existing standards as identified in the literature. These documents include the Vermont Groundwater Enforcement Rule and Strategy (for groundwater standards), the EPA Region III Risk-based Concentration Tables, or other valid documents which provide risk-based standards. Exposure pertains to the concentration of the contaminant and the expected duration that an individual comes into contact with the contaminant, and is determined by using sampling data and EPA or DOH exposure assumptions. An exposure pathway is the expected route that the contaminant will travel to get onto or into an individual (e.g., drinking water ingestion, dermal contact, soils ingestion and inhalation). These factors must be considered in order to determine the level of risk posed by the contaminant.

The SMS will accept a two-tiered approach in determining risk: a qualitative approach and, if necessary, a quantitative approach. The qualitative approach requires that representative sampling results be obtained for each possible pathway of concern (see the SMS document "Site Investigation Guidance" for guidance on how this is done). These results are then compared with existing standards or risk based concentrations. The SMS uses existing Vermont Groundwater Enforcement Standards, Vermont Health Advisory Levels and EPA Maximum Concentration Levels, as well as risk-based guideline concentrations for soil, surface water, and indoor and outdoor air. Background levels of contaminants which may be obtained from sampling or from valid and pertinent literature are also considered in these determinations. If the contaminant concentrations identified by sampling are approximately an order of magnitude less than the above referenced state and federal standards or risk-based concentrations, then the SMS will conclude that there is little risk posed by the hazardous compounds. If the concentrations identified by sampling are approximately

an order of magnitude greater than these standards or risk-based concentrations, then the SMS will conclude that there may be an unacceptable risk posed by the hazardous compounds and will require additional work, including a detailed quantitative risk assessment, cleanup, or on going monitoring. If the concentrations identified by sampling are between an order of magnitude less than and an order of magnitude greater than the standards or risk-based concentrations, then the risk that the contamination poses is unclear. In these cases, the SMS may ask for additional evaluation concerning risk, including additional qualitative, and in some cases, quantitative evaluation of risk posed by the hazardous compounds.

The SMS has not adopted formal soil standards for hazardous material contamination. Additionally, the SMS has not adopted any particular modeling approach for determining risk to human health or risk of soil contamination affecting groundwater. The SMS may accept any valid risk model as long as it is appropriate for the subject site. Several examples of this include the use of Risk Based Corrective Action (RBCA), the Massachusetts Contingency Plan, or numerous groundwater transport models. Consultants must work with the SMS Site Manager to ensure that the proposed model is appropriate for the subject site .

Quantitative risk assessment used by the SMS follows standard EPA and Vermont DOH risk assessment methodology. Refer to EPA risk assessment documents for additional detail into this methodology. Also, the SMS strongly recommends hiring a consultant with expertise in risk assessment to perform quantitative risk assessments.

OBJECTIVES OF CORRECTIVE ACTION AND THE CAP

The objectives of corrective actions are simple: contain contaminants, remove gross contamination, and minimize/eliminate risk or impacts to receptors. In many cases, cleanup of soils and groundwater is not needed, feasible, or cost effective. In these cases allowing for natural attenuation with long-term monitoring may be sufficient. Additional reasons for corrective action, which are secondary to the interests of the state, include minimizing responsible party liability and restoring property values. Such actions may be in the best interest of the responsible party. However, the Vermont Petroleum Cleanup Fund will not reimburse costs for corrective action performed at leaking underground storage tank sites for the benefit of the RP or property owner. The Fund was not intended to provide for these additional purposes.

The objectives of a CAP are simple as well; to *clearly communicate* the basis and details of a proposed cleanup strategy to the SMS such that Site Managers can ensure technical feasibility of the plan, effective engineering design, reasonable cost, public participation, and above all, protection of human health and the environment. Ultimately, the CAP represents a consensus agreement on the corrective action and provides the foundation for all future work at the site. Completeness and clarity in presentation are, therefore, paramount.

ELEMENTS OF THE CAP

The ideal CAP is short, well organized, concisely written, and highly visual. The SMS believes that there are certain minimum elements of a CAP and recommends certain methods of presentation for ease of review. These minimum elements and formats are incorporated into the following checklist. A complete CAP will include the following:

- G A document cover that includes the site name, location, and SMS site number as well as the responsible party's name, address, and phone number. A suggested format is attached as Appendix 1.
- G An Executive Summary that includes a statement of the problem (why corrective action is needed), a review of the results of the investigation(s), a description of the chosen corrective action technology, a statement of site operations and monitoring activities, and an estimate of the duration of the cleanup.
- G A one-page News Brief (under separate cover) that consists of the CAP Executive Summary.
- G A Table of Contents.
- G A copy of the Executive Summary from the Site Investigation.
- G Tabular, time series summaries of contaminant concentrations by media and water table elevations.
- G Appropriately scaled maps including a detailed site plan, area plan (including sensitive receptors and neighboring properties), and a USGS 7.5 minute topographical map.
- G At least two cross-sections of the contaminated zone (ideally, along the long axis and perpendicular to the contaminated zone) depicting well or boring depths, soil stratigraphy, recent soil contaminant concentrations, and recent water levels.
- G A recent groundwater elevation contour map.
- G A recent contaminant concentration isocontour map.
- G A list of all sensitive receptors at risk or affected as well as all interested, threatened, or impacted third parties including contact names, locations and addresses, and phone numbers.

- G A discussion of the reasons for and the goals of the corrective action; e.g., to remediate gross contamination, to reduce impacts on a receptor, to reduce risk to a receptor, etc.
- G A qualitative feasibility study of various corrective action alternatives ⁴ (e.g., CAFI).
- G An in-depth, quantitative review of the recommended remedial alternative(s) chosen with a discussion of 'real-world' limitations.
- G A schedule for CAP implementation.
- G An estimate of the contaminant mass or volume, expected removal rates, and the duration of the cleanup.
- G Plans and specifications of the corrective action remedial design and related calculations.
- G All CAFI data.
- G A list of all contractors and sub-contractors, including contact people, addresses and phone numbers.
- G A list of all permits required for the project, and the contacts necessary to obtain these permits.
- G A discussion of all hazardous and solid waste disposal issues.
- G A separate itemized cost estimate for CAP implementation and system operations and maintenance (O&M) . This cost estimate should be broken down by task and by labor costs, sub-contractor costs, and equipment costs. Estimates for sub-contractors must also be itemized into labor and equipment costs. Lump sum estimates will not be accepted. The requirement for a cost estimate may be waived for sites using private funds.
- G A schedule for evaluation of start-up of remedial system .
- G A formal long-term monitoring and O&M plan for the corrective action.
- G An updated Health & Safety Plan.

⁴This may have been prepared as a separate document. If so, then a summary of the findings of this document should be included in the CAP.

G A Professional Engineer's signature of review.

SUBMITTAL OF THE CAP

Two copies of the CAP shall be submitted to the SMS site manager at the following address:

Vermont Dept. of Environmental Conservation
Waste Management Division
Sites Management Section
103 South Main Street
Waterbury, VT 05671-0404

CAP APPROVAL

Once a CAP has been submitted to the SMS, it will be reviewed for completeness and content. If a CAP is not complete, the SMS will inform the responsible party that additional information is needed. Once a CAP is complete, the SMS will make every attempt to review the CAP in the shortest period of time possible. A CAP that is complete and well organized is likely to require less time to review.

If the CAP is approved, the SMS will draft a cover letter and send a copy of the cover letter, News Brief, and CAP to the appropriate town/city clerk to solicit public comments. The SMS will ask the clerk to post the cover letter and News Brief in a public location in the town/city offices. In addition, the SMS will request that the town/city clerk make their copy of the CAP available to any interested party. The SMS will also send a copy of the cover letter and News Brief to all interested/threatened third parties and other appropriate town officials. Finally, a copy of the cover letter will be sent to the responsible party and his or her consultant for their information and files.

In most cases, the SMS will allow two weeks for public comment. However, if public comment is extensive, this public comment period can be extended to a duration which is reasonable for the level of public interest. Notice of any extension will be provided in writing to the parties listed above. If there is public interest, the SMS will hold an informational meeting to discuss the details of the corrective action plan, and to answer any questions the public may have about the project. Once the public notice period is closed and all questions raised during this period have been answered. The SMS may request modifications to the CAP. After final approval, implementation of the CAP may begin. Any significant modifications to the CAP must be made to the SMS in writing, and must be approved by the SMS. An exception will only be made in cases of emergency corrective actions. In these cases, part or all of this procedure may be modified in order to expedite implementation of the CAP to protect human health and/or the environment. Such emergency work may only be performed at the direction of an SMS Site Manager.

MONITORING THE OPERATION AND MAINTENANCE (O&M) OF CORRECTIVE ACTION SYSTEMS

Once a CAP has been implemented at a site, O&M of the remedial system are necessary to ensure the system efficiency and to achieve the goals of the corrective action. O&M of a system should occur as identified in the O&M plan that is included in the approved CAP, and should be summarized in the form of O&M reports submitted to the SMS. However, if a remedial system is shutdown or is not functioning as intended, the SMS site manager must be notified immediately of the problem and the steps being taken to remedy the problem. O&M reports should be submitted on a quarterly basis, unless otherwise requested by the SMS. If a system has been effectively running for over a year, the SMS may allow for a reduction in the frequency of reporting. O&M reports should consist of the following information:

- Site name, location, and SMS site number.
- A brief overview of remedial system operation and general site status.
- Remedial system operation data as specified in the approved O&M schedule of the CAP. This data should be in tabular form, and may include: pre- and post-blower pressures; fluid flow rates; influent, mid and effluent vapor concentration readings from vapor phase carbon units; influent, mid and effluent sample analysis data from aqueous phase carbon units; temperature differentials across incinerator processes; vapor extraction well vacuum differentials; air sparging pressure differentials; groundwater treatment system samples; soil vent balancing data; etc. Graphs of the remedial system data versus time should be provided in cases where the presentation is useful in understanding site conditions or in supporting any conclusions which are drawn from the data.
- Groundwater elevation data both in tabular form and presented on a groundwater contour map. Free product thickness data, where applicable, should be presented on the groundwater contour map or on a separate map or maps. Graphs of elevation (and/or thickness) versus time should be included if appropriate.
- Analytical data from groundwater sampling in tables, graphs, and their original laboratory forms. Groundwater sampling should be conducted in accordance with the approved CAP. Analytical information should be presented on a site plan, preferably with contaminant isoconcentration lines.
- Contaminant removal estimates for the remedial system. Free product, dissolved phase, and/or vapor phase recovery should be tabulated. When incinerators are used, removal estimates based on temperature differentials, PID readings, and other

applicable data should be included. Product recovery estimates should be presented in graphs of product recovered per day and cumulative product removed versus time. Multi-system operations (i.e. soil vapor extraction and free product recovery) should include graphs of recovery rates for each system.

- Discussion of system down times and the reasons for such down times . Any system balancing activities should be noted, justified, and follow the consultant SOPs, manufacturer literature and/or guidelines presented in the appropriate WMD guidance document for the particular technology. All repairs of the system must be documented.
- Recommendations for system design and/or operational changes in the system should be made to increase efficiency. These may include sampling frequency, site visitation frequency, system modifications or additions, etc.
- Any other pertinent information detailing activities conducted during the last reporting period.
- O&M Reports should be submitted to the SMS Site Manager within one month of the sampling date.

SITE MONITORING

Many hazardous sites need monitoring after the degree and extent of contamination has been defined and a Site Investigation has been completed. Site monitoring may also be necessary during corrective action activities. Site monitoring should be conducted as part of an approved site monitoring plan, or as identified in an approved CAP. Site monitoring is conducted for a variety of reasons including the following:

- identifying time variant trends in environmental conditions and/or in the operation of remedial systems;
- understanding environmental conditions and tracking the fate and transport and/or natural attenuation of contamination ; and
- determining if and when action must be taken to further control the release, reduce risks to receptors, improve remedial system performance, conduct further site investigation, or discontinue corrective actions.

Typically, monitoring includes obtaining groundwater elevation data, sampling and analyzing groundwater monitoring wells, screening stockpiled soils with field analyzers, sampling and analyzing drinking water supplies, inspecting sensitive receptors, and obtaining other relevant information. This information must be collected by a consultant at a set frequency (monthly, quarterly, biannually, annually), as detailed in a site monitoring plan or CAP and must be submitted to the SMS in the form of summary reports.

The frequency of monitoring at a site is usually determined once the site investigation is complete. The frequency will depend on the degree of contamination observed on-site, the potential for the contaminants to adversely affect sensitive receptors, and the potential for site conditions to change. For instance, a site with monitoring wells containing petroleum contamination at concentrations above Vermont Health Advisory Levels or EPA Maximum Contaminant Levels in an area near drinking water wells should be sampled more frequently than an area where there are no nearby drinking water wells or other sensitive receptors. The frequency of monitoring should be recommended by the consultant in the site investigation report. The SMS will allow for a reduction in the sampling frequency once long term trends have been established for a site. The SMS will offer an amended frequency if it deems necessary. This may include a request to submit brief monthly or quarterly reports followed by more inclusive quarterly or annual reports, respectively. In most cases, the frequency of site monitoring and report submittals will be the same.

Summary reports of site monitoring need to be clear and concise to allow for a timely review by the SMS. Summary reports should be submitted no more than one month after any on-site sampling or activity. When corrective action activities are occurring at a site along with site monitoring, the O&M report should be combined with the site monitoring report. A summary report

should consist of the following information:

- Site name, SMS site number, and location.
- A brief overview of the site status.
- A site plan drawn to scale with North arrows, monitoring well locations, suspected and identified source areas, sensitive receptors, surface water, and other pertinent physical features, including on and offsite buildings, roadways and utility locations.
- Groundwater elevation data should be summarized in tabular form and presented on a groundwater contour map. Free product thickness data, where applicable, and presented in the groundwater contour map. Graphs of elevation (and/or thickness) versus time if appropriate.
- Analytical data in tables and in their original forms (lab reports) , with QA/QC sample results included. Graphs of concentration versus time, if appropriate. Non-detectable results should not be shown as zero, rather as below the detection limits of the analysis. Contaminant isoconcentration maps if possible.
- Field screening results from contaminated stockpiled soils in tabular format , with a map showing the locations of the screened samples and the stockpile location in reference to other pertinent physical features including buildings, roadways, surface water bodies, etc.
- Discussion of the current site conditions should be included. This should be based on the analytical results, groundwater elevations, etc. Recommendations concerning site management or the frequency or scope of monitoring should be provided based on the data gathered during the site visit.

The SMS encourages the use of double-sided, recycled, chlorine-free paper in all report submittals. The SMS also encourages the submittal of this information in electronic form, and may require it for sites with large amounts of site data. The format and method for this submittal would require prior coordination with the SMS Site Manager to ensure the information is presented in a manner which is compatible with the WMD computer system.

Corrective Action Plan Guidance approved by:

P. Howard Flanders, Director, WMD

Date

APPENDIX 1. Example Title Page

Phase (check one)	Type (check one)
G Initial Site Investigation	G Work Scope
G Corrective Action Feasibility Investigation	G Technical Report
G Corrective Action Plan	G PCF Reimbursement Request
G Corrective Action Summary Report	G General Correspondence
G Operations & Monitoring Report	

(cover window)→

CORRECTIVE ACTION PLAN

Bob's BTEX Barn
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SMS Site # 45678

**A Facility Owned By:
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November 25, 1997

**APPENDIX 2
CORRECTIVE ACTION TECHNOLOGIES**

A variety of corrective action technologies have been successfully utilized in Vermont. A list of the most commonly used is provided in the table below. This list is not intended to be a complete list of all remedial technologies. The SMS encourages the use of alternative and innovative technologies in the interest of expediting cleanup and controlling cleanup costs.

Common Corrective Action Technologies			
Free Product Recovery	Soils	Groundwater	Containment
Skimmers	EX-SITU:	Pump and Treat with:	Slurry Walls
Vacuum Trucks	landfilling	wells	Interceptor Trenches
Single Pumps	asphalt batching	trenches; with	Containment caps
Dual Pumps	landfarming	air stripping	
Product Bailers	bioremediation	activated carbon	
Manual Recovery	composting	bioreactors	
Soil Vapor Extraction (SVE)	polyencapsulation		
Absorbents	incineration	Air Sparging with SVE	
	IN-SITU:		
	SVE	Bioremediation	
	Bioventing		
	Bioremediation		