Monitoring and Performance

Monitoring ICs is paramount to IC management success. Monitoring of ICs refers to actions and procedures that observe, inspect, review, and evaluate activities and land uses to help assure that obligated parties are in compliance with IC requirements. Monitoring ultimately supports the integrity and effectiveness of the IC. USEPA notes that IC assurance monitoring generally is designed to help evaluate whether IC instruments "remain in place, operate in the manner envisioned during response action selection, and continue to be effective in preventing unacceptable exposures or protecting the integrity of response action components" (USEPA 2012).

Optimizing IC monitoring through prioritization tailors monitoring activities and approaches to meet the needs of the varying ICs. Limited resources can be focused on sites that pose the greatest potential threat to human health and the environment.
▼*Read more*

A performance evaluation assesses IC monitoring data to determine the extent to which an IC is meeting its stated goals. Results of a performance evaluation can confirm the IC is working as intended, identify the need for IC modifications, the need for changes to the monitoring protocol, or the need for enforcement and compliance assurance actions.

While a common set of issues can be addressed during IC monitoring and performance evaluations, the monitoring approaches vary based on the ICs that are in place, along with a site-specific assessment of the potential threats to the ICs. Listed below are examples of the common issues that are evaluated during IC monitoring and performance evaluations:

- Are the property conditions in compliance with the restrictions/requirements found in the IC?
    - Is there evidence of excavation, groundwater or surface water usage, or other restricted activities occurring where not allowed?
    - Is there evidence of water well use when none is allowed?
    - Is there evidence of prohibited uses (such as residential or day care use) when none is allowed?
- Are the affirmative obligations in the IC being complied with?
- Is the IC effectively serving its purpose in maintaining the overall protectiveness of the remedy?
    - Are potential human and environmental exposures to the affected environmental media mitigated? For example, is the vapor barrier, cap, or other engineering control operational to prevent exposures to contaminated groundwater and soil?
    - Are natural resources protected until conditions for unrestricted use are met?
- Is the integrity of the IC being maintained?
    - Does the footprint of the IC continue to match the area that requires control?
    - If the property has changed hands or been subdivided, does the IC remain discoverable?
    - Could the IC expire before unrestricted use criteria is met?
    - Will the IC survive property sale, including division of the property into multiple parcels?
    - Are locations of significant features (such as structures, areas of contamination, and vapor barriers or other engineering/access controls) appropriately mapped so they can be located even as property uses and features change?
- Are all affected stakeholders aware of the ICs and their associated requirements?
    - Are current property owners correctly identified and are they aware of ICs?
    - Are lessees on the property aware of the ICs and their associated requirements?
    - Do procedures exist to inform other stakeholders (for example, excavators, tenants, or buyers) of the ICs and their requirements?
- Is there an opportunity or need to modify or terminate ICs?
    - Have site conditions, activities, or receptors changed and does the IC need to be modified to maintain its protectiveness?

        - Have cleanup goals, site conditions, activities, or receptors changed to the extent that additional investigation or remediation needs to be conducted?
        - Have remediation/cleanup goals changed (increased) or has additional remediation or natural attenuation occurred so that there is an opportunity to terminate the IC, reduce the boundary of the IC, and return the site to unrestricted use?
    - Are IC enforcement actions needed?
        - Have minor violations, such as late reporting occurred that require informal corrective action?
        - Has a breach of an EC/IC occurred that requires a corrective action in the form of a physical repair or replacement of an EC?
        - Is there a pattern of continuing or repeat violations?
        - Is there a need for formal enforcement due to the severity, or frequency of violation(s)?

Recognizing that these issues may be addressed during IC monitoring and performance evaluations, the following sections discuss: 1) current IC monitoring practices; 2) optimizing and improving IC monitoring approaches; 3) IC performance evaluations to determine whether, based on monitoring data, an IC is meeting its stated goals or requires some type of modification or can be terminated; and 4) a summary discussion on best practices for IC monitoring and performance evaluation.

Current Practices for IC Monitoring Programs

The statutory framework, regulatory structure, and policy and procedures associated with IC monitoring vary across the states. While those variations may affect the amount and type of monitoring currently being conducted in individual states, the ITRC survey indicates that most states are conducting some form of IC monitoring. Many states, however, cited the need for improved IC monitoring.

According to the ITRC survey, states listed the following IC monitoring practices as being currently in place (see Survey Summaries and State-Specific Survey Responses).

- monitoring via coordination with local governments
- obligated party inspections and certifications
- periodic record reviews and inspections by state agencies
- IC permit programs
- land disturbance monitoring via one-call systems
- land use and activity monitoring

▼*Read more*

Monitoring via Coordination with Local Governments

Of the states responding, 12% reported using monitoring via coordination with local government. IC monitoring via coordination with local governments requires communication and coordination that does not routinely exist between local and state government agencies. This type of monitoring divides into two categories: ordinary local government functions and directed/site-specific programs. These approaches both continue to slowly evolve as IC monitoring and management practices improve.

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First, ordinary local government functions can prove relevant to IC monitoring even if the local government had no involvement with the IC or any direct responsibility for the IC. For example, local governments issue permits for land excavation, building, well drilling, and other invasive activities that could conflict with ICs established by the state agency (if information on AULs (alternative use limitations) is not previously available to the local government). City zoning ordinances limit the type of land use that can occur in defined “zones” (such as residential, commercial, industrial). City ordinances often provide environmental protection, such as well drilling prohibitions. Local governments, particularly counties, may also be responsible for recording deed restrictions.

These types of ordinary government functions generate information related to IC monitoring. Permit applications, zoning variance requests, water well permit requests, grading permit requests, and similar land development permit applications, when they affect IC sites, identify possible future uses and, in turn, possible IC conflicts. Thus, state IC monitoring

approaches attempt to leverage local government activities by either (or both): 1) notifying local governments that ICs exist; and 2) requesting local governments to notify state agencies or otherwise take action when their ordinary procedures identify activities at IC sites.

Coordination with local governments has not proved to be a prevalent monitoring approach, but occurs nevertheless. Examples include the following:

- In many states, under regulatory requirements or standard practices, the state environmental agencies notify the local government of the existence of ICs.
- A USEPA Region 3 pilot program involves reaching out to local governments to inform them of the status of sites undergoing environmental cleanup. (USEPA 2016).
- In some states, such as Colorado (Colo. Rev. Stat. § 25-15-324), New York (N.Y. Envtl. Conserv. Law §71-3607), and Washington (WDOE 2013), state law requires state agency coordination with local governments on ICs.
- USEPA and some states are developing procedures, particularly as part of their IC registries, to improve communication with local governments so that pertinent IC data are available to multiple government agencies and the public.
- Maryland site GIS information is designed to provide information to local governments for their permitting processes (http://imap.maryland.gov/Pages/default.aspx).

Second, local governments sometimes directly and purposefully develop city-wide programs or site-specific measures for the purpose of operating as an IC. In these local government IC situations, the local government accepts the role of monitoring the IC:

- Texas municipalities establish Municipal Setting Designations (MSDs) to prevent unauthorized use of groundwater. An MSD is an official state designation given to a property that certifies groundwater will not be used as potable water due to contamination. The actual prohibition may be in the form of a city ordinance or restrictive covenant that is enforceable by the local municipality. In this case, the municipality monitors and enforces the prohibition (TCEQ 2015).
- The Illinois Environmental Protection Agency (IEPA) has approved hundreds of groundwater ordinances for use as ICs (http://www.epa.illinois.gov/topics/cleanup-programs/institutional-control/groundwater-ordinance/index and http://epadata.epa.state.il.us/land/gwordinance/). The municipality or county is responsible for enforcing the prohibition. If a memorandum of understanding has been entered into with the IEPA, the municipalities or counties are also responsible for monitoring the status of the ordinance and notifying IEPA of any changes. for cases where no memorandum of understanding has been entered into, the current owners or successor in interest of a site that used and ordinance as an institutional control is responsible for monitoring the status of the ordinance.
- A site-specific local ordinance in Jasper County, Missouri, addresses a Superfund-designated area related to historical mining contamination. The local ordinance, administered and enforced by the county health department, helps assure that new residences or other child-occupied facilities are not constructed unless the area is free of soil and groundwater contamination (http://www.jaspercounty.org/health_department/environmentalservice/contamination_ord_environmental.html)

Obligated Party Inspections and Certifications

More than two thirds of the states reported use of obligated party inspections and certifications as a monitoring element. An “obligated party” is the party responsible for ensuring that the restrictions and obligations within an IC are being observed. For a given site, the obligated party is often, but not always, the same entity as the responsible party. The responsible party is generally the individual or entity liable for cleanup, while the obligated party may be a current land owner or other party who, under some circumstances, is only responsible for compliance with an IC. States have various reporting requirements for obligated parties to verify and/or certify compliance with IC requirements, such as:

- New Jersey relies on third party Licensed Site Remediation Professionals (LSRPs) (Administration 2016) to provide biennial certifications of IC compliance.
- Many states, including Colorado (CDPHE 2012), Missouri, and Minnesota, require submittal of annual IC compliance self-certification by obligated parties.
- New York uses environmental easements that contain site management plans, which detail site-specific

reporting requirements (NYDEC 2015).

These reports or certifications may include inspection results, environmental data, and other supporting information. Parties responsible for sites regulated under RCRA, Superfund, Brownfields, or state voluntary programs are generally required to provide site information according to the scopes and schedules included in their permits, orders, or other enforcement documents.

Periodic Record Reviews and Inspections by State Agencies

State agency reviews and inspections are one of the primary IC monitoring program elements and are used by 71% of the states (Question 16). Record reviews may include evaluations of data reports, IC registries, one-call system notifications, review of stakeholder reports, aerial photography for indications of site activities, and land use changes. These reviews may also include court decisions (such as bankruptcy) and property records (such as change of ownership). Site inspections are used to verify compliance with ICs and ensure that ECs are operating as designed.

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Many states conduct periodic record reviews and inspections of sites subject to ICs. For example, California generally conducts record reviews on an annual basis and site inspections every one to five years based on site-specific circumstances. Florida generally conducts inspections every three years and Wisconsin rotates through its sites by inspecting about 50 sites per year (see Summary of State Surveys, Survey Question 9). Hawaii uses a standard Land Use Inspection Form and has evaluated its IC monitoring plan to determine whether the approach will ensure compliance at sites with land use controls. The Washington Department of Ecology monitors sites with ICs through periodic reviews conducted every five years. The objectives of the record reviews and inspections may include:

- Ensure that the selected ECs are being properly operated and maintained.
- Verify that the actual property use conforms to the applicable land and resource use restrictions.
- Ensure that the footprint of the IC matches the current area of concern.
- Verify that affirmative obligations are being implemented.
- Determine if there are any past or current noncompliance issues and if so, ensure that appropriate actions are taken to address them.

The type, scope, and frequency of IC inspections and reviews may vary based on the regulatory program under which a site is regulated. In addition, site specific information also influences the frequency of IC inspections and reviews. For example, for small sites consisting of fenced and posted vacant land with restrictions limiting construction on the property, inspections may consist of a drive-by windshield observation. For more complex IC sites where multiple ICs and ECs may be included, a more detailed inspection may be necessary. As with the record review, the frequency of the site inspections also could vary depending on the available resources and an assessment of the potential for a breach or failure of the EC/IC and the harm that might occur as a result of that failure.

Effective state oversight of IC compliance requires access to current information on multiple IC requirements, which are often established by different entities. Figure 4-1 illustrates a registry website view of a site that has multiple land and activity use restrictions.

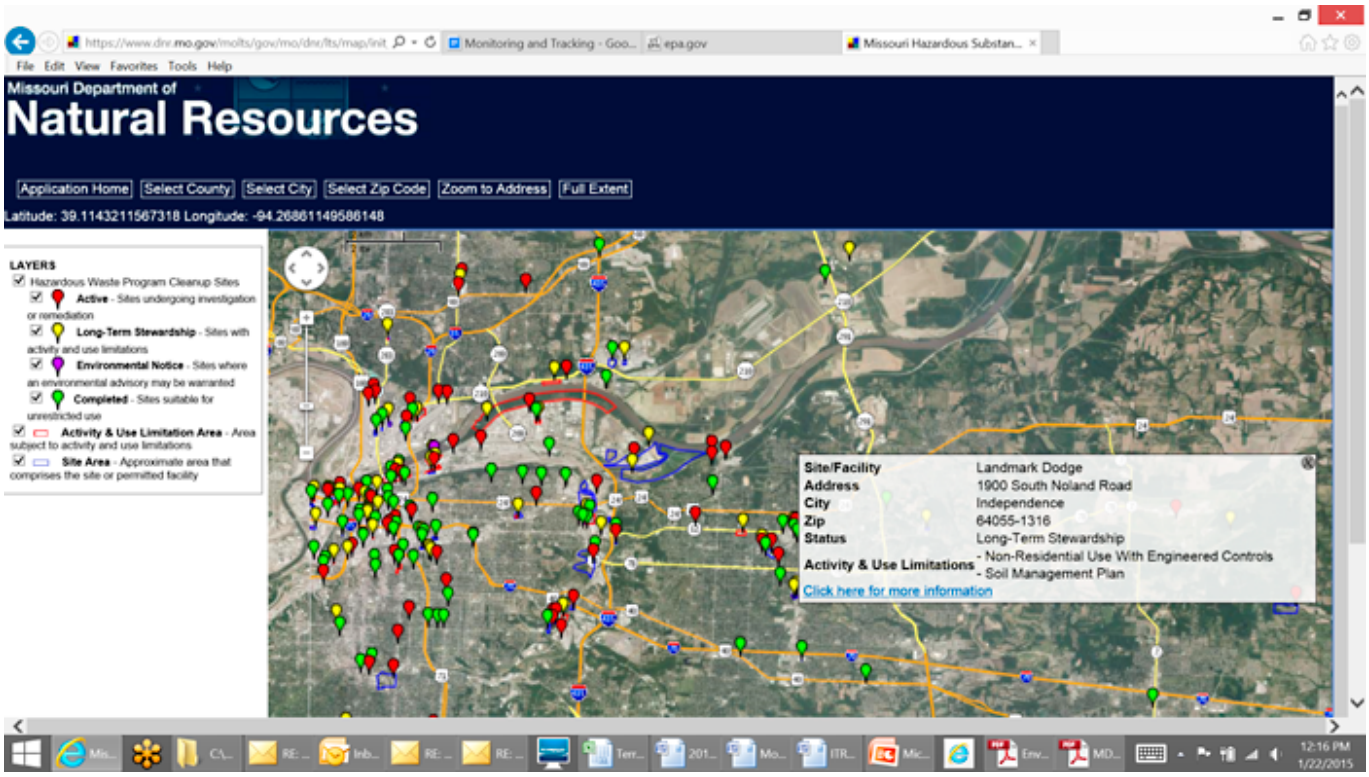

Figure 4. Illustration of multiple land and activity use restrictions in Missouri.
Source: Missouri Department of Natural Resources.

The ICs for the property in Figure 4-1 are provided in a "Declaration of Restricted Access and Grant of Access" and include the following use restrictions and obligations:

- No residential land use is permitted, with 120-day advance notice and possible response actions to change land use.
- No soil disturbance is permitted in a specific area of the property where a cap is located without written permission from the enforcing agency (with 30-day advance notice).
- Cap inspections, damage repair, and notification of requested modifications to the cap are required.

Effective oversight of sites requires current information on land use (local government), evaluation of excavation or other permit applications (local government), and inspection reports (obligated party).

IC Permit Programs

Of the states responding to the survey question regarding IC permits, 16% reported using permits as a vehicle for monitoring ECs and ICs (Question 16). These responses describe approaches that rely on the review of local land use permits and rely on environmental permits that address ICs (such as RCRA permits), as well as approaches that use a state-issued permit specifically for ICs.

New Jersey has established a state-issued permit program specifically for ICs. New Jersey's Site Remediation and Reform Act of 2009 established IC permits, formally known as Remedial Action Permits, as the mechanism for sites implementing ECs and ICs when contamination remains in soil or groundwater in excess of the residential soil remediation standard. New Jersey issues periodic permit invoices resulting in direct state contact with the responsible entities, rather than relying on their submission of periodic reports and certifications. Nonpayment of permit fees might indicate a problem, such as the sale of a property, and would result in follow-up actions by the state.

New Jersey adopted this approach in 2009. The state replaced or otherwise augmented the previous system of attaching ongoing requirements to the issuance of a conditional No Further Action letter. Overall, New Jersey has experienced improvement in compliance through use of these permits. A planned electronic permit application submission and generation process will result in shorter permit turnaround times and decreased transaction costs.

Land Disturbance Monitoring via One-Call Systems

Land disturbance monitoring via one-call systems (ITRC BRNFLD-3, 2008 Section 4.4) is reported by 22% of the states (Question 16). One-call systems in these states collect details of all planned excavations and, in ten states, send excavation notices to all entities that own or operate underground hazards (such as underground pipes or electrical lines). These owners and operators then notify the excavator of any hazards so the excavation can proceed with proper precautions. By interfacing with one-call systems, state environmental agencies can similarly be alerted to planned excavations at or near IC or EC areas. One-call excavation notices may come directly to a state agency or, more commonly, be first received, processed and forwarded to the state by a third party intermediary service. USEPA has favorably evaluated the viability of including sites with ICs into state one-call systems, and USEPA guidance documents frequently cite the one-call approach as a means for IC monitoring and management. (see Table 3 listing USEPA guidance).

California, Delaware, Idaho and West Virginia have implemented, and Maryland is piloting, IC monitoring programs that incorporate one-call system information through a third-party service; other states are considering adopting similar programs (personal communication, Michael Sowinski). An outside contractor monitors one-call system information via third party services. (personal communications Michael Sowinski). A third party monitors and filters one-call system information to identify and report excavation activity that may violate ICs. The third party service can provide notification by e-mail alerts, fax, or other means to the state, a site excavator, or both when an excavation activity is planned for a site with environmental contamination. Based on site-specific circumstances, the state agency may prohibit the planned activity, impose conditions on the planned activity, or may impose additional requirements such as modification of ICs or ECs, use of additional safety procedures, or submittal of a follow-up report.

States use a variety of monitoring practices.

Read More

California

- *Monitoring via Coordination with Local Governments*
- *Obligated Party Inspections and Certifications*
- *Periodic Record Reviews and Inspections by State Agency*
- *Land Disturbance Monitoring via One Call Systems*
- *Land Use and Activity Monitoring*

New Jersey

- *Monitoring via Coordination with Local Governments*
- *Obligated Party Inspections and Certifications*
- *Periodic Record Reviews and Inspections by State Agencies*
- *IC Permit Programs*
- *Land Disturbance Monitoring via One Call Systems*
- *New York*
- *Obligated Party Inspections and Certifications*
- *Periodic Record Reviews and Inspections by State Agencies*
- *Land Disturbance Monitoring via One Call Systems*

Department of the Navy

- *Obligated Party Inspections and Certifications*
- *Periodic Record Reviews and Inspections by Responsible Agencies*

See Case Studies for monitoring details.

Land Use and Activity Monitoring

Twenty-four percent of the states reported that they use land use and activity monitoring (Question 16). Land use and activity monitoring involves the monitoring of site/property activities and usage, such as excavation, construction, sensitive uses (for example, day care), water well construction, building permit or land development applications, environmental releases (reported to government agencies), real estate sales/ownership changes, and similar activity to help learn whether land activity at and around IC sites conflicts with IC restrictions. This powerful approach provides an ongoing and frequent view of IC compliance. Ordinarily, land activity monitoring relies on remote monitoring procedures (meaning the review of electronically-available or otherwise accessible information), which are provided by third-party services, to obtain and review land activity against the requirements of the IC. Often when states use this approach, multiple information sources capture a land use activity that may violate the conditions of an IC. This “layering” or “redundancy” of information on potential IC violations decreases the potential for missing an activity in conflict with an IC.

Improving and Optimizing IC Monitoring Programs

Optimizing IC monitoring means tailoring monitoring approaches to meet the needs of the varying ICs and sites across a state program. The limited resources available to the state can be focused on sites that pose the greatest potential threat to human health and the environment. Therefore, a system to evaluate and prioritize IC sites based on available information helps to ensure that monitoring resources are allocated on a prioritized basis. This system considers the potential for an IC breach in conjunction with the potential harm that would occur in the event of a breach.
▼*Read more*

IC Monitoring Guidance

States can develop (if it does not already exist), maintain, and periodically update formal guidance for IC monitoring. Ideally, this guidance would be included as part of a comprehensive IC policy, or it could exist as a stand-alone document. The complexity of any guidance developed by a state for IC monitoring will reflect the number and diversity of the ICs being managed by that state. States with a “one-size-fits-all” approach to IC monitoring does not accommodate site-specific optimization. A reasonable approach would be to establish a base monitoring program that would be directly applied to low threat sites, while providing for augmentation on a site-specific basis to address higher threat sites. Without this site-specific flexibility, states may find that they are over-using monitoring resources on low threat sites and under-using monitoring resources for high threat sites.

In the following sections, the concept of using a triage approach to optimize IC monitoring is discussed and a simple matrix is presented as an example of how it might be used. The concept is then explored in relationship to the optimization of individual monitoring elements.

Triage as a Tool for IC Monitoring Optimization

States can use a triage approach to optimize available monitoring tools and ensure that monitoring resources are applied to reflect the threat that individual IC sites pose. The threat posed by an IC site consists of two factors: the potential for an IC breach and the potential for harm in the event of a breach. A breach is an IC failure that can result in human exposure or an environmental or ecological impact. Harm is the adverse human health, environmental, or ecological impact that would occur as a result of a breach.

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Evaluating the potential for an IC breach is generally qualitative. The evaluation relies on the experience and knowledge of the evaluator, and considers things such as location, land use and occupancy, development pressure, and the level of knowledge about the IC within the affected community. Evaluation of the potential for harm can be quantitative, semiquantitative, or qualitative. For example, the potential impact to human health under an intrusive worker exposure scenario may be quantitative based on site-specific knowledge of contaminants, concentrations, and the results of a human health risk assessment conducted for the site. On the other hand, the evaluation of ecological impacts may be semiquantitative because of the use of a variety of assumptions and imprecise modeling. Because the potential for harm evaluation relies on risk assessment principles and practices, state risk assessment professionals should be involved in the development of the criteria used for determining the relative harm. Risk assessment professionals should also be involved in the site-specific evaluation of the potential for harm.

The following triage matrix (Figure 5) describes a simple approach for evaluating the threat associated with an IC. The matrix can be used on an IC-specific basis, or can be used to evaluate multiple ICs across a site. The matrix weighs the potential for harm more heavily than the potential for breach. The progression of color, from light green to darker yellow and red, and increasing numerical values in the matrix indicate increasing threat.

IC Monitoring Triage Matrix		Potential for Harm		
		Low (1)	Moderate (3)	High (5)
Potential for Breach	Low (1)	2	4	6
	Moderate (2)	3	5	7
	High (3)	4	6	8

Figure 5. Example IC monitoring triage matrix.

Optimization of Monitoring Elements

The agency or evaluator always seeks opportunities to optimize the IC monitoring program. The four monitoring program elements each have strengths and weaknesses, and each may be optimized based on the triage process or on a more general basis.

Optimization of Monitoring Information from Local Governments

The strength of monitoring activity involving local agencies is their local presence and direct involvement in land use decisions and activity permitting. The weaknesses are two-way communication and information sharing, along with a lack of resources that would allow local agencies to become more involved in IC monitoring efforts. Because of the potential value of local agency involvement in IC monitoring, USEPA and other entities are exploring ways to make information sharing easier. This monitoring element will become more useful as those efforts continue. To optimize this monitoring element in states where it is currently used, enhanced communication and outreach between state regulators and local officials may prove beneficial.

Optimization of Monitoring Information from Obligated Parties

This monitoring element is particularly valuable when the obligated party exercises regular control over the IC location and has established a history of compliance with IC management and reporting requirements. When the obligated party does not exercise daily control over the IC location (such as a property that is leased to a tenant or vacant land far from where the obligated party is located), IC violations can occur without the obligated party's knowledge (see Introduction). Optimization of this monitoring element primarily involves the frequency and content of required reporting. For low threat sites, semiannual reporting using a simple checklist may be sufficient. For higher threat sites, more detailed reporting on an annual basis may be beneficial. In addition to required periodic reporting, short deadline incident reporting should also be included. As needed, periodic reporting frequency can be increased and report content expanded to included greater detail.

Optimization of Periodic Reviews and Inspections by State Agency

The strength of this monitoring element lies in the hands-on involvement of state agency personnel responsible for ensuring compliance with restrictions and reporting requirements and any associated compliance or enforcement actions that become necessary. Optimization of this monitoring element primarily involves the frequency and thoroughness of the review and inspections and continuity of oversight. For example, inspections may be conducted every five years for low threat sites

and annually for higher threat sites.

As conditions associated with a given IC site change, a reevaluation of the frequency and scope of inspections and reviews can ensure that the inspections occur on a basis that is consistent with the threat posed by the IC site. Changes in agency personnel can result in a lack of proper understanding of the IC goals and objectives as well as insufficient or inadequate reviews and inspections.

Optimization of Land Disturbance Monitoring via One-Call Systems

The strength of a one-call system is its ability to detect and report information on land disturbances that could potentially result in a breach of an IC before they occur. This reporting enables states to be proactive in preventing breaches from occurring. This method is particularly valuable for those sites where the potential for harm if a breach were to occur is high. Challenges associated with this monitoring element include funding of the one-call or private third party service and allocation of sufficient staffing resources to ensure timely response to notifications. Therefore, optimization of this monitoring element general involves establishing a process to select IC sites where it will be used. Obligated parties can also contract with private third-party services for monitoring ICs and can often arrange for notification of potential impacts to be sent directly to regulators. Some obligated parties may also subscribe directly with the one-call service.

Optimization of Land Use and Activity Monitoring

Generally, land use and activity monitoring involves contracting with a third-party provider that collects and evaluates electronically-available or otherwise accessible information to identify activities and usage which may be in conflict with ICs. Information is filtered on a geographical basis to identify activities with the potential to violate a specific IC and then reported to the agency. The strength of this monitoring method is both the range of information that can be reviewed and the timeliness with which it is received. The types of information monitored and collected can often be tailored to match specific site/IC needs. Two challenges that states encounter when using this monitoring method are: 1) accounting for costs and cost recovery and 2) internal implementation related to staffing resources and procedures. Optimization of this monitoring element generally involves establishing a process to select IC sites where it will be used, along with land use and activities that will be monitored.

Evaluating IC Performance

A variety of IC monitoring approaches are emerging. Performance evaluation is an assessment of the findings from IC monitoring and not subject to a list of “what should be contained in a performance monitoring evaluation” – rather there are common issues that arise when monitoring data is reviewed. Ultimately, IC monitoring efforts are used as part of a performance evaluation to determine if the ICs are adequately protective and effective, if modifications (including revision of the IC or even reopening of the case) are needed, or if termination of the IC is appropriate. IC performance evaluations may also lead to a conclusion that the IC remains effective, but changes in the monitoring protocol are needed. The key considerations of the performance evaluation include an understanding of the goals and objectives of the IC as related to the environmental concern, the potentially affected parties/receptors or activities, and the potential impacts of failure of the IC. This information could also be considered to develop a programmatic fee structure.
▼*Read more*

Generally, limited resources are available to the state and in some instances, the IC holder or obligated party. An IC management system provides an oversight tool to evaluate sites and available information to ensure that limited resources are prioritized on sites that demonstrate the greatest risk of exposure or harm to human health and the environment (see triage discussion).

The documents that typically contain the goals for site ICs may not be included in the monitoring and inspection reports; however, to ensure adequate evaluation of the ICs, this information needs to be included in the evaluation. The reviewer needs to understand the decision documents, permits, or other pertinent information in order to evaluate the effectiveness of the IC. This information is often not linked directly to the monitoring report and can be difficult to interpret.

Another challenge is the identification of triggers that could require reopening a site that is closed or removed from the monitoring and inspection program. This challenge results from continually evolving regulatory standards, scientific and technological advancements, and rapid urban expansion. These triggers could include an increase of contaminant concentrations, a change of site usage or receptor (such as new drinking water source), updated/revised cleanup standards,

or the availability/practicability of more permanent remedies. These triggers should be identified for each site and the information made available for the reviewer.

In light of these considerations and challenges, the following subsections discuss 1) the need to consider IC goals and site conditions to evaluate overall protectiveness as part of IC monitoring; 2) the possible need to modify ICs based on IC monitoring findings; and 3) whether the current monitoring protocol needs to be revised.

Understanding IC Goals and Objectives

When IC monitoring yields findings, whether through land activity monitoring, site inspections, or another approach, action may need to be taken. Decision maker's review of the details of the site cleanup and the goals of the IC shed light on whether the monitoring findings indicate a risk and whether the protectiveness of the remedy is at risk.

To ensure adequate evaluation of the ICs, information related to the original goals of the IC need to be integrated into the evaluation of monitoring findings. The decision documents, permits, or other pertinent information need to be available to, and be understood by, the reviewer in order to evaluate the effectiveness of the IC. This information is often not linked directly to the monitoring report and it can be difficult to interpret.

Regulations change, clean up levels can be adjusted, or the site conditions may have changed such that the ICs are no longer appropriate or properly tailored to the site. These types of changed conditions can be tracked by state programs so that IC monitoring efforts benefit from this information.

IC monitoring programs substantially depend on good planning. Clearly defined goals of the ICs and remedies improve the evaluation of site conditions in order to determine whether the ICs are providing sufficient protection for human health and the environment. The reviewer can research the decision, work plans, or remedial design documents to fully understand the site history so that IC monitoring can address what is often the ultimate issue— remedy protectiveness. The LTS tool uses this historical information to develop the Long-Term Stewardship Plan (LTSP).

Modification of ICs Based on IC Monitoring Findings

To ensure that an IC accurately depicts the conditions of a site, provisions for modifying the control will ensure the IC remains protective of human health and the environment. At the same time, IC management can facilitate the process using forms, instructions, guidance, and other appropriate assistance. The long-term management of an IC or EC includes procedures and processes to evaluate, approve, and disseminate changes in the IC control document. These procedures include:

- administrative changes (ownership transfers, occupant changes)
- minor modifications, disruptions, or alterations to site conditions which do not require refiling of deed notices, restrictions, or easements
- major modifications/changes in the engineering controls or site conditions/receptors which may result in, or require, the termination or amendment of the deed notice, restriction, or easement with the county or local government

Administrative Changes

Based on monitoring findings, a wide array of general site information changes and data updates can be routinely captured and recorded, such as: contact information (names and addresses), fee billing contacts, site data (for example, current groundwater monitoring data), or local government redesignation of block and lot information. The state agency can establish forms, instructions, and guidance as necessary to facilitate reporting such changes.

The most important, most common, and perhaps most problematic administrative change is the transfer of ownership of the site, as well as the responsibility for the ongoing long-term obligations under the IC. It cannot be assumed that a purchaser has conducted complete due diligence or that the seller has disclosed all property defects or restrictions. Even after due diligence and full disclosure, the new owner may not necessarily assume and perform the ongoing responsibilities. These situations may only become evident later, after a subsequent site inspection or failure to submit required monitoring/site inspection reports. Property transactions are time sensitive and to be acted upon quickly to ensure that the purchaser is aware of the IC and any restrictions or ongoing obligations associated with the IC.

Minor Modifications, Disruptions or Alterations

Utility repairs, engineering control repairs, or building demolition with a concrete slab left in place or in which the

engineering control will be restored to its original condition are examples of minor modifications. These minor modifications do not require changes in the information contained in the applicable deed notice, easement, or deed restriction document or exhibits. The regulating agency should be aware of these minor modifications and may or may not choose to respond.

While some states may require prior approval for these types of disturbances (except for emergencies), the One Call notification system, or similar notification process, typically provides sufficient notification to utility workers and may be configured to provide notification to the regulating agency. At a minimum, disruptions are to be reported and documented.

Major Modifications to the Site Conditions or Engineering Controls

A wide variety of EC/IC modifications may require review and approval by the state, federal, or local government agencies. These modifications include termination or vacating of the existing deed restriction, notice or easement, as well as the refiling of new notices, exhibits, and possibly legal descriptions. Major modifications could include the following:

- *EC/IC Failure*. Failure of the IC due to site or receptor changes or improper modification or damage to the EC may require a major modification of the EC/IC to remain protective. The major modification could consist of increased (more stringent) land use and activity restrictions or additional engineering controls. This failure could also trigger enforcement
- *Additional Remediation Performed*. In most cases, submitting a remedial action work plan precedes the start of remedial action at a site. This submittal may result in the modification or termination of the EC or IC (see below, *Change in Remediation Standard*). Similarly, attenuation of the contaminants to below the remediation standard or cleanup level may result in modification or termination of the EC or IC.
- *Site Rezoning or Reuse*. The local government has a critical role in ensuring the ongoing protectiveness of ICs when considering rezoning applications, issuing building permits, or issuing certificates of occupancy. The applicants are normally required to identify any land use restrictions on the site and identify whether the proposed site use is consistent with those restrictions.
- *Change in Remediation Standards*. In cases where the soil or groundwater remediation standard changes upward and the site now meets the unrestricted use requirements, the responsible party of the EC/IC may ask to terminate the control. A termination of deed notice, restriction, or easement may be filed based on the review and approval of a remedial action report or similar documents explaining the basis for the termination request. The state may then formally close the site, issue a “No Further Action” document, or issue a final site remediation document, with a release of any financial assurance.
- *Stricter Remediation Standard*. A stricter change to a remediation standard may or may not result in additional remedial action or, at a minimum, trigger a formal re-evaluation of the remedial action/IC for the protectiveness of human health and the environment. This review may require remapping the extent of a contaminant plume.
- *Change in Monitoring/Reporting Requirements*. Over the course of monitoring groundwater, a modification of the sampling locations, frequency, or contaminants of concern and reporting frequency may be warranted. This modification can result when site conditions have improved, or more importantly, when conditions are not improving and require additional delineation and evaluation.
- *Construction Projects within Public Easements*. Construction projects within public easements (existing or new/expanded) may modify or otherwise obliterate established ECs and ICs. This situation could arise when any type of construction occurs within public easements (for example, street light replacement, facilities maintenance in parks, new rail lines, or utility repair/relocation).

IC Requirements Not Tailored to Site Risks

Occasionally, a performance evaluation may identify an IC that does not address all threats posed by a site. For example, a deed restriction may be recorded against a property, which limits future use to industrial/commercial activities due to soil contamination being present at concentrations exceeding unrestricted use criteria. However, neither deed restriction, nor any other IC is included for that location which would preclude soil from that site being moved to another location where sensitive uses will occur. This case would result in the performance review identifying the need to modify the deed restriction or institute another IC.

Modifying IC Monitoring Protocol Based on Performance Evaluation

A performance evaluation may indicate a weakness in the monitoring protocol for an IC or site. For example, increased development activity may occur near an IC. This situation could result in adding new land disturbance and activity monitoring to an IC. When IC monitoring must be modified, portions of Section 4.2 may be used in conjunction with other information to assist in the development of a revised monitoring protocol.

Best Practices for IC Monitoring and Performance Evaluations

Currently the methods available to monitor and, in turn, evaluate the performance of ICs vary from state to state. They depend on state-specific environmental statutes and authorities, as well as staffing and funding levels.

The monitoring program draws from the tools available in a given state on a site-specific basis. Sites with a higher potential for IC breach, and sites with a higher potential for harm in the event of a breach can be given the maximum monitoring resources available; while those with lesser risk may use less frequent and intensive monitoring methods; see Figure 5 and Section 4.2. For example: a small retail petroleum station with an insignificant amount of residual heavy petroleum hydrocarbons remaining beneath an impermeable structure might be appropriate for infrequent site inspections conducted by the regulatory agency in conjunction with simple reporting by the obligated party. A site with ECs to contain PCB contaminated soils or contaminated groundwater might require a higher frequency and intensity of monitoring.
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Redundancy in monitoring may be appropriate when the potential for harm in the event of a breach is significant. Inspection by regulatory agencies may be combined with inspection by an obligated party at a site where the obligated party has a regular presence and is capable of observing potential breaches as they occur. If a site is vacant and has a high risk of breach and/or high potential for harm in the event of a breach, it may be appropriate for third party or real-time monitoring through a one-call system if that monitoring element is available.

Moving forward, states may improve their monitoring programs by implementing the following actions as resources allow:

- Provide guidance that addresses how the state will pursue IC monitoring. The complexity of that guidance reflects the nature of the IC inventory in a given state.
- Incorporate a triage approach guidance that allows the available monitoring tools to be used as efficiently and effectively as possible.
- Assess the value of, and where feasible, pursue the means to incorporate each of the monitoring approaches discussed in this section into their monitoring program for use statewide, for certain categories of “triaged” sites, or on a site-specific basis.
- Support and pursue the standardization of how IC information is formatted, managed, and shared.
- Assure that clearly documented IC goals exist for each IC and the evaluator understands these goals. Without this information, it is impossible to gauge the success of the IC over the long term and determine if changes are necessary.

While not specifically discussed as a monitoring program element in this section, a benefit is derived from stakeholder knowledge and awareness of efforts to ensure that ICs remain viable and protective. Distributing and generally making information about ICs available in a clear, concise, and easily accessible format will help keep a diverse group of stakeholders aware of the presence and purpose of ICs. Any information shared with stakeholders should provide contact information that will connect them directly with regulatory staff who can address any concerns that they might have.