Over the past 20+ years, passive sampling technologies have become more commonplace in the United States and other countries as research has advanced and technologies have been used in practical settings. As passive sampling has been adopted more frequently, and with the increasing number of contaminants of emerging concern, there has been an increase in the number and type of passive sampling devices that are commercially available and in use for collecting samples from different media.

In the United States, at the federal level, passive sampling data have been accepted in decision-making in the U.S. Environmental Protection Agency's (USEPA) Superfund Program at many contaminated sediment sites. Specifically, passive sampling has been used in several phases of the remediation process at more than 20 sediment sites around the United States. As such, sampling implementation at Superfund sites may require advisement and discussion as to what phase of the remedial process and applications the regulatory agencies may deem appropriate. In contrast, passive sampling of groundwater contaminants at Superfund sites is less developed and its use would require site-specific review and acceptance. Similarly, regulatory acceptance of passive sampling methods varies substantially by state, regulatory group within each state, sampled media, and other factors.

Unfamiliarity with the technologies, their use, or the state of the science can lead to a hesitance to accept the use of passive sampling technologies in practical applications. Even in states where passive sampling is commonplace within one department or for one application, it may be discouraged or not allowed in others. Lack of information sharing within or between organizations has resulted in a wide disparity in regulatory approaches and requirements for the use of passive sampling technologies. In some cases, limiting regulatory language, often written in previous years, around legacy methods may even discourage or altogether disallow the use of data collected using passive sampling in decision-making processes.

Using passive sampling methods can benefit both the regulated community and regulators. For instance, passive sampling technology can often be more representative of site conditions across multiple media compared with active sampling methods, allows for more efficient high-resolution characterization (interval sampling and rapid data collection), and uses methods that have undergone rigorous review through the scientific community. When deployed for long-term monitoring programs, the ease of use for passive sampling can allow for less variability in results due to small variations in sampling methodology and gives greater confidence that changes in data over time reflect actual changes in conditions rather than sampling variability. For some media, sampling events can be completed more quickly using passive sampling methods, providing a consistent snapshot of site conditions. Additionally, because the use of passive sampling in investigation and long-term monitoring can be more cost-effective and labor-efficient than active methods, the regulated community has greater resources available at hand to focus on completing remediation efforts. Incorporating high-resolution sampling, which can be completed using passive sampling programs for some media, allows for defensible and cost-effective remedy development overall.

To better understand the need for passive sampling guidance, ITRC surveyed state regulators with respect to current regulatory language surrounding passive technology use, asking if there was any regulatory language prohibiting the use of passive sampling. The team received responses from 48 states and Puerto Rico, and conducted research for the remaining states as summarized in Figure 3-1. Some states do not have any regulatory language prohibiting passive sampling but differ in acceptance across agency departments. Always check with the state's regulatory program to see if passive sampling is applicable for your site or project.

Figure 3-1 Key:



General State Acceptance of Passive Sampling *(no formal policy prohibiting the use of passive sampling at large within the state; check with your Project Manager if passive sampling is applicable).*



Passive Sampling Team conducted research as no state POCs were able to confirm



Site-Specific State Acceptance of Passive Sampling *(check with your project manager if passive sampling is applicable*

Passive Sampling Team conducted research as no state POCs were able to confirm

3.1 Site-specific Regulatory Program Concerns

The use of passive sampling technologies can cause concern among regulators, deterring its use in that state. Some of these concerns are discussed in this section in hopes that passive sampling will become more widely used and accepted. Compliance monitoring in many states relies upon meeting specific regulatory levels. Generally, site-specific contamination is measured through grab or single point of time sampling. Many regulatory programs have little to no guidance or user experience with passive sampling technology. Regulatory use of passive samplers can include, but is not limited to, their use during investigative stages, compliance monitoring, and meeting closure requirements. In determining if passive sampling is appropriate, a key consideration is whether chemicals effectively move within the medium under natural (passive) conditions so that a sample taken at one location represents the spatial-temporal concentrations of target chemicals in the surrounding medium. These concerns tend to center around contaminant transport:

In determining if passive sampling is appropriate, a key consideration is whether chemicals effectively move within the medium under natural (passive) conditions so that a sample taken at one location represents the spatial-temporal concentrations of target chemicals in the surrounding medium. These concerns tend to center around contaminant transport:

- Does natural groundwater flow through a well carry chemicals through the well at the same concentrations found in the larger aquifer?
- Does the mechanism of the sampler—for example, diffusion through a membrane or grabbing from a column—acquire a representative sample of the specific chemicals?
- Will external factors, such as biofouling, scaling, or sediment load, affect sample validity?
- How to compare results from passive sampling to historical data, or what to expect from results on new sites—for example, how does a flow-weighted average (pumped) sample compare to an instantaneous (grab) sample, or a time-weighted average (equilibrated diffusion) sample compare to a time-integrated (accumulation) passive sample?

This document provides guidance based on data from research and case studies to address these concerns; to suggest when, where, and how to use passive samplers; and to support the appropriate use of passive sampling methods. It is always best to check with your state prior to using a passive sampling method.

3.2 Technology Acceptance

Regulators may be reluctant to accept passive methods due to a perception that the technology is new or untested. Individuals or organizations may apply an unfavorable experience with one passive technology to their views of all passive technologies, perceive a deficiency or uncertainty around sampling results, or have concerns about the consequences of changing methodologies. In reality, each passive sampling technology and specific device has its own history of use and applicability, and many have been in use for more than 20 years.

Although the data collected using passive sampling devices may differ slightly from data collected using traditional sampling methods, properly designed sampling programs with appropriately deployed devices will result in scientifically valid data demonstrating a level of precision and accuracy to meet performance standards for decision-making. This document provides case studies and general use guidelines to support acceptance of passive sampling with the latest information available.

3.3 Acceptance Varies by Media

The interconnection and coordination of environmental regulations across media (water, soil, sediment, and air, etc.) and

regulatory groups differ significantly state to state. As such, the use of passive sampling technology may vary accordingly for different media and different applications in different places. Regulations governing multimedia investigations and remediation may differ from those governing routine monitoring. Further, the use of passive sampling for these different media can vary greatly, even across regulatory groups. Similarly, regulations for surface water sampling may differ considerably from those governing air or groundwater, each with its own barriers or flexibilities toward passive technology use. This document is intended to support the entire regulatory community, regardless of media or specific application, to help provide the technical basis for decision-making surrounding the use of passive sampling technology.

3.4 Remedial Phase Acceptance

Passive sampling techniques that are acceptable for collecting data throughout the entire remedial process, including site remedial characterization and monitoring, human health or ecological risk assessments, remedial action performance monitoring, long-term monitoring, and site closure activities, vary by state and regulatory agency. It is best to check your state's guidance and contact the regulatory program when considering passive sampling use for a specific remedial phase.

3.5 Performance Standard Acceptance/Approval

For states where the responsible party and the consultant are required to obtain written approval from the regulatory environmental agency prior to the implementation of remedial activities, the environmental consultants typically contact the assigned regulatory case manager for the site and/or the applicable regulatory agency program director to obtain approval to change data collection methods. Further details for regulatory approval are presented in Section 3.6.

For states with a regulatory program that is performance- and/or voluntary-based, where the regulatory state environmental agency delegates and/or relies on the environmental decision made by a licensed professional in that state, the licensed site professional must be able to demonstrate that the use of passive sampling technologies meets the state's performance standards during remedial activities. See Section 4 for comparison methods that can be helpful in analyzing and evaluating data from different methods when considering transition. In these states, the regulatory environmental agency typically performs periodic reviews and audits of report submittals certified by the licensed professional and responsible party performing the environmental work, and receives all documents associated with regulatory site closure requests.

The licensed professional and/or environmental consultant needs to properly design sampling programs (active and/or passive) with appropriately deployed devices. They should demonstrate that the data collection methods are scientifically valid and defensible, and that the level of precision and accuracy are commensurate with the intended use and meet performance standards for decision-making. The licensed professional and/or environmental consultant can rely on published and unpublished methods, sampling-device manufacturer studies, case studies, and/or site-specific data to demonstrate that passive sampling is representative of site conditions. Prior to the transition to a new method, the state should be consulted if preapproval is required.

3.6 Concurrent Regulatory Oversight

Due to the highly site-specific challenges across environmental sites, it is good practice to contact the state regulatory program when considering passive sampling or switching from active to passive sampling at individual projects. Each regulatory program may have policies, guidance, or standard operating procedures that explain the use (or nonuse) of passive sampling technologies within their respective programs. Including the regulatory team early in your project can address any regulatory conditions or approvals that may be required. Depending on the state where your project is, additional concurrence from the regulatory agency may be required prior to using passive sampling. Some states have little to no restrictions on the use of passive sampling. Other states have some limitations for the application of the data collected from passive sampling devices or restrict the use of devices to certain phases. (See Figure 3-1 for a map of states and their approach to the use of passive sampling.) The regulatory agency may typically require documentation to demonstrate that the data collected by the passive sampling devices are representative of the conditions of the actual media and are better than or comparable to other methods of sampling. The review team may require side-by-side comparisons of both active and passive sampling data, or a review of data collected and criteria for passive sampling data to meet the applicable state regulation performance standard. The data comparison methods (Section 4) provide guidance on how to present site data to support a change to passive sampling methods.