UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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OFFICE OF
ENFORCEMENT AND
COMPLIANCE ASSURANCE

MEMORANDUM

SUBJECT: Advanced Monitoring Technologies and Approaches to Support Long-Term Stewardship

FROM: Cynthia L. Mackey, Director
Office of Site Remediation Enforcement

TO: Superfund National Program Managers, Regions 1-10
RCRA Division Directors, Regions 1-10
Regional Counsels, Regions 1-10

I. Introduction

This memorandum provides information about the potential uses of specific advanced monitoring technologies and approaches for monitoring and maintaining institutional controls (ICs) and engineering controls (ECs), which are aspects of long-term stewardship (LTS), at sites and facilities addressed under federal and state cleanup authorities.[1] Such monitoring and maintenance of ICs and ECs through the use of these advanced monitoring technologies may help EPA and other stakeholders sustain the appropriate implementation of such controls. This, in turn, will help foster the goal of ensuring that cleanups remain protective, thereby supporting the safe and productive reuse of properties.

There exist several different technologies and approaches (such as one-call monitoring systems, mapping, and internet-based monitoring) that can facilitate more efficient and timely monitoring and maintenance of ICs, ECs, and other LTS activities. Until now, EPA has briefly introduced some of these technologies and approaches in earlier guidance.[2] This memorandum is intended to provide more

[1] The information contained in this memorandum pertains to sites and facilities addressed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Resource Conservation and Recovery Act (RCRA), and other federal and state cleanup programs and authorities. Though the information and examples provided in this memorandum are CERCLA- and RCRA-specific, and the memorandum relies heavily in many areas on CERCLA-specific terminology, this memorandum is intended to provide guidance for all EPA cleanup programs, including brownfields, federal facilities, and underground storage tanks.

[2] *See, e.g.*, *Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites* 28, 31 ("PIME Guidance") (OSWER/OECA Dec. 2012) (providing that state one-call systems may be an effective way to help ensure that certain activities do not conflict with land and/or resource restrictions during the life cycle of the IC, and that mapping and Internet-based remote monitoring of land activities can be contracted out by the responsible party), available at https://www.epa.gov/fedfac/institutional-controls-guide-planning-implementing-maintaining-and-enforcing-institutional; *Institutional Controls: A Guide to Preparing Institutional Control Implementation and Assurance Plans at Contaminated Sites* 10, OSWER Dir. 9200.0-77 (OSWER/OECA Dec. 2012) ("ICIAP Guidance")

details about these and other technologies, as well as specific illustrative examples where Regions, states, responsible parties, or third parties have used them at sites and facilities. Generally, except for geographic information system (GIS) mapping tools, the development of the advanced monitoring technologies and approaches described in this memorandum have been developed by states or third-party companies that provide monitoring services or products. Many of EPA's Regional offices have developed GIS mapping technologies and approaches, as discussed below.

The U.S. Environmental Protection Agency (EPA) has described ICs as "non-engineered instruments, such as administrative and legal controls, that help to minimize the potential for exposure to contamination and/or protect the integrity of a response action," and are "designed to work by limiting land and/or resource use or by providing information that helps modify or guide human behavior at a site."[3] Conversely, "[p]hysical or 'engineered' controls are the engineered physical barriers or structures designed to monitor and prevent or limit exposure to the contamination" (e.g., landfill soil caps, impermeable liners, underground slurry walls, other containment covers, and fences).[4]

EPA describes LTS as "generally includ[ing] the establishment and maintenance of physical and legal controls, implementation entities, authorities, accountability mechanisms, information and data management systems, and resources that are necessary to ensure that these sites remain protective of human health and the environment."[5] Thus, LTS includes ICs and ECs, but also operation and maintenance (O&M) of ECs, monitoring of ICs and ECs, and repairs of ECs. Institutional controls, ECs, and related LTS activities play a vital role at cleanups because they help to ensure that whatever residual waste or contamination is left in place stays contained, they minimize or prevent human and environmental exposure for current and future users of the property, and they help maintain the integrity of the remedy or corrective measure.

EPA believes that "[o]ften the most useful post-implementation approach to ensuring the long-term effectiveness of ICs and maintaining the integrity of the cleanup is rigorous periodic monitoring and reporting."[6] Periodic reviews of the site and the physical documents related to ICs, five-year reviews, and coordination with state, tribal, and local governments include some of the monitoring and maintenance actions taken to ensure the effectiveness of these controls.[7] EPA has explained that typically, "the responsible parties, including federal facilities, have the primary obligation to monitor and report on the effectiveness of the ICs," but the Region, state, or tribe may play a role, as well.[8] Bona fide prospective purchasers[9] or other entities interested in the reuse of a site or facility can also play a role in the implementation, maintenance, and monitoring of effective controls and LTS. Where a

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(stating that a third party service provider may assist in IC monitoring at a site), available at http://semspub.epa.gov/src/document/HQ/175449; *Ensuring Effective and Reliable Institutional Controls at RCRA Facilities* 5 (OSW/OSRE Jun. 14, 2007) (providing the example of using one-call systems to provide a monitoring and safety mechanism over ICs that may be in place), available at https://www.epa.gov/hw/guidance-long-term-care-corrective-action-sites.

[3] PIME Guidance, *supra* note 2, at 2. A good discussion of EPA's current guidance on ICs, including proprietary controls, can be found in the PIME Guidance. Please refer to the PIME Guidance for additional information on ICs, how they are defined and how they fit within the cleanup process. This memorandum does not modify or supersede the PIME Guidance.

[4] *Long-Term Stewardship: Ensuring Environmental Site Cleanups Remain Protective Over Time* 6 (OSWER Sept. 2005).

[5] *Id*.

[6] PIME Guidance, *supra* note 2, at 28; *see also Ensuring Effective and Reliable Institutional Controls at RCRA Facilities*, *supra* note 2, at 6.

[7] *See* PIME Guidance, *supra* note 2, at 28-30.

[8] *Id*. at 28.

[9] Bona fide prospective purchasers are defined in CERCLA section 101(40), 42 U.S.C. § 9601(40).

responsible party carries out these monitoring and maintenance activities under an agreement or other enforcement-related document, there is an opportunity for the responsible party to implement or adopt some of the advanced monitoring technologies or approaches discussed in this memorandum.

The technologies and approaches discussed in this memorandum are not meant to replace existing monitoring or review requirements prescribed by statute or regulation,[10] or other monitoring practices currently in use. Each situation is different and use of these technologies and approaches may not be appropriate at every site or facility. Interested readers should review other EPA guidance, such as the *Planning, Implementing, Maintaining, and Enforcing (PIME) Institutional Controls at Contaminated Sites* guidance,[11] for more information on how to implement ICs and ECs.

Regions are expected to follow the appropriate EPA guidance, and the approaches described in this memorandum should be considered together with relevant, existing EPA guidance. Moreover, the Regions should work with their state, local, and/or tribal counterparts as appropriate.

II. Advanced Monitoring Technologies and Approaches

Advanced monitoring, as applied in the LTS context,[12] refers to a broad range of analytic systems, techniques, technologies, and approaches for better detecting potential land uses or activities that are inconsistent with the cleanup, that conflict with an IC, and/or that may impede the effectiveness of an EC. With respect to ICs, ECs, and LTS activities, advanced monitoring technologies and approaches, generally, are those that are not yet in widespread use, monitor LTS activities on a real-time or near real-time basis, and/or are existing technologies or approaches used in new ways to provide better information on the LTS activities at the site or facility.

The advanced monitoring tools and approaches discussed below may improve the effectiveness of ICs and ECs, facilitate the monitoring and maintenance of ICs and ECs, and expand the transparency of LTS at the site or facility by making information about ICs and ECs more accessible to the public. As a result, these advanced monitoring tools may also support the reuse and revitalization of contaminated sites and facilities by helping communicate important information to those parties interested or involved in the reuse of the property. Furthermore, where recorded notices of contamination (or deed notices) are selected as part of the remedy and used to provide information to parties interested in a contaminated property, layering such notices with these advanced monitoring tools may help achieve the remedy's intended result.[13]

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[10] For example, CERCLA § 121(1) and 40 C.F.R. § 300.430(f)(4)(iii) require five-year reviews whenever a remedial action results in hazardous substances, pollutants, or contaminants remaining on site.

[11] PIME Guidance, *supra* note 2.

[12] Advanced monitoring can be applied in other environmental regulatory programs. In those situations, advanced monitoring refers to sampling and analytic equipment, systems, techniques, and technologies for better detecting and measuring pollution. This memorandum is illustrating how advanced monitoring is and can be applied to the LTS aspects of EPA's various cleanup programs.

[13] Recorded notices of contamination are contained in deeds conveying real property or an interest therein, or some other written instrument that would be examined during a title search on a particular parcel or parcels. These documents are intended to provide notice to anyone reviewing the chain of title (e.g., lenders, prospective purchasers) about contamination on the property and can help identify potential land and/or resource uses that could result in unacceptable exposures to contamination. Notices of this type generally do not serve as an enforceable instrument that imposes restrictions on the use of properties. Regions should note that if the decision document selecting the remedy requires a different, specific IC (such as a restrictive covenant), then the decision document may need to be modified or amended as appropriate.

The technologies and approaches discussed in this memorandum are: (1) land activity monitoring; (2) one-call excavation monitoring; (3) land use and building permit monitoring; (4) geographic information system mapping and database approaches; (5) vapor intrusion system remote monitoring; and (6) change detection monitoring. Sections II.A. through II.F. of this memorandum describe each of the six advanced monitoring technologies or approaches. Section II.G. discusses institutional control implementation and assurance plans (ICIAPs) and how ICIAPs can be used to identify and implement advanced monitoring technologies or approaches at a site or facility. The appendices that follow provide specific examples of these technologies and approaches that have been implemented by some Regions, states, responsible parties, or third parties at sites and facilities.[14]

A. Land Activity Monitoring

Land activity monitoring is an advanced monitoring technology that gathers and reviews, through a remote Web-based computer program, a wide set of data and information about activities occurring at IC- or EC-impacted properties and compares the activities to the requirements or restrictions of the ICs, ECs, or other mechanisms. The types of land activities that can be monitored under this approach may include, but are not limited to: real estate activities (e.g., sales and sale listings, foreclosures, transfers, changes in tenancy); issuance of building permits, excavation permits, and land development permits; sensitive land uses (e.g., schools, child care, nursing homes, hospitals); water well permits and/or completion reports of water wells; and reported environmental releases.

Generally, depending on the Web-based program used, the first step is to map the relevant boundaries to be monitored: for instance, boundaries of the specific IC, EC, and/or site or facility. The program then uses defined appropriate land activity criteria that are developed by the regulator (i.e., EPA, state, tribe, or local government) and implements procedures established by the regulator for comparing detected land activities (e.g., issuance of a water well permit) against prohibited activities (e.g., an IC prohibits the pumping or use of groundwater within the site). The program reviews the various land activity criteria on a predetermined time frame (e.g., once a week, once a month, once a quarter, depending on the land activity monitored). Depending on the monitoring program used, the Region, states, tribes, and/or responsible party would have access to the Web-based program through the third-party intermediary retained to operate the land activity monitoring program. In some programs, there is a dashboard that both the third-party and the appropriate stakeholder have access to. Thus, the Region, state, tribe, or responsible party can remotely review reports and alerts that are generated by the program.

If a prohibited use is detected, the program sends an alert to the responsible party and/or the regulator for appropriate follow-up action to maintain the integrity of the control and prevent a release of hazardous substances left in place. Depending on any previous agreements or enforcement-related documents, such as an ICIAP, the responsible party or regulator would take appropriate action.

For specific case examples, see Appendix A.

[14] Any mention of trade names, manufacturers or products in this document and its appendices does not constitute an endorsement by the United States Government or the U.S. Environmental Protection Agency. EPA and its employees do not endorse any commercial products, services, or entities.

B. One-Call Excavation Monitoring

One-call excavation monitoring, also known as the "call-before-you-dig approach," is similar to land activity monitoring. It is a monitoring approach that collects and screens excavation activities, including various forms of drilling, at or near the site or facility. Through this approach, notices of excavation activities are screened for whether those activities might conflict with a particular IC, EC, or other LTS feature of the remedy or corrective measure. Unlike land activity monitoring, however, one-call monitoring is typically limited to excavation activities. Although not entirely novel given that it has been encouraged and used for many years at sites and facilities around the country,[15] one-call monitoring is a useful tool for maintaining the integrity of ICs and ECs, and there are now third-party intermediary technologies that can facilitate the monitoring process.

Under the general one-call excavation monitoring approach, which states have used for many years for underground utilities (and more recently for environmental contamination), persons performing excavation are required to contact the one call center before a planned excavation. Persons owning or managing underground hazards (utilities or environmental contamination) join the state one call centers and provide the centers with locational, geospatial, or geographic information for the areas that need to be protected from excavation damage. When the one-call center receives notice from the excavator, they route the resulting "excavation ticket" to those who own, operate, or manage the underground hazards who, in turn, send back "all clear" messages or marks the underground hazard in the field so the excavator does not hit or damage the underground hazard.

The same approach is used for sites and facilities with underground contamination or remedies built in place. The IC, EC, or site boundary is identified to the one-call center using a GIS map and/or a Web-based application that allows for drawing or defining the boundary to be monitored. The one-call centers use software to accept calls and/or Web-based forms and online maps that describe the nature, location, and timing of the planned excavation. This software technology compares the location of the planned excavation against the location of the applicable boundary (IC, EC, and/or site). Then the technology identifies the parties who own or manage the site or facility and transmits an electronic excavation ticket (generally via e-mail or other electronic means) to a specified recipient or point of contact.

Specific to sites or facilities with residual environmental contamination, however, is the added availability of third party intermediary technology. These technologies accept electronic excavation notices disseminated from one-call center software, read the excavation details and location information, and compare them to the location and nature of the IC, EC, or site or facility boundary. This intermediary technology then generates, delivers, and records as historical records electronic advisories that alert stakeholders (Region, state, tribe, responsible party) as to the nature of environmental risks in relation to planned excavations. States (such as Idaho, West Virginia, and Delaware) and responsible parties have contracted with third-party intermediaries, which use technologies to perform a secondary screening process tailored to ICs, ECs, and LTS, to perform this monitoring approach at sites and facilities.

For specific examples, see Appendix B.

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[15] *See* PIME Guidance, *supra* note 2, at 26 (discussing the potential use of one-call systems); *Recommended Evaluation of Institutional Controls: Supplement to the "Five-Year Review Guidance"* 4, 25 (OSWER Dir. 9355.7-18 Sep. 13, 2011), available at https://www.epa.gov/superfund/writing-five-year-reviews-superfund-sites.

C. Land Use and Building Permit Monitoring

Land use and building permit monitoring through coordination with state, local, or tribal governments is another advanced monitoring approach for LTS activities. This approach uses GIS (or other mapping technologies) together with the state, local, or tribal local government permitting processes to identify land use activities that may conflict with ICs, ECs, or other LTS activities. Generally, through this approach, the agency overseeing the cleanup or the responsible party creates a GIS file to flag the property or parcel at which LTS obligations exist, and then shares this file with the state, local, or tribal government entity responsible for reviewing and issuing the relevant permit. State, local, or tribal governments can issue permits for a variety of land or resource use activities such as building, excavation, groundwater use, and drinking water well construction. Through the normal permit review process, the state, local, or tribal permitting agency performs the initial screen of permit applications against the flagged properties to identify activities that could conflict with the LTS obligations. The state, local, or tribal permitting agency then notifies the permit applicant about the flag and any additional information, and/or notifies the stakeholder (Region, state, tribe, or responsible party) about the permit application. The stakeholder is responsible for determining whether the permitted activity conflicts with the LTS obligations and, if so, taking appropriate follow-up action.

The entity that partners with the state, local, or tribal government for this approach can be the Region, another state agency, tribe, or even the responsible party. Furthermore, this approach can be used at multiple sites with LTS obligations, or at one site with multiple parcels of property that have LTS obligations.

For specific examples, see Appendix C.

D. Geographic Information Systems Mapping and Database Approaches

Using GIS mapping and similar databases is another approach to monitoring ICs, ECs, and other LTS activities at sites and facilities. Some Regions and many states are already using GIS mapping technology to map IC, site or facility boundaries, and are making this information publicly available. For example, Region 1 recently launched a pilot project to map IC and site boundaries at Superfund sites and RCRA corrective action facilities within the Region. The project consists of three main pieces: (1) polygon mapping of site and IC boundaries through EPA's *Cleanups In My Community* map;[16] (2) linking the maps to the site or facility information Web page that includes information about the ICs, as well as the instruments implementing the ICs; and (3) improving ICs Web page. Similarly, Region 3's RCRA corrective action program uses GIS files for Web-based mapping of the geographic extents of ICs and ECs, and provides links to the supporting documents describing the controls. The maps and supporting information, as well as monitoring reports completed by the Region, are provided to the public on each of the Region's facility Web pages.[17] In addition, Region 7 has created a Corrective Action Long-Term Stewardship Database that acts as a one-stop management tool to help ensure remedy effectiveness. This database includes a control area mapping tool, an automated "tickler" notification tool, customizable dashboard reports for managing the ICs and ECs workload universe, a source tool for LTS assessment guidance and checklists, and an internal user interface for

[16] U.S. EPA, Cleanups in My Community Web page, available at https://www.epa.gov/cleanups/cleanups-my-community.
[17] *Region 3 RCRA Corrective Action Long-Term Stewardship Approach* (EPA Region 3 June 2015) and *Mapping of Institutional and Engineering Controls in RCRA Corrective Action* (EPA Region 3, Land and Chemicals Division, Jan. 23, 2017) are available from the Corrective Action Resources Specific to EPA's Region 3 Web page at https://19january2017snapshot.epa.gov/hwcorrectiveactionsites/corrective-action-resources-specific-epas-region-3_.html.

secure access to control and authority mechanism documents, mapping, and facility information both in the office and the field. In particular, Region 7's LTS mapping initiative will provide other Regions, states, tribes, and the public with high quality geospatial data that describe the restrictions placed on a facility and a visual of where they are applicable.

GIS enables people to more easily see, analyze, and understand patterns and relationships through capturing, storing, checking, and displaying data related to positions on Earth's surface. In an ICs context, GIS can bridge the information gap between EPA and the public by increasing awareness and understanding of ICs in their community. Because the design and details of GIS mapping programs and databases vary by state, Regions and other stakeholders should conduct meaningful research into each state's program. Generally, making site and associated mapping information publicly available helps increase transparency of cleanups. GIS mapping information, made publicly available and easy to use, can be one of the most effective monitoring tools because they promote awareness of ICs and ECs, as well as the risks associated with a breach of these controls.

EPA's Office of Land and Emergency Management is currently developing guidance on the collection and documentation of general descriptive geospatial site data.[18]

For specific examples, see Appendix D.

E. Vapor Intrusion System Remote Monitoring

Vapor intrusion (VI) system remote computer monitoring automatically detects whether VI mitigation systems, such as sub-slab depressurization systems, remain operational according to their intended design.[19] For instance, at appropriate intervals, these remote monitoring systems can detect if the VI mitigation system loses power, if the vacuum pressure or temperature of the VI mitigation system changes beyond what is intended, or if the VI mitigation system otherwise fails. In the event of one of these unintended operation failures, the remote monitoring system automatically transmits an alert to the stakeholder for the appropriate response.

For specific examples, see Appendix E.

F. Change Detection Monitoring

Change detection monitoring is an advanced monitoring technique that periodically compares high resolution aerial photography, obtained through satellite technology, to detect any land use activities or changes (such as new buildings, new tenants, or excavations) that may conflict with ICs, ECs and other LTS activities.[20] Although on-site inspections could detect many of these changes, change detection monitoring may be more efficient and may be particularly useful at especially large sites, remote sites, and/or sites with hard to access areas.

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[18] For more information about the collection, documentation, and use of general descriptive geospatial site data, contact EPA's Office of Superfund Remediation and Technology Innovation, Information Management Branch. (*See* "About OLEM" office page on Agency website at https://www.epa.gov/aboutepa/about-office-land-and-emergency-management.)

[19] Discussing vapor intrusion system remote monitoring in this document does not exclude the possibility that other remedy systems, such as pump and treat, might benefit from some monitoring technology or approach. Rather, this is one system, with specific case examples, that has incorporated monitoring technologies.

[20] For purposes of this memorandum, change detection monitoring is not intended to refer to or include the use of drones or unmanned aerial vehicles.

Generally, there are two main components, though not necessarily interdependent, to change detection monitoring. The first component is the collection of high resolution aerial photographs. This imagery is commercially available, but the quality and imagery vary. High resolution aerial photography is typically best for detecting changes related to LTS activities at a site or facility. In addition to resolution, the locational accuracy, specifically the precision in placing objects near other locational features such as property boundary lines, is also relevant.

The second component of change detection monitoring is the analysis of the high-resolution aerial photographs. This analysis involves comparing the images over a set period to detect any changes to the property that could affect the LTS of the site or facility. In some cases, automated-based review of the high-resolution aerial photographs may be needed to detect less obvious changes.

For specific examples, see Appendix F.

G. Use of Institutional Control Implementation and Assurance Plans

In several of the examples provided in the appendices to this memorandum, ICIAPs[21] were employed to identify the use of the particular advanced monitoring technology or approach. In some instances, the ICIAP further detailed how the technology or approach would be implemented and maintained at the site or facility, and which party or stakeholder would implement and maintain the technology or approach.

In 2012, EPA issued a guidance to the Regions for developing ICIAPs at contaminated sites where the remedy or corrective measure included ICs. The ICIAP guidance explains the scope of an ICIAP and discusses the recommended components of an ICIAP. Furthermore, when incorporated as a requirement in, for example, a consent decree, administrative order on consent, or federal facility agreement, an ICIAP becomes an enforceable and binding document.[22]

An ICIAP may serve as a helpful tool to establish and document the advanced monitoring technologies or approaches at a site or facility, and specify who will be responsible for carrying out the monitoring activities. For monitoring technologies that require responding to alerts or land use conflicts, an ICIAP can provide an opportunity to identify parties' responsibilities for response and follow-up to site alerts. ICIAPs may also detail the procedures for recordkeeping, data management, and reporting of IC information, including the roles and responsibilities for developing monitoring reports and related plans. For instance, an ICIAP may note the requirement that the PRP or other party develop and maintain a data management plan.[23] Furthermore, PRPs and other parties are encouraged to share information with EPA upon request.

EPA recommends that such information provided to EPA, except for GIS data, conform with the Agency's data standards.[24] For GIS data, EPA recommends PRPs and other parties of interest provide

[21] ICIAPs are also known as "institutional control work plans," "institutional controls monitoring and enforcement work plans," "institutional control plans," and other similar titles. These all refer to the same kind of document.
[22] ICIAP Guidance, *supra* note 2.
[23] *See id*. at 10. In cases where ICIAPs are not used to identify advanced monitoring technologies and approaches, data management plans may still need to be developed and parties made aware of their responsibilities through appropriate documentation.
[24] Data at every step of the process, beginning at initial collection, is considered a Superfund record, as well as part of the overall deliverable. This data should be accessible by the Superfund program for analysis and review throughout the course

such data in an agreed upon format, preferably in advance, that complies with Federal Geographic Data Committee (FGDC) standards. Regions and other interested stakeholders are encouraged to review the ICIAP Guidance for further information about the use of ICIAPs.

III. Conclusion

Institutional controls, ECs, and other LTS activities are commonly used at cleanups, sites and facilities. As more sites and facilities addressed under federal and state cleanup authorities move into the post-construction completion phase, ensuring that ICs or ECs selected as part of the remedy or corrective measure are maintained will remain critical, particularly to support and safeguard the future use of the affected properties. Though limited in application up to this point, the use of advanced monitoring technologies and approaches is growing. As the availability and use of these technologies and approaches grow, the opportunities to employ these tools may help to more efficiently and effectively monitor LTS obligations at sites and facilities.

EPA continues to collect examples of the use of these advanced monitoring technologies and approaches at clean-up sites and facilities. For questions concerning this memorandum or to submit additional case studies, please contact Anthony Austin, (202) 564-6943 or austin.anthony@epa.gov; Craig Boehr, (202) 564-5162 or boehr.craig@epa.gov.

IV. Disclaimer

This memorandum and attached appendices do not substitute for CERCLA or RCRA, or the associated federal regulations,[25] nor is this memorandum a regulation itself. This memorandum does not impose legally binding requirements on EPA, states, tribes, or the regulated community, and may not apply to every situation based upon the circumstances. Further, the information provided in the memorandum and appendices do not modify or supersede existing EPA guidance. The Regions retain the discretion to adopt approaches on a case-by-case basis that differ from this memorandum where appropriate.

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of the project as well as at its completion. The definition of the format, delivery timeline, delivery method, and access requirements as part of a data management plan will help support this effort. To facilitate acceptance of data, data and records should be maintained so it is or can be submitted in compliance with Agency and/or Federal Geographic Data Committee (FGDC) standards. Information about the appropriate standards can be found in the following resources: U.S. EPA, *List of EPA Data Standards* Web page available at https://www.epa.gov/data-standards/list-epa-data-standards#file-150395; U.S. EPA, *EPA National Records Management Program* Web page, available at https://www.epa.gov/records; Federal Geographic Data Committee, *FDGC Geospatial Standards* Web page, available at https://www.fgdc.gov/standards/list.

[25] National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. Part 300; RCRA regulations governing hazardous waste and underground storage tanks are found at 40 C.F.R. Parts 260-273 and Parts 279-282, respectively.

Attachments

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RCRA Corrective Action Branch Chiefs
Superfund Remedial Program Branch Chiefs
Superfund Regional Counsel Branch Chiefs

APPENDIX A
LAND ACTIVITY MONITORING SITE EXAMPLES

Example 1: RACER Trust Sites and Facilities – Regions 3, 5, and 7

Site Background:
The Revitalizing Auto Communities Environmental Response (RACER) Trust was created in 2011 by the General Motors Corporation (GMC) bankruptcy. The Trust originally owned and is responsible for cleaning up 89 sites (RCRA corrective action facilities, Superfund sites, and State cleanup program sites) formerly owned by GMC, and positioning those properties for redevelopment. At its inception, the Trust received approximately $475 million to clean up these properties, and approximately $137 million to facilitate the resale and redevelopment of the properties and to administer the properties and the Trust.[26]

Synopsis of Land Activity Monitoring Activities:
The land activity monitoring technology at the RACER sites was originally launched over two years ago as a one-year pilot program and included five RACER sites.[27] There are now 15 sites, located in EPA Regions 3, 5, and 7, where the Trust has instituted land activity monitoring technologies at varying intervals and for numerous activities, depending on the property.[28] Though the pilot has ended, the Trust is planning to continue using land activity monitoring technology. At sites that are sold and have ICs, ECs, or other remedial features that require long-term monitoring to ensure they remain protective, the Trust seeks to add them in the land activity monitoring program when appropriate.

The following land activities are monitored at one or more of the 15 properties currently subject to land activity monitoring: (1) real estate-related activities (for sale listings monitored weekly, foreclosures monitored weekly, property transfer monitored quarterly, and occupancy monitored monthly); (2) excavation clearance (monitored daily); (3) land development activities (building permits issuance monitored monthly and land development monitored quarterly); (4) water well permits (monitored quarterly); (5) sensitive land use (daycare and school use monitored monthly); and (6) environmental releases (monitored monthly). Property transfers, occupancy, excavation clearance, environmental releases, and land development are the most common land activities monitored, subject to monitoring at 8 or more of the 15 sites.

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[26] *Roadmap for Auto Community Revitalization* 53 (OSWER Sept. 2013), available at https://www.epa.gov/sites/production/files/2015-09/documents/draft-roadmap-toolkit.pdf.

[27] "RACER Trust Hires Terradex to Provide Environmental Monitoring Services," RACER Trust Web page, Mar. 19, 2015, available at http://www.racertrust.org/News/RACER-Trust-Hires-Terradex-to-Provide-Environmental-Monitoring-Services.

[28] The 15 sites/properties are the following: Wilmington Assembly Plant, Wilmington, DE; Delphi I Plant, Anderson, IN; Indianapolis Stamping Plant, Indianapolis, IN; Fairfax Industrial Plant, Kansas City, KS; Parma Powertrain Plant, Parma, OH; Moraine Industrial Plant, Moraine, OH; Grand Rapids Stamping Plant, Wyoming, MI; 6241 Cass Avenue Property, Detroit, MI; PCC Validation Industrial Land, Pontiac, MI; Pontiac Centerpoint Campus (3 separate properties), Pontiac, MI; and Pontiac North Campus (3 separate properties), Pontiac, MI.

Land activity monitoring gathers and reviews, through a remote Web-based computer program provided by a third-party contractor, a wide set of data and information about activities occurring at IC-impacted properties and compares the activities to the requirements or restrictions of the ICs, ECs, or other mechanisms.

Enforcement Document/Instrument Used:
The RACER Trust, which was not obligated to use this technology or, generally, to carry out ICs, ECs, or LTS monitoring is voluntarily implementing this advanced monitoring technology at these 15 sites. However, the Trust's obligations are established, and it performs these activities, in accordance with the provisions of the Environmental Response Trust Consent Decree and Settlement Agreement entered by the U.S. Bankruptcy Court for the Southern District of New York on March 29, 2011, in the case of *In re Motors Liquidation Company*, etc. *et al.*, Debtors, Case No. 09-50026 (REG) (among the Debtors, the United States of America, certain states including Massachusetts, New Jersey, New York, Delaware, Virginia, Pennsylvania, Ohio, Indiana, Illinois, Wisconsin, Missouri, Kansas, Louisiana, and Michigan, the Saint Regis Mohawk Tribe and EPLET, LLC, (not individually but solely in its representative capacity as Administrative Trustee of the Trust)). Some of these 15 sites also may have been subject to pre-existing settlement agreements. For example, in 2007, before the GMC bankruptcy and creation of the Trust, GMC and EPA Region 5 entered into an agreement that pertained to three of the 15 sites: three properties comprising the Pontiac Centerpoint Campus facility.[29] Under the agreement, GMC agreed to ensure that the ICs and ECs selected as part of the corrective action at the facility would be maintained.

Enforcement Document/Instrument Language:
Under the 2007 RCRA 3008(h) administrative order on consent (AOC), referenced as an example above, GMC was required to, among other things, "assure that the institutional and engineering controls selected in the U.S. EPA's Final Decision are continually maintained unless and until U.S. EPA determines that performance standards have been met such that the controls are no longer necessary," and to "take all necessary measures to restrict the use of the Facility in any manner that may interfere with operation and maintenance, monitoring, or other measures necessary to assure the effectiveness and integrity of the remedy to be implemented pursuant to this Order."[30] Although the 3008(h) AOC pertained to GMC and not the Trust, carrying out this land activity monitoring for the Pontiac Centerpoint Campus properties likely satisfies, at least in part, these ICs and ECs maintenance provisions.

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[29] Administrative Order on Consent Under RCRA § 3008(h) In the Matter of General Motors Corporation, Pontiac Centerpoint Campus/Pontiac Assembly Center Former Pontiac Truck Group, Pontiac, Michigan, Docket No.: RCRA-05-2007-0009 (May 24, 2007), available at https://yosemite.epa.gov/OA/RHC/EPAAdmin.nsf/Filings/B6B19D532784348C8525764E00640E33/$File/RCRA-05-2007-0009%20AOC%203008h.pdf; *see also* WDI Superfund Site Profile Web page, available at https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0902140. Letter from Margaret M. Guerriero, Land and Chemical Division Director, EPA Region 5, to David Favero, RACER Trust (Apr. 23, 2015) (approving RACER Trust's request for RCRA Corrective Action Complete with Controls determination at the Pontiac Centerpoint Campus), available at http://www.racertrust.org/Properties/Detail?Id=13080.

[30] Administrative Order on Consent Under RCRA § 3008(h) In the Matter of General Motors Corporation, Pontiac Centerpoint Campus, *supra* note 29, at ¶ 11.

This AOC at the Pontiac Centerpoint Campus sites is just one example. At this moment, it is unknown what, if any, other cleanup agreements or orders exist related to the other 12 sites subject to this land activity monitoring.

Example 2: Waste Disposal Inc. Superfund Site – Los Angeles, CA, Region 9

Site Background:
The Waste Disposal, Inc. (WDI) Superfund site is in Santa Fe Springs, California, on approximately 38 acres of land divided into 22 individual land parcels that are owned by as many as 20 landowners.[31] Parts of the site and adjacent areas support residential, light industrial, and commercial uses, and a high school with athletic fields is located immediately adjacent to the northeast corner of the site. The main feature of the WDI site is a buried 42-million-gallon capacity concrete-lined reservoir initially constructed for crude petroleum storage. The reservoir was decommissioned in the 1920s, but was later used for storage of liquid and solid wastes. Wastes disposed of in the reservoir include petroleum-related chemicals, solvents, sludges, construction debris, drilling muds, and other waste materials. Numerous chemicals of concern have been identified in soil, soil gas, and groundwater, with most of the contamination detected in subsurface soils covered with relatively clean fill.

The site remedy is designed to prevent exposure to contaminated soil, buried wastes, soil gases, and site liquids by containing on-site waste, blocking exposure pathways, and preventing migration of vapors off site or to on-site indoor air. A main component of the remedy is the implementation of ICs which are formalized in Environmental Restriction Covenants (ERCs) that incorporate 31 land use restrictions under 14 consent decrees (CDs) with landowners at the site.

Synopsis of Land Activity Monitoring Activities:
The settling party, the Waste Disposal, Inc. Group (WDIG), performs formal inspections of the entire site on a quarterly basis to ensure the integrity and protectiveness of both ECs and ICs. Inspections address outdoor aspects of the parcels and indoor air monitoring at four parcels. WDIG and its contractors electronically review building permits, land use, construction, financial, and title records on an ongoing basis to monitor potential changes in land use, title, or upcoming construction. WDIG can also conduct file reviews of physical records in Santa Fe Springs and the Los Angeles County Records Offices. WDIG submits an annual Operations, Maintenance & Monitoring (OM&M) Report to EPA on compliance with ICs, the status of ECs, changes in owners and tenants of site properties, and the results of land activity monitoring conducted by WDIG's contractor.

Electronic and digital internet-based searches and record reviews are used to monitor ICs at the WDI site. The digital monitoring, conducted by the third-party intermediary provides notifications of "events," which are potential changes in site status that might indicate unauthorized onsite construction, pending permit changes, or changes in title status. The process filters and reviews events internally and then issues event notifications to WDIG. If needed, WDIG can then take steps to intervene and/or enforce the ICs. WDIG contracts with a third-party contractor that provides real-time notifications and alerts to WDIG and EPA for appropriate and necessary follow-up action to maintain the integrity of the remedy and prevent future releases of hazardous substances left in place.

[31] For additional information on the WDI site, see https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0902140.

Enforcement Document/Instrument Used:
A 2003 CD called for WDIG to develop and regularly update an Institutional Controls Monitoring and Enforcement Work Plan (ICMEWP). The ICMEWP is the guiding document for IC monitoring and enforcement at the site and is a companion document to an OM&M Plan, which the EPA approved in 2006. The ICMEWP is intended to contain IC and ERC monitoring and enforcement provisions to limit human exposure to potentially contaminated materials as well as protect the integrity of the remedial action. The CD requires the WDIG Site Trust to be the covenantee of the ERCs and part of its responsibilities as covenantee include monitoring and enforcing the ERCs, which are enforceable under California law against all future property owners and tenants. The ERCs provide access to EPA and the potentially responsible parties (PRPs) conducting the remedial action, and their contractors. Among other activities, access may be granted to monitor the remedial action and O&M, verify any data or information submitted to EPA or the State, conduct investigations related to contamination at or near the site, and assess compliance with access easements and environmental restrictions. Further, the ERCs include land and water use restrictions to prohibit and restrict certain site activities that may adversely affect the implementation, integrity, or protectiveness or remedial measures. A sample ERC is included as an appendix to the ICMEWP.

APPENDIX B
ONE-CALL EXCAVATION MONITORING SITE EXAMPLES

Idaho, West Virginia, and Delaware Use of One-Call Systems

Site Background:
The Idaho Department of Environmental Quality (IDEQ) currently uses the one-call monitoring approach for almost 100 sites. The West Virginia Department of Environmental Protection (WVDEP) uses the approach for about 170 sites, including sites subject to the state's voluntary remediation program.[32] And the Delaware Department of Natural Resources and Environmental Control (DNREC) uses the one-call approach to monitor over one thousand sites across various programs, including: brownfield sites, sites with environmental covenants under the Uniform Environmental Covenants Act, petroleum-related sites, underground and aboveground storage tank sites, and groundwater management zones.

Synopsis of One-Call Monitoring Activities:
One-call excavation monitoring is an approach that collects and screens excavation activities at or near the site or facility and screens notices of excavation activities for whether those activities might conflict with an IC, EC, or other LTS feature of the cleanup.

These three states rely on one-call monitoring in a similar manner. These state agencies use the one-call monitoring approach specifically to monitor, among other things, sites that contain an environmental covenant, which is a servitude (imposed on the property) arising under an environmental response project that imposes activity and use limitations on the property. Furthermore, all three of these state agencies contract with a third-party intermediary, which plays an important role in this monitoring process.

The first step requires developing or preparing the pertinent boundary data or GIS files that describe the boundaries to be monitored. In both Idaho and West Virginia, the environmental covenants authorized by IDEQ or WVDEP define the boundaries of the property impacted and include restrictions on future land use and activities. In Delaware, the Delaware Environmental Navigator database contains the site information. This boundary data or the GIS files are then provided to the state one-call center, which imports the data or files into its one-call center software, as well as to the agency's third-party intermediary.

During the next major step, when the state one-call center receives an excavation notice from an excavator, the center sends an excavation ticket to the agency and third-party intermediary; the ticket describes the location and nature of the planned excavation. The third-party intermediary evaluates and screens the excavation tickets, comparing the exact location and nature of the planned excavation against the location and nature of the ICs (or ECs) to determine whether the excavation may conflict with the controls in place. If the planned excavation may, in fact, conflict with controls or restrictions in place, the third-party intermediary generates a notice to be sent electronically to the excavator, informing them of the potential environmental conflict of excavation. The notice provides details as to the location of the excavation in relation to the IC-

[32] *See State Brownfields and Voluntary Response Programs: An Update from the States* 38 (OSWER/OBLR 2014), available at https://www.epa.gov/brownfields/state-brownfields-and-voluntary-response-programs-update-states.

impacted area, and, depending on the state, may also direct the excavator to the state environmental agency's website that contains additional information about the site and the IC-related documents.

Finally, in these three state examples, the third-party intermediary sends the notice to the state agency for a third review and to confirm that the notice should go to the excavator. If so, the agency can use the third-party intermediary's software technology to forward the notice on to the excavator.

Enforcement Document/Instrument Used:
It is unknown what, if any, enforcement document is used to require or memorialize the use of one-call monitoring at the sites within these three states. It appears that these states' use of this monitoring approach is part of their own monitoring and maintenance activities such that an enforcement document may not be required.

APPENDIX C
LAND USE AND BUILDING PERMIT MONITORING SITE EXAMPLES

Del Amo Facility Superfund Site – Los Angeles, CA, Region 9

Site Background:
The Del Amo Superfund Site in Los Angeles, California, was a center of large-scale industrial activities from 1943 until 1972.[33] Originally built to produce synthetic rubber during World War II and owned by the United States government, the 280-acre operation led to releases of chemicals into soil and groundwater beneath the manufacturing facility. Plant operators disposed of wastes in a 4-acre area of unlined pits and evaporation ponds, and other releases included leaks from pipelines, storage tanks, and processing units. Shell Chemical Company (Shell), which had owned and operated the facility since 1955, sold the property to a developer in the early 1970s, and the unlined pits and evaporation ponds were covered with soil. Most of the facility has since been redeveloped as a commercial and industrial business park. Light industrial/manufacturing activities, import/export warehouses, and commercial office space currently characterize land use within the business park, and more than 250 businesses employ nearly 6000 workers on site.

The Del Amo site was placed on the NPL in 2002 and was split into three operable units (OUs) to manage cleanup better. The final remedy for the Waste Pits Area OU required that Shell and the U.S. General Services Administration (GSA), the primary responsible parties for Del Amo, secure the waste pits by placing a RCRA-equivalent cap over the sludge and contaminated sediments at the waste pit area, install and operate a soil vapor extraction system beneath the area, and perform routine inspections. EPA placed restrictive covenants on the waste pit area properties to prohibit future residential use and any use that could threaten the integrity of the cap. EPA selected the final remedy for the Site Soils and Nonaqueous Phase Liquid (NAPL) OU in 2011 and updated it in 2013. The remedy includes ICs to minimize potential future exposures to residual contamination, capping of some shallow contaminated soils, soil vapor extraction to remove some soil contamination, building ECs to prevent unacceptable indoor air exposures, chemical oxidation to reduce contamination affecting groundwater, and addressing any areas of contamination exceeding action levels found during future construction. EPA, Shell, and the GSA have established an agreement to implement these remedy components.

Synopsis of Land Use and Building Permit Monitoring Activities:
In 2008, EPA began implementation of an Institutional Controls Pilot Program (Pilot Program) in cooperation with the California Department of Toxic Substances Control (DTSC), the City of Los Angeles Department of Building and Safety (LADBS), and the City of Los Angeles Department of City Planning.[34] The Pilot Program involved an environmental review process before proceeding with any planned construction activities, for specific parcels located within the Del Amo site that had been identified by EPA. The program, set up as part of the site's feasibility study, enabled EPA to interact effectively with the City of Los Angeles and permit applicants, adjust processes as needed, and evaluate whether the notification and environmental review

[33] For more information on the Del Amo site, including a description of the land activity monitoring activities, see *Cleanup, Continued Use and Redevelopment in a Thriving Business Park: The Del Amo Superfund Site in Los Angeles, California*, at https://semspub.epa.gov/src/document/09/1156984.
[34] *See* EPA Fact Sheet, *EPA and City of Los Angeles to Implement Environmental Review Pilot Program at Del Amo Superfund Site* (Apr. 2008).

system could serve as an IC to protect human health and the environment over the long term. The Pilot Program developed a system to create and add notification flags in the City's Zone Information Map Access System (ZIMAS), a detailed online property information database of site parcels where IC restrictions exist. A GIS layer of the Del Amo site's boundaries was added to capture all site properties, and then flags that the public would see for identified parcels on the site were added. Each flag linked to an EPA notification document, which includes general information about the site and instructions to contact the Del Amo Environmental Review Team (ERT), which consists of staff from EPA, DTSC, and Shell. The ERT is responsible for review and assessment of all construction and excavation projects.

The City of Los Angeles notifies building permit applicants if the property at issue is flagged in the ZIMAS database by directing the applicants to call a toll-free number, which is operated by a contractor for the responsible parties. The contractor then uses EPA screening criteria to determine whether the permit application is for either excavation below 18 inches or would result in a change in land use to one deemed a "sensitive use" such as a daycare, school, or hospital. The contractor then interviews the applicant, finds out the details of their project, and as necessary asks them to submit specific excavation details. If there are no issues, the permit applicant is "screened out." If a potential issue exists, the planned activity is evaluated against the site data to determine any IC conflicts. If there are conflicts, the contractor prepares a Screening Evaluation Summary Report (SESR) which describes the nature of the risk posed by the planned activity considering the residual contamination, the nature of the site as a Superfund site, and the requirements that the person performing the work must meet. The SESR is sent to EPA for consultation before sending it to the permit applicant.

The Pilot Program environmental review process was incorporated into the final remedy for the Site Soils and NAPL OU as one of the site's four layers of ICs. These IC layers work to minimize the potential for future exposure to residual contamination and protect the site remedy.[35]

Enforcement Document/Instrument Used:
The roles, responsibilities, and goals of the Pilot Program were initially specified in a 2007 Work Plan Supplement to the RI/FS Administrative Order on Consent. Later, the Statement of Work for the 2016 RD/RA Consent Decree for the Site Soils and NAPL OU clarified that the settling defendant should continue implementing the building permit review process and should include the steps required to implement this IC in an IC Implementation and Assurance Plan (ICIAP). The Statement of Work notes that the ICIAP should include "a description of the permit review IC including the identity of the governmental entity, agency, or department(s) involved in the IC, a copy of the work plan establishing the review process, and a description of and map showing the boundaries of the IC."[36]

[35] The site's ICs also include a one-call monitoring component, where the responsible parties receive notices of excavation from the one-call center/third-party intermediary when excavation activities meet pre-defined alert criteria. This one-call component was included in the site remedy and helps ensure that projects not picked up in the building permit process, such as the digging of irrigation lines, are monitored, tracked, and evaluated by the Del Amo ERT.
[36] *See Statement of Work for the Remedial Design and Remedial Action at Del Amo Superfund Site*, 7, 25.

APPENDIX D
GEOGRAPHIC INFORMATION SYSTEMS (GIS) MAPPING & MONITORING SITE EXAMPLES

Lower Fox River & Green Bay Superfund Site – Green Bay, WI, Region 5

Site Background:
The Lower Fox River begins near Lake Winnebago and flows northeast for 39 miles where it discharges into Green Bay and Lake Michigan. Approximately 270,000 people live in the communities along the river. During the 1950s and 1960s, pulp and paper mills routinely used polychlorinated biphenyls in their operations which ultimately contaminated the river. Efforts to dredge and cap highly contaminated sediment the Lower Fox River have been ongoing and cleanup is projected to be completed shortly. This cleanup has been performed under a settlement agreement EPA and Wisconsin Department of Natural Resources (WDNR) reached with the potentially responsible parties. All references to GIS activities and ICIAPs in this example will be regarding the work associated with OUs 2, 3, 4, and 5 for the Lower Fox River & Green Bay Superfund Site.

As put forth in the ICIAP, the implementation, monitoring, and enforcement of the ICs for OUs 2 to 5 is primarily the responsibility of WDNR. However, Brown County does share responsibility for collecting and maintaining a portion of the GIS mapping data. As further described in the ICIAP, the ICs discussed in the 2007 ROD Amendment for OUs 2 to 5 are as follows: (1) water use restrictions; (2) construction limitations; (3) monitoring and maintenance requirements for certain areas including dams; and (4) providing additional information to the public to assure protectiveness of the remedy. The ICIAP includes the development and maintenance of GIS data related to the site, to be stored on Wisconsin's publicly accessible online GIS database system, the Wisconsin Remediation and Redevelopment Database (WRRD). The WRRD is discussed further in the next section.

Synopsis of GIS Mapping & Monitoring Activities:
In order to increase access to and awareness of information regarding use and activity restrictions at the site, EPA leveraged Wisconsin's existing GIS mapping and database capacities.[37] WDNR's online GIS database system, WRRD, provides publicly available information on different contaminated land activities in the state to assist with the investigation, cleanup and eventual re-use of those lands.[38] The roles, responsibilities, and data collection guidelines were documented in the ICIAP, which insured proper and consistent collection of GIS mapping data.

Enforcement Document/Instrument Used:
Institutional Control Implementation and Assurance Plan (ICIAP), prepared on behalf of three of the PRPs at the Site and finalized in December 2009.

Enforcement Document Language:
The following language was used in the Lower Fox River ICIAP for OUs 2 to 5:
"A comprehensive GIS database will be created and maintained for the entire length of the Lower Fox River from OUs 2 to 5. The Respondents [PRPs] will provide WDNR with GIS compatible databases for all the caps. Since the capping activity in OUs 2 to 5 is confined to Brown County, WDNR and the

[37] In addition to the Lower Fox River Site, two other examples of EPA leveraging Wisconsin's existing GIS platform include the Tomah Armory Landfill Site and the Burnham Canal Superfund Alternative Site. These sites also memorialized GIS data collection and reported responsibilities in an ICIAP.
[38] Wisconsin Department of Natural Resources, Wisconsin Remediation and Redevelopment Database Web page, available at http://dnr.wi.gov/topic/Brownfields/wrrd.html.

Respondents will coordinate with Brown County in the development and maintenance of the database to ensure consistency between Brown County's mapping databases and the WDNR GIS Registry. WDNR and the Respondents will also make the database available to other municipalities such as the Cities of Green Bay and DePere and the Villages of Allouez and Ashwaubenon. In coordination with WDNR, the database will be linked to the existing WDNR BRRTS database [now known as the Wisconsin Remediation and Redevelopment Database], or its equivalent replacement(s). The database will include, at a minimum, the following information: (1) Location of government and utility infrastructure, including underwater lines, bridges, etc.; (2) Location of all public access points; (3) Location of all private access points including marinas and private piers (private pier locations are only applicable in riparian cap areas); (4) Location of all pierhead and bulkhead lines; [and] (5) Location of all caps with links to identify the nature of the cap."[39]

[39] Lower Fox River Remedial Design, Final Design Report: Institutional Control Implementation and Assurance Plan, 14 (Dec. 2009).

APPENDIX E
VAPOR INTRUSION SYSTEM REMOTE MONITORING SITE EXAMPLES

Example 1: RACER Trust Cleanup Site – Indianapolis Stamping Plant, IN, Region 5

Site Background:
The Revitalizing Auto Communities Environmental Response (RACER) Trust was created in 2011 by the General Motors Corporation (GMC) bankruptcy. The Trust originally owned and is responsible for cleaning up 89 sites (RCRA corrective action facilities, Superfund sites, and State cleanup program sites) formerly owned by GMC, and positioning those properties for redevelopment. At its inception, the Trust received approximately $475 million to clean up these properties, and approximately $137 million to facilitate the resale and redevelopment of these properties and to administer the properties and the Trust.[40]

At the Indianapolis Stamping Plant property, the Trust worked with the Indiana Department of Environmental Management (IDEM) to perform cleanup of the 103-acre property. Cleanup included investigations of sub-surface soil and groundwater, including the groundwater in the neighborhood to the south of the site. Investigations indicated the presence of soil and groundwater contaminants (volatile organic compounds, or VOCs) in the western portion of the property that housed the former chemical facility. To date, the soils on the site have been fully investigated and cleaned up to IDEM Industrial Criteria. The investigations also showed that the groundwater beneath the site and a part of the neighborhood contains a VOC called trichloroethylene (TCE). Permanent monitoring wells have been installed in the neighborhood south of the site to allow groundwater monitoring on an ongoing basis. RACER also studied homes to determine if the TCE in the groundwater led to vapor intrusion (VI). The tests showed some homes exceeded IDEM criteria for VI and were retrofitted with mitigation systems to prevent the vapors from entering the homes.[41]

VI System Remote Monitoring Synopsis:
In the three homes that had VI mitigation systems installed, monitoring of the systems were originally carried out by the individual homeowners and through annual inspections conducted by the Trust's consultant. The Trust then implemented monitoring systems that provide remote, hourly verification and documentation that the VI mitigation systems are operating as designed.

VI system remote monitoring detects whether the mitigation systems remain operating according to their design. The monitoring device can be installed directly on the VI mitigation system. The monitoring device detects system changes, including airflow, pressure, temperature, and power. In the event of a system change, the device will transmit an alert via e-mail and/or text message.

Enforcement Document/Instrument Used:
This advanced monitoring technology was voluntarily implemented by the RACER Trust. Accordingly, it was not obligated to use this VI mitigation monitoring system at the site and, thus, there is no enforcement document discussing this technology.

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[40] *Roadmap for Auto Community Revitalization*, *supra* note 26, at 53.
[41] Environmental Fact Sheet for Indianapolis Stamping Plant, available at http://www.racertrust.org/Properties/PropertyDetail/Indy_11910.

Example 2: Massachusetts Regulations for VI Mitigation System Monitoring

Site Background:
The Massachusetts Contingency Plan (MCP, the state regulations establishing requirements and procedures for the cleanup of oil or hazardous materials) requires the use of remote monitoring of active VI mitigation systems when implemented to support a Permanent Solution with Conditions, a Temporary Solution, or Remedy Operation Status.

A Permanent Solution with Conditions is defined as "a measure or combination of measures which will, when implemented, ensure attainment of a level of control of each identified substance of concern at a disposal site or in the surrounding environment such that no substance of concern will present a significant risk of damage to health, safety, public welfare, or the environment during any foreseeable period of time," and that contains certain Conditions or requirements set forth for permitting, regulating, or prohibiting any activity pursuant to 310 CMR 40.0000, such as activity and use limitations.[42] A Temporary Solution means "any measure or combination of measures which will, when implemented, eliminate any substantial hazard which is presented by a disposal site or by any oil and/or hazardous material at or from such site in the environment until a Permanent Solution is achieved."[43] Remedy Operation Status "applies to disposal sites in Phase V [the operation, maintenance and/or monitoring phase of a remedial action] where a Comprehensive Remedial Action that relies upon Active Operation and Maintenance of a remedial system or program and meets the requirements of 310 CMR 40.0893 is being conducted for the purpose of achieving a Permanent Solution."[44]

Under Massachusetts' regulatory framework for addressing VI, mitigation systems that use a fan or blower to draw VOC vapors into collection points and discharge them away from the affected building are active mitigation systems and are called "Active Exposure Pathway Mitigation Measures" under the MCP.[45]

In Massachusetts, there are approximately 210 active VI mitigation devices currently in place at 91 sites where cleanup activities under the MCP have occurred. Twenty-two of these sites are Permanent Solution with Conditions sites, meaning that they have been deemed closed and that an IC has been recorded that specifies the need for remote monitoring. The other 69 are sites with Temporary Solutions, Remedy Operation States, or in other earlier phases of the cleanup process that have not yet reached closure, nor implemented necessary ICs.

VI System Remote Monitoring Synopsis:
Under Massachusetts' regulatory regime for its cleanup program, Active Exposure Pathway Mitigation Measures (AEPMM) that are part of a Permanent Solution, Temporary Solution, or Remedy Operation Status require the use of remote monitoring technology to provide immediate notification to both the Massachusetts Department of Environmental Protection and the owner

[42] 310 CMR 40.0006(12).
[43] *Id*.
[44] 310 CMR 40.0893.
[45] 310 CMR 40.1025(3)(d), 310 CMR 40.1026(3)(d); *Vapor Intrusion Guidance: Site Assessment, Mitigation, and Closure* (Policy #WSC-16-435) (Mass. Dep't of Envtl. Protection Oct. 2016), available at http://www.mass.gov/eea/docs/dep/cleanup/vapor-intrusion-guidance-10-14-2016.pdf.

and operator of the building protected by the AEPMM upon failure of the AEPMM due to loss of power, mechanical failure, or other significant disruption to the system.[46]

The remote monitoring system must be able to perform numerous function. The system must be able to communicate via text or email and to immediately communicate both system shutdown and system restart. It must also be able to communicate in the CSV (comma separated values) format and identify the site, the device number, the event description (e.g., shutdown, restart), the event date, and the event time.[47]

Enforcement Document/Instrument Used:
For sites that are designated as Permanent Solution with Conditions, a Temporary Solution, or Remedy Operation Status and that rely on an active VI mitigation system, Massachusetts regulations (the MCP) mandate the use of remote monitoring with the VI mitigation system.

[46] 310 CMR 40.1025(3)(d), 310 CMR 40.1026(3)(d); Mass. Dep't of Envtl. Protection, Remote Telemetry Information for Active Exposure Pathway Mitigation Measures Web page, available at http://www.mass.gov/eea/agencies/massdep/cleanup/regulations/remote-telemetry-information.html.
[47] Mass. Dep't of Envtl. Protection, Remote Telemetry Information for Active Exposure Pathway Mitigation Measures Web page, *supra* note 46.

APPENDIX F
CHANGE DETECTION MONITORING SITE EXAMPLES

Site Name: RACER Trust Cleanup Site – Pontiac Centerpoint Campus, MI, Region 5

Site Background:
The Revitalizing Auto Communities Environmental Response (RACER) Trust was created in 2011 by the General Motors Corporation (GMC) bankruptcy. The Trust originally owned and is responsible for cleaning up 89 sites (RCRA corrective action facilities, Superfund sites, and State cleanup program sites) formerly owned by GMC, and positioning those properties for redevelopment. At its inception, the Trust received approximately $475 million to clean up these properties, and approximately $137 million to facilitate the resale and redevelopment of these properties and to administer the properties and the Trust.[48]

The Pontiac Centerpoint Campus[49] – which includes the Central, East, and West properties, as well as other properties – make up ten of the 89 sites being cleaned up. From 1927 to 1990, the Campus was home to a plant that produced medium and heavy-duty trucks and buses. Major manufacturing activities associated with this production included machining, stamping, plating, smelting, fiberglass laminating, heat treating, painting, and sealing. Between 1991 and 1995, the plant was environmentally decommissioned and the area was redeveloped as the GM Truck Product Center Central, the hub of the Centerpoint Business Campus, which is a large scale industrial and commercial business development.[50]

In 2005, GMC performed the RCRA facility investigation at the campus properties, and in 2006, completed the corrective measures proposal. Both activities were done under a 1998 RCRA 3008(h) corrective action administrative order on consent (AOC).[51] In 2007, GMC entered into a 3008(h) corrective action AOC to perform corrective measures implementation activities. The selected corrective measures that were implemented at the Campus included ICs to prohibit groundwater use and restrict land use for any purpose other than commercial/industrial; recovery of light non-aqueous phase liquid; implementation of a long-term groundwater monitoring program; closure of underground storage tanks (USTs); and addressing releases from USTs in two areas of concern.[52] The ICs included the recording of several restrictive covenants that contain activity and use limitations at numerous properties. In 2015, EPA approved RACER Trust's request for a corrective action complete with controls determination.[53]

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[48] *Roadmap for Auto Community Revitalization*, *supra* note 26.
[49] *See* RACER Trust Property List Web page at http://www.racertrust.org/Properties/Property_List#mi.
[50] *Request for RCRA Corrective Action Complete with Controls Determination*, RACER Trust 3 (Jan. 15, 2010, updated June 2011).
[51] RCRA Facility Investigation Report (Oct. 21, 2005); Corrective Measures Proposal (Apr. 21, 2006), both available at http://www.racertrust.org/Properties/Detail?Id=13080.
[52] *Request for RCRA Corrective Action Complete with Controls Determination*, *supra* note 50, at chapter 3; Addendum to the June 2011 Request for RCRA Corrective Action Complete with Controls Determination, RACER Trust (Oct. 2014), available at http://www.racertrust.org/Properties/Detail?Id=13050.
[53] Letter from Margaret M. Guerriero to David Favero, *supra* note 29.

Change Detection Monitoring Synopsis:
At the Pontiac Centerpoint Campus, the Trust is using change detection monitoring to help monitor land activities at the entire approximately 470-acre site and to monitor compliance with the restrictive covenants that were recorded to limit certain activities and uses. The site is comprised of almost two dozen individual parcels that are owned by different parties. The Trust instituted change detection monitoring due to the size of the site, the number of parcels, and the numerous parcel owners.

Change detection monitoring compares high resolution aerial photography periodically to detect any land use activities or changes that may conflict with LTS activities. This monitoring technology may be particularly useful at especially large sites, remote sites, and/or sites with hard to access areas.

Enforcement Document/Instrument Used:
This advanced monitoring technology was voluntarily implemented by the RACER Trust, which was not obligated to use this technology or, generally, to carry out ICs, ECs, or LTS monitoring. In 2007, before the GMC bankruptcy and creation of the Trust, however, GMC and EPA Region 5 entered into an agreement for the Pontiac Centerpoint Campus facility; the facility included four properties that would later come to be RACER Trust properties.[54] Under the agreement, GMC agreed to ensure that the ICs and ECs selected as part of the corrective action at the facility would be maintained.

Enforcement Document/Instrument Language:
Under the 2007 RCRA 3008(h) administrative order on consent (AOC), GMC was required to, among other things, "assure that the institutional and engineering controls selected in the U.S. EPA's Final Decision are continually maintained unless and until U.S. EPA determines that performance standards have been met such that the controls are no longer necessary," and to "take all necessary measures to restrict the use of the Facility in any manner that may interfere with operation and maintenance, monitoring, or other measures necessary to assure the effectiveness and integrity of the remedy to be implemented pursuant to this Order."[55] Although the 3008(h) AOC pertained to GMC and not the Trust, carrying out this change detection monitoring for the Pontiac Centerpoint Campus properties likely satisfies, at least in part, these ICs and ECs "maintenance" provisions.

[54] Administrative Order on Consent Under RCRA § 3008(h) In the Matter of General Motors Corporation, Pontiac Centerpoint Campus, *supra* note 29; Letter from Margaret Guerriero to David Favero, *supra* note 29.
[55] Administrative Order on Consent Under RCRA § 3008(h) In the Matter of General Motors Corporation, Pontiac Centerpoint Campus, *supra* note 29, at ¶ 11.