Scientific Assessment and Workforce Development Assessment and Evaluation

Environmental Protection Agency's Laboratory Enterprise

Essential Products and Services; Recommendations to Increase Coordination and Performance

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Contents

Executive Summary

The U.S. Environmental Protection Agency's (EPA) Laboratory Enterprise Forum (LEF) was established under the Science and Technology Policy Council (STPC) in July 2015. This cross-Agency Forum focuses on improving the effectiveness, efficiency, and collaboration across EPA's Laboratory Enterprise. In June of 2017, the LEF was tasked with assessing the services provided by EPA's Laboratory Enterprise, evaluating the value of those products and services in the context of EPA's mission of protecting human health and the environment and the Agency's strategic goals (FY 2014-2018 EPA Strategic Plan), and providing recommendations for making the Laboratory Enterprise even more effective through continuous improvement. The Laboratory Enterprise consists of EPA's Program, Regional and Research laboratories.

An essential component of this study was the identification and use of quantitative and qualitative approaches to characterize the products and services from EPA's Laboratory Enterprise, explain how the Enterprise supports EPA's mission, and to demonstrate the value these products and services provide to customers and stakeholders. The study provides data that can be used to identify processes, procedures, and other approaches to improve effectiveness and efficiency.

EPA's Laboratory Enterprise Value Statement

EPA's Laboratory Enterprise provides expert knowledge and unique capabilities to address environmental and public health concerns on a national, state, local, and tribal level using the latest state-of-the-art and innovative approaches. The Enterprise is specially positioned to advance communication, cooperation, and management activities across the three Agency laboratory types, as well as with other federal and non-federal entities, to provide consistent and effective environmental analysis, data collection, and other customer-driven scientific and technical functions. These functions ensure that EPA continues to produce world-class scientific results to make informed decisions about our nation's most pressing environmental and public health concerns.

The LEF initially identified major products and services categories offered by the Laboratory Enterprise. Once these categories were determined, a data collection tool was used to collect information across the Laboratory Enterprise on these products and services for Fiscal Year (FY) 2017. Additional information was also collected from across the laboratories to provide greater context and a more complete understanding of the Laboratory Enterprise's efforts. The information in the report will help improve the Agency's understanding of the value provided by its Laboratory Enterprise system, and its ability to communicate this value both internally and to parties outside the Agency (e.g., the Office of Management and Budget - OMB, the U.S. Government Accountability Office - GAO, the States, etc.). Through this report, the Agency will gain a better understanding of the categories of functional products and services (as opposed to individual products such as research papers or reports) that are provided, approaches for improving effectiveness and efficiency, and how the laboratories complement each other to collectively form a world-class laboratory enterprise.

Laboratory Enterprise Functional Products and Services

Mission Support Functional Products and Services

The Laboratory Enterprise identified six core products and service categories that are key for EPA programs and regions to meet their mission, using quality science to protect environmental and public health:

- Sample analysis;
- Field sampling, field measurements, and monitoring;
- Method development, validation, and evaluation;
- Tool development and use;
- Technical assistance; and
- Training and education.

Source: EPA

In FY 2017, EPA laboratories provided extensive sample analysis (~1,088,000) and supported a wide range of customers, stakeholders and programs. While 14 of the 21 labs indicated use of a Laboratory Information Management System (LIMS) for the sample analysis data, ~90% of the analyses were not conducted on equipment that were part of a LIMS. In the field, the Labs collected samples (~111,700), conducted field measurements (~379,600), and undertook monitoring. Monitoring was conducted at 1,572 sites, which resulted in billions of data points used to prepare products for decision-making.

The Laboratory Enterprise also provides a variety of other products and services. In FY 2017, the Enterprise developed, validated, and/or evaluated nearly 300 analytical methods. Over 300 different types of tools have been developed by the Laboratory Enterprise to support both EPA and its myriad of stakeholders protecting human health and the environment. These tools are unique, both in structure and application. The most common forms of technical assistance provided by EPA's Laboratory Enterprise in FY 2017 were providing reference standards to states, localities, and tribes (over 4,200 instances), followed by assisting with technical inquiries/support or troubleshooting requests associated with measurement methods (over 3,900 instances) and performing or supporting risk assessments (approximately 2,500 instances). Additionally, the Laboratory Enterprise plays a critical role in training and educating students, partner organizations, and others to help prepare the next generation of scientists dedicated to environmental protection and public health. In FY 2017, the Laboratory Enterprise trained approximately 68,000 people, e.g., EPA and state staff, and members of the public.

Scientific Excellence Functional Products and Services

In addition to products and services that support the EPA's mission, the Enterprise is also dedicated to creating and supporting scientific excellence. The Laboratory Enterprise has institutionalized practices that promote credibility, transparency, and quality assurance practices to support the Agency's commitment to crucial scientific needs, producing the highest quality scientific information for environmental decision-making, and making data more publicly available.

The report also provides the numbers of labs and centers conducting peer reviews, external accreditations held by EPA laboratories, and datasets generated. In FY 2017, respondents indicated that: 1,400 scientific products were peer reviewed externally (most of which were reported by the Office of Research and

Development [ORD]), EPA labs hold 19 external accreditations, and EPA datasets include qualitative and quantitative data pertinent to EPA's Laboratory Enterprise. Datasets support internal and external decision-making and assist EPA's collaborative partners (local, state, and tribal agencies or other federal agencies) in generating their own datasets. The report provides descriptions of highlighted datasets.

Recommendations

While EPA's Laboratory Enterprise produces world-class scientific results that inform decisions about our nation's most pressing environmental and public health concerns, there are always opportunities to increase effectiveness, efficiency, and collaboration within the Laboratory Enterprise. Recommendations include:

Leadership

Greater focus in the following areas:

- Reaffirmation or refinement of the Agency's vision for the Laboratory Enterprise and increased intra-agency communication and improved coordination of management processes.
- Continuous evaluation and tracking by refining the FY 2017 data collection tool to improve the quality and consistency of future data gathered across the Laboratory Enterprise.

Data Management

A high priority need for improving the Laboratory Enterprise centered on approaches to strengthen data management capabilities by:

- Greater use of automated systems to promote more consistent data collection, storage, and management (e.g., greater adoption of Laboratory Information Management Systems [LIMS]).
- Improving accessibility and availability of datasets through the Environmental Dataset Gateway (EDG) to ensure the Agency maintains a culture of transparency and openness with the public.

Functional Areas

Data call respondents also highlighted the following operational activities needing focus:

- Establish goal that approved Quality Assurance Project Plans (QAPPS) should be in place for 100% of projects that include components of the Laboratory Enterprise by FY 2020.
- Develop best practices and approaches for planning scientific activities that promote effectiveness and efficiency in laboratory and field work.
- Increase use of existing equipment's capacity using a database system to search available equipment within the Agency, creating processes to prioritize equipment purchasing and identify opportunities for equipment reuse.
- Increase efforts to maintain a well-educated, experienced workforce by retaining seasoned personnel's knowledge and investing in the future thought leaders within the Agency through professional training opportunities.
- Enhance intra-agency coordination and collaboration on sampling and method development activities to safeguard best practices and prevent redundancies in data gathering procedures.
- Establish a tool similar to TechTracker, developed by ORD, to track and coordinate technical assistance efforts across the Agency at the federal, state, local, and tribal levels.

Introduction

The U.S. Environmental Protection Agency's (EPA) Laboratory Enterprise is made up of three major laboratory types: (1) research and development laboratories located in the Office of Research and Development (ORD) that generate environmental data, assessments, and scientific tools in support of EPA's mission; (2) Regional Laboratories that provide scientific support for decision-making for each Regional office; and (3) Program Office Laboratories that provide applied science to support regulatory development, implementation, and enforcement efforts on a national level. Together these laboratory organizations form a unique set of assets that are not duplicated elsewhere in the federal government.

In the March 20, 2015 Synthesis Report of the U.S. EPA Laboratory Enterprise, EPA committed to providing rigorous science to protect human health and reduce the Agency's environmental impact. The Science Advisor for EPA was tasked to develop a vision of the Laboratory Enterprise that would strengthen its communication, coordination, and management processes. As a result, a Laboratory Enterprise Forum (LEF) was established with areas of focus guided by the vision developed for the Laboratory Enterprise.

Vision Statement

EPA laboratories are recognized as unequalled in the performance of their missions and act collaboratively, efficiently, and creatively to deliver results based on sound science and to meet Agency science and technology needs essential for the protection of human health and the environment, now and in the future.

Unlike the Synthesis Report, where the report was prepared, at least in part, to make decisions about real property, the term "laboratory" in this report is not used in the sense of a physical building for several reasons. This report will be used to identify and make corporate recommendations on increasing coordination and performance, but not used to make decisions on real property. The major focuses of this report are to characterize the broad range of functional products and services provided by the Laboratory Enterprise; establish a baseline set of activities from which EPA can assess trends in the future; qualitatively assess the value of the products and services; and evaluate whether there are areas that present opportunities for corporate recommendations for improvements. Due to the wide variety of products and services that are conducted outside of a physical laboratory setting (e.g., technical assistance, field measurement and monitoring, training and education), limiting this assessment to only the activities that occur within a physical laboratory setting would provide inaccurate information that could not be used to characterize the breadth of products and services provided by the Laboratory Enterprise. A list of the organizational units of the Laboratory Enterprise facilities, research centers, and other components of the Laboratory Enterprise that produce products and services for EPA, whether in a building or in the field, are provided in *Appendix A: Organizational Units within EPA's Laboratory Enterprise that were Queried*.

This report describes the work of the Agency laboratory system from a functional science product and service viewpoint and allows the Laboratory Enterprise the opportunity to articulate its value to EPA. Frequently, EPA's Laboratory Enterprise demonstrates its value and success by providing outputs in the form of specific science articles and reports as products. While these products are critically important, this approach masks the true amount of work that underpins the products and may not accurately reflect the services that are requested and provided to support the Enterprise's customers and stakeholders.

Although the laboratory facilities, research centers, and other components that perform the work of the Laboratory Enterprise operate independently, the laboratory system, as a whole, delivers essential support for EPA's mission by providing critical science and science support that impacts the implementation of federal programs related to environmental health. The Laboratory Enterprise enables EPA to meet its mission by conducting analyses that range from routine to highly complex; undertaking field work; developing, validating, and modifying analytical methods; developing tools; providing technical assistance and training and education; and ensuring the quality of its products through peer review, audits, accreditation, and quality assurance. The lab system supports regulatory and enforcement work, emergency response, site characterization and cleanup, complex issues requiring novel methods and tools, and research. The laboratories provide a set of products and services that are high-quality and tailored to the needs of EPA customers and its stakeholders. Customers and stakeholders for Laboratory Enterprise products and services include, but are not limited to: 1) state, local and tribal (environmental) authorities and labs, 2) emergency responders and law enforcement, 3) other federal agencies, 4) EPA program and regional offices, and 5) the public.

Charge and Process Used

In June 2017, the LEF was charged with characterizing the scientific products and services provided by the Laboratory Enterprise and the value these products and services provide to EPA's mission of protecting environmental and public health and the Agency's strategic goals (FY 2014-2018 EPA Strategic Plan) and providing recommendations for making the Laboratory Enterprise even more effective through continuous improvement. In response, the LEF established a workgroup representing all three lab types – ORD, Regional, and Program Laboratories – to ensure equal representation in providing input on the broad range of products and services offered in laboratory facilities across the nation (*Appendix B: LEF Essential Services Report Workgroup* Members). Oak Ridge Institute for Science and Education (ORISE) independent evaluators assisted the workgroup by collecting and analyzing feedback from the workgroup members, laboratory entities from across the Enterprise, as well as comparing the range of products and services produced by EPA's Laboratory Enterprise to the products and services offered by other environmental laboratory institutions.

The workgroup's charge was to use quantitative and qualitative approaches that characterize the value of the products and services that support EPA's mission. The process used to identify the Laboratory Enterprise's products and services is described in *Appendix C: Process Used to Determine Phase I and Phase II Products and Services for Mission Support and Scientific Excellence*.

The products and services were characterized at the functional level rather than an inventory of products. Once the major products and services categories were identified (see *Appendix D: Phase I Products and Services for Mission Support and Scientific Excellence* and *Appendix E: Phase II Products and Services for Mission Support and Scientific Excellence*), a data call was performed for the Phase 1 Products and Services. The products and services addressed in the data call included the following:

- Sample analysis
- Field work
- Method development – validation and evaluation
- Tools development and use
- Technical assistance
- Training and education
- Quality Assurance
- Peer Review

The data call was distributed to the 23 organizational units shown in *Appendix A: Organizational Units within EPA's Laboratory Enterprise that were Queried*. In addition to the data call, information on tools and datasets produced by various organizational units were collected. Information was also collected on an ORD pilot project called TechTracker, which collects information on technical assistance that is provided through ORD organizations, and on technical support centers that are overseen by components of the Laboratory Enterprise.

Survey responses were received from 21 of 23 organizational units. Two organizations (one Regional and one Program lab) did not respond to the request. The 21 respondents consisted of: 6 ORD respondents, 9 Regional respondents, and 6 Program respondents. Data were requested for FY 2017. Data were also collected from other sources on tools and data sets provided by the components of the Laboratory Enterprise, and technical support centers that are overseen by units of the Laboratory Enterprise. Oak Ridge Associated Universities (ORAU) also explored benchmarking opportunities and compiled a list of non-EPA laboratories that could be used to perform benchmarking, if a suitable methodology can be developed (*Appendix F: Potential Comparison Laboratories for Benchmarking*).

This report describes information about the most important functional products and services (but does not address all the products and services) provided by the Laboratory Enterprise. In some cases, the data provided by respondents are estimates based on information from laboratory equipment, laboratory books, and other sources since an automated system did not exist or had not been deployed to collect this information. These estimates are nonetheless an important way of assessing the magnitude of the workload and demonstrating that the Laboratory Enterprise is made up of diverse organizations that are utilizing different approaches for tracking data on products and services. Estimated data was essential for the characterization of products and services and helped inform recommendations to increase corporate coordination and performance.

The portfolio of work performed by each laboratory, center, and other component in the Laboratory Enterprise varies according to the needs of clients and also varies over time. This variation is caused by many factors including emergency response, Superfund site characterizations, and periodic monitoring of media (e.g., air, water, etc.). For this reason, comparisons among or between ORD, Regional, and Program laboratory organizations, in terms of outputs such as the number of samples analyzed, or the number of field samples collected during a specified time, are not practical.

Laboratory Enterprise Functional Products and Services

Functional products and services fall into two major categories: Mission Support and Science Excellence. Data from Phase 1 are presented below on products and services in these categories. This information can help establish a baseline for the Laboratory Enterprise and help to identify recommended areas for improvement to increase the overall effectiveness and efficiency of the organizations.

Additional products and services are listed in *Appendix E: Phase II Products and Services for Mission Support and Scientific Excellence*. Data on these topics were not included in this initial effort for various reasons, such as there was not a method in place for collecting information on these products and services at the time the data call was developed. Further discussions with the LEF are needed to determine next steps on these Phase II topics.

Mission Support Functional Products and Services

Mission support products and services provide or support EPA's mission by generating reproducible, high-quality data on environmental conditions that are used for decision-making by federal, state, and local government agencies. The Laboratory Enterprise identified six core products and services that are key for EPA programs and regions, using quality science to protect environmental and public health.. These areas are:

- Sample analysis;
- Field sampling, field measurements, and monitoring;
- Method development, validation, and evaluation;
- Tool development and use;
- Technical assistance; and
- Training and education.

Sample Analysis

Sample analysis services offered by the Enterprise are defined as samples analyzed in a laboratory by one or multiple methods/tests, quantitative (measurable and verifiable) or qualitative (non-measurable), for different chemical, biological, physical, and radiological type parameters. EPA's national presence means that sampling may occur at a facility, in a city-, or on a county-, state-, or nation-wide basis.

Of the 21 respondents, all but two respondents (one ORD and one Program) indicated that their facility performs some type of laboratory sample analysis. These data demonstrate when and how the laboratories focus their analytical assets to support EPA's mission. The data provided by the respondents do not provide insight into the complexity of the analyses, amount of time needed to conduct analyses, and the inherent quality assurance and other factors that are driven by the use of the data. All of these factors can impact the time required to perform analyses. The analyses were performed in support of local, state, or

tribal agencies; emergency response; Superfund or brownfield sites; investigation and enforcement; or an EPA Program Office (Table 1). The magnitude of analyses performed in FY 2017 demonstrates the level of responsiveness provided by the Laboratory Enterprise in support of the Agency's mission.

Source: EPA

This client-driven model indicates that certain laboratories (that have the requisite expertise) providing the bulk of analyses in support of a particular client (e.g., ORD's National Risk Management Research Laboratory [NRMRL] provided 73% of the analyses in support of local, state, or tribal agencies, while ORD's National Center for Computational Toxicology [NCCT] provided 47% of the analyses in support of EPA Program Offices; Table 1).

Table 1. Number of Analyses Performed in Support of:

Respondent Type	Local-state-tribal Agencies	Emergency response	Superfund or brownfield sites	Investigation/ Enforcement	EPA Program Offices
ORD	217,026 (3)	2,165 (1)	36,073 (3)	12,824 (2)	745,272 (5)
Regional	27,596 (9)	1,499 (7)	88,897 (9)	5,769 (9)	25,250 (8)
Program	639 (3)	26* (1)	275* (1)	11,748 (3)	30,103 (2)
Total	**245,261 (15)**	**3,690* (9)**	**125,245* (13)**	**30,341 (14)**	**800,625 (15)**

Note. # of analyses (# of org units that performed the analyses). Categories are not mutually exclusive and numbers should not be totaled across the table.

*This table does not include data from the OLEM Contract Laboratory Program (CLP) and Environmental Response Team (ERT), which provide the majority of the analyses of samples for Superfund or brownfield sites and Emergency response.

Data were also collected on the number of analyses by medium (air, soil, water, complex mixtures, biological, and other; *Appendix G: Sample Analyses Performed, Field Samples Collected, and Field Measurements Taken by Media*). Respondents indicated the largest number of sample analyses were biological (463,164), followed by water (419,397), and complex mixtures (106,821). Complex mixtures may require substantial pre-treatment before analyses can occur. Other analyses such as tire crumb rubber, fish tissue, and vegetation (see *Appendix G*: Sample Analyses Performed, Field Samples Collected, and Field Measurements Taken by Media) demonstrate the unique and broad capacity of the laboratory organizations to meet client needs and expectations. Sampling and analysis methods may not exist or need to be modified to perform this work and to provide information on these sample types.

For FY 2017, the bulk of the air analyses was performed by ORD's National Exposure Research Laboratory (NERL) (50%) followed by the Office of Air and Radiation's (OAR) National Air and Radiation Environmental Laboratory (NAREL) (21%). ORD's NRMRL lab completed 62% of the water samples while OAR's National Vehicle and Fuel Emissions Laboratory (NVFEL) performed 33% of the complex mixtures. ORD's NCCT lab completed 81% of the biological analyses. The organizations of the Laboratory Enterprise have the scientific and technical depth to perform the wide range of analyses and respond to high volumes of analyses during times of emergency or when an emerging contaminant is identified.

The locations where analyses were performed are described in Table 2. These data indicate that the Laboratory Enterprise performs analyses at in-house EPA labs, as well as using commercial laboratories under contract to EPA, and in mobile EPA labs, to support the Agency's mission. Sample analyses performed in-house are supported by well-trained and knowledgeable scientists that are widely recognized for their expertise and are called to testify in court cases. Many of EPA's laboratories address a wider scope than commercial laboratories, which often focus on through-put (associated with routine analysis of large numbers of samples). Note that the number of analyses performed at commercial laboratories on EPA's behalf is underreported as the total number of analyses does not include analyses performed by Contract Laboratory Program (CLP) or Environmental Response Team (ERT) contractors (Table 2).

Table 2. Number of Analyses Performed by Location

Respondent Type	Performed at In-House EPA labs	Performed by Commercial Labs for EPA	Performed in Mobile EPA Lab
ORD	814,535 (5)	152,530 (4)	6,493 (2)
Regional	134,543 (9)	16,192 (4)	884 (3)
Program	53,887 (4)	250* (1)	39 (1)
Total	**1,002,965 (18)**	**168,972* (9)**	**7,416 (6)**

Note. # of analyses (# of org units that performed the analyses).

* The Office of Land and Emergency Management (OLEM) did not provide responses to the data call. Therefore, these numbers do not include the Contract Laboratory Program (CLP) or Environmental Response Team (ERT) contractors.

Use of Laboratory Information Management Systems (LIMS)

The broad range of analyses conducted and data types produced by EPA's Laboratory Enterprise, makes it difficult to design standardized processes and systems for managing the resulting data in a one-size-fits-all manner. Laboratories that do not use a LIMS have other processes, procedures, and systems to capture information on sample analyses. Some of the data provided in Table 1 and Table 2 were gathered from these non-LIMS sources (e.g., lab notebooks, Access databases, spreadsheets, lab equipment, etc.). Collecting information from these sources is time-consuming; has the potential to introduce errors, especially when transcribing paper notes to electronic files; introduces the risk that data stored in personal files (hard copy or electronic) will be lost when a researcher/analyst departs; and risks undercounting

work performed due to a lack of centralized data storage. Electronic data, that are not centrally maintained, may also be left in obsolete file types, rendering the information inaccessible.

Data indicated that 14 of the 21 respondents (67%) use a LIMS to manage their data. However, the usage of LIMS to manage data varied widely between respondent types. For example, nine Regional laboratories reported their data using their LIMS while three of six program labs and four of six ORD labs stated they used other methods*. While 67% of respondents reported they use a LIMS, a majority of the analyses data (~ 90%) was not reported from a LIMS. Ten of the 14 respondents (71%) use off-the-shelf LIMS products, although some of these systems have been customized to address the specific needs of those laboratories. Four of the 14 (29%) respondents indicated they used a LIMS that was developed in-house. See Table 3 for a breakdown of LIMS users by respondent type.

Table 3. *LIMS Use by Organizational Type*

Respondent Type	Use a LIMS to Manage at Least Part of Their Data	Use an Off-the-Shelf LIMS	Use an In-house LIMS	Do Not Use a LIMS
ORD (*n* = 6)	2	2	0	4
Regional (*n* = 9)	9	7	2	0
Program (*n* = 6)	3	1	2	3
Total (*n* = 21)	**14**	**10**	**4**	**7**

Note. *Respondents that do not use a LIMS indicated that they used internal reporting systems, laboratory records, spreadsheets, lab equipment records, and electronic files tracked by the scientist to manage the data.

While a LIMS may not be suitable for all types of laboratory analysis, (e.g., non-automated analysis, equipment that is used infrequently or integrating it with a LIMS would not be cost effective) several respondents reported that using a LIMS allowed them to automatically upload sample data from instruments to the system and create comprehensive electronic systems containing all relevant information about particular analyses. These comprehensive systems allow users to more easily distribute, search, and maintain information than other approaches.

Data management for sample analyses requires further consideration to determine the types of laboratory analysis that can be tracked using a LIMS; to compare the different LIMS that are available; to consider standardized criteria for the LIMS to ensure comparable data and usage; and to more fully characterize the costs and benefits of moving to broader use of a LIMS for tracking data. Other consistent processes, procedures, and systems will likely be needed for data that cannot be managed in a LIMS.

Field Sampling, Field Measurements, and Monitoring

Another vital function of the Laboratory Enterprise is field sampling, measurements, and monitoring. Field samples are primarily, but not exclusively, air, water, or soil collected for analysis in a laboratory setting. Measurements are also taken in the field to assess environmental conditions during field sampling events. Monitoring generally consists of taking field measurements at a certain frequency to assess various environmental conditions over time (e.g., weather, contamination, etc.). This activity can include single or multiple sites or locations and varies in type (active or passive) as well as frequency (intermittent to continuous). For this report, data on the number of sites being monitored was the focus, rather than the amount of data being collected.

Source: EPA

Seven Laboratory Enterprise respondents (33%) indicated that they did not perform any kind of field sampling or measurement and do not participate in monitoring. Two were ORD organizations, two were Regional lab entities, and three were Program lab entities. The remaining 14 respondents do undertake field sampling and measurement.

Field samples were taken to support Agency partners and activities (local, state, and tribal agencies; emergency response; Superfund or brownfield sites; and investigation and enforcement; Table 4). Respondents reported the largest number of samples taken in the field supported local-state-tribal partners (58%) followed by the Superfund or brownfield sites (26%).

Table 4. *Field Samples Collected in Support of:*

Respondent Type	Local-state-tribal	Emergency response	Superfund	Investigation/ Enforcement
ORD	52,927 (2)	2,096 (1)	3,037 (2)	342 (1)
Regional	13,695 (6)	4,930 (1)	27,354 (6)	805 (4)
Program	0 (0)	9,651 (1)	0 (0)	315 (1)
Total	**66,622 (8)**	**16,677 (3)**	**30,391 (8)**	**1,462 (6)**

Note. # of samples (# of org units that collected the field samples). Categories are not mutually exclusive and numbers should not be totaled across the table.

Data on the types of field samples (by media types) that were collected indicated the largest number of field samples were for water (69,886 samples), followed by complex mixtures (19,193) and air (14,609) (*Appendix G*: Sample Analyses Performed, Field Samples Collected, and Field Measurements Taken by Media). These data also show the variation in the types of field samples collected by each laboratory organization type. For example, ORD respondents reported collecting the largest number of water

(63,236) and complex mixtures (13,959) samples, while Program labs reported the largest number of air samples (9,291) collected.

Data on field measurements taken to support Agency partners (local, state, and tribal agencies; emergency response; Superfund or brownfield sites; and investigation and enforcement; Table 5) were also reported. The largest number of field measurements taken support local-state-tribal partners (87%), followed by the Superfund or brownfield sites (11%). The Regional and ORD laboratories performed all of the field measurements in support of primary local-state-tribal partners and nearly all (99%) of the field measurements in support of the Superfund or brownfield sites. Laboratories supporting Program Offices indicated that most of their field measurements were done in support of investigation and enforcement.

Table 5. Field Measurements Taken in Support of:

Respondent Type	Local-state-tribal	Emergency response	Superfund	Investigation/ Enforcement
ORD	68,140 (3)	782 (1)	2,050 (2)	342 (1)
Regional	317,793 (6)	0 (0)	39,973 (3)	1,123 (4)
Program	0 (0)	0 (0)	500 (1)	11,685 (1)
Total	**385,933 (9)**	**782 (1)**	**42,523 (6)**	**13,150 (6)**

Note. # of measurements (# of org units that took the field measurements). Categories are not mutually exclusive and numbers should not be totaled across the table.

Respondents indicated the largest number of field measurements were for water (203,664), followed by soil (159,041). ORD respondents reported the largest number of field measurements (85%) followed by Regional respondents (12%). See *Appendix G*: Sample Analyses Performed, Field Samples Collected, and Field Measurements Taken by Media.

Data provided by respondents on field samples and field measurements indicate a substantial workload conducted outside laboratory facilities, but these efforts still require the use of instrumentation; space to prepare for, maintain, and store equipment; samples, and data collection, analysis, and archiving. This presents an opportunity to better understand the variations in this area of mission support and to explore options for increasing the coordination of equipment use, data, and personnel.

Source: EPA

Respondents were asked about the number of sites at which monitoring was conducted. For this report, a monitoring site was defined as: a project/site at which monitoring is being conducted (active or passive, at any frequency from intermittent to continuous) for any parameter (e.g., pH, conductivity, nutrient, ozone) in any media (air, water, soil, chemical, biological).

Monitoring activities were conducted by all the three major types of EPA laboratories at (an estimated) 1,572 sites, resulting in billions of data points used for environmental decision-making. These sites vary in size ranging from a few acres (e.g., some Superfund sites) to the entire nation (e.g., National Lakes Assessment). These monitoring activities provide critical data that describe environmental conditions which impact human and ecological health. The ongoing management and storage of these data, as well as approaches for making data available to Agency partners and the public, are important considerations that require focused attention.

Some examples of the extensive monitoring conducted by the Laboratory Enterprise include:

- Collecting samples from 1,200 U.S. lakes and reservoirs as part of the National Lakes Assessment (NLA) survey conducted every five years. This nationwide effort evaluates the condition of 1,200 U.S. lakes and reservoirs by analyzing samples from these water bodies for chemical, biological, and physical parameters. This information is used by states and tribes to assess the condition of waterbodies under the Clean Water Act.
- Collection of water quality monitoring data (hundreds of thousands of data points combined with data from collaborators) using offshore and nearshore vessels for assessing nutrient pollution and the Gulf of Mexico Dead Zone. Nutrient pollution is a national water quality issue and a primary factor in the listing of impaired waterways. This work supports efforts to reduce nutrient loads and lessen the impacts of hypoxia.
- Nearshore sampling efforts in one of the Great Lakes (Lake Huron) as part of a U.S. -Canada binational research event. The approximately 10 million data points collected were used for near shore condition assessments, and to develop monitoring methods, sampling designs, and watershed terrestrial indicators for assessing connecting river systems to Lake Huron.

Method Development, Validation, and Evaluation

The Laboratory Enterprise is heavily involved in developing methods to assess environmental conditions. Method development describes an analytical measurement procedure or computation method for chemical, biological, physical, and radiological parameters in the laboratory or field. Standardized sampling and methods are essential for sound science although method development can be costly and time-consuming. This is of special concern due to the fast-pace of technological change and the time-consuming, rigorous method development, validation, and approval processes. This concern has been expressed several times by members of the Environmental Laboratory Advisory Board, a Federal Advisory Committee that provides input to EPA on environmental measurement issues and some progress has been made. Additional coordination and collaboration on method development and consistent approaches to issues such as method validation would promote greater efficiency and effectiveness within the Laboratory Enterprise.

The data call requested information on the number of methods developed, validated, or evaluated by the laboratories and centers in FY 2017; the number of methods supporting regulatory mandates or programs; methods developed collaboratively with external partners; and methods put into use. Nineteen of the 21 organizational units (90%) reported some form of method development: 4 ORD respondents, all responding Regional facilities (9) and 6 Program respondents (Table 6).

Table 6. Method Development, Validation & Evaluation

Respondent Type	Developed/validated /evaluated by EPA labs & centers	Support regulatory mandates or programs	Developed collaboratively with external partners	Methods put in use
ORD	210 (2)	120 (2)	65 (3)	407 (4)
Regional	27 (9)	231 (6)	5 (4)	208 (9)
Program	53 (6)	45 (4)	20 (4)	45 (6)
Total	**290 (17)**	**396 (12)**	**90 (11)**	**660 (19)**

Note. # of methods (# of org units that developed, validated, and/or evaluated methods). Categories are not mutually exclusive and numbers should not be totaled across the table.

Method development, validation, and evaluation are conducted across the Laboratory Enterprise. The Enterprise directly supports regulatory mandates or programs. ORD respondents indicated the greatest extent of method development is completed collaboratively with external partners. The number of methods put into use indicates the importance of and need for these functions. Increasing internal coordination and external collaboration will benefit not only EPA, but also its partners and stakeholders, and enhance the effectiveness of the Laboratory Enterprise. A new cross-agency Environmental Methods Forum has been established that could improve the collaboration and coordination needed in this area. The anticipated activities of the new forum and the LEF should be aligned to maximize the impact of their work in support of EPA's mission.

Tools Development and Use

The Laboratory Enterprise develops tools to better assist the Agency in performing environmental assessments and informing regulatory and non-regulatory decision-making by EPA and its partners (state, tribal, local levels), and other communities. For this report, a tool was defined as "a model/data/database/interactive user interface/process accessed via computer (website, download, web services) that is used to inform decision-making." Tools produced include technological advances made by the Enterprise to visualize, analyze, and synthesize information to increase efficiency in data collection and analyses and effectiveness in decision-making.

EPA's Laboratory Enterprise has developed over 300 types of tools to help both EPA and its myriad of stakeholders in protecting human health and the environment. These tools are unique, both in structure and application. This section showcases six tools used or developed by ORD, Regional, and Program Laboratories in the Laboratory Enterprise. For a more descriptive narrative regarding each of the six tools, see *Appendix H: Detailed Description of Highlighted Tools*.

Source: EPA

- The EPA's *Water Security Test Bed (WSTB)* facility is a full-scale representation of a typical municipal drinking water distribution system, designed in collaboration with the Department of Energy's Idaho National Laboratory. The WSTB facility is a one-of-a-kind facility that provides a physical water system model (with continuous on-line water quality monitoring systems that can be accessed by web services) to study contamination scenarios of a wide range of pathogens, chemicals, and radionuclides that may be accidentally or intentionally introduced into drinking water systems. Research conducted at the WSTB has proven invaluable in helping water systems respond to actual contamination incidents such as the chemical spills in West Virginia in 2015 and Corpus Christi in 2016 and oil spill incidents across the nation. ORD's Dr. Jeffrey Szabo was selected as the recipient of the 2017 Arthur S. Flemming award, a prestigious award that honors outstanding federal employees, based on his innovative vision and leadership in directing the design and building of the WSTB.

  The EPA is the lead federal agency responsible for working with water utilities to protect water distribution systems from contamination and to clean up already contaminated systems. The WSTB allows researchers to contaminate a model water distribution system and then monitor the fate and transport of contaminants within the water infrastructure to determine the efficacy of decontamination technologies. The WSTB facility can support water research on a variety of topics, including infrastructure decontamination, wash water treatment, biofilms, sensors, and maintaining water quality within a distribution system. The WSTB provides data at a realistic scale that informs decision-making by emergency response personnel, On-Scene Coordinators (OSCs), water utility managers, and drinking water administrators. The WSTB research results are also used by water quality managers at municipal and private utilities to make decisions about available decontamination technologies and equipment for use in emergency response planning.

  
  Source: EPA

- *EPANET*, developed by EPA's ORD, is a tool that models drinking water distribution piping systems by performing extended period simulations of water movement in pressurized pipe networks. Analysis from EPANET increases the efficiency and accuracy of water system planning and maintenance by providing quantitative information necessary for decision-making without having to take actual field measurements. The tool provides insight about drinking water system planning, operations, and water quality, all of which ultimately impact public health.

  EPANET is a free public domain software used by EPA and other researchers, water utilities, consulting engineers, software developers, government agencies, and students to solve drinking water problems. With over 50,000 downloads per year, EPANET is the most extensively used and downloaded model from the EPA website, and forms the basis of the most widely used commercial modeling packages.

- *VIPER* is a tool deployed by EPA's Office of Land and Emergency Management (OLEM) that provides acquisition, storage, analysis, and visualization for real-time sensor data related to EPA's hazardous waste sites (e.g., Superfund program). The tool allows response leaders to make instantaneous decisions in the field, eliminating the reliance on data loggers or manual recording of data.

  Users of the tool include EPA On-Scene Coordinators, Remedial Project Managers, and their site support contractors. VIPER can accept and store data from other sources, allowing it to be employed to visualize all sensor data collected on a site, including data from state and federal agencies, as well as potentially responsible parties.

- The *National Stormwater Calculator (SWC)* is an online tool developed within ORD that estimates the amount of stormwater runoff generated under different development and control scenarios. The tool uses a long-term period of historical rainfall based on information about a site's location and land cover. The SWC helps site developers and property owners determine how to reduce stormwater runoff by decreasing the footprint of sites and using low-impact development (LID) controls. Reducing the amount of runoff flowing into storm drains and onto roadways helps to prevent contamination of waterways and infrastructure degradation and overwhelming water treatment plants.

  Specific benefits of the SWC include the ability to: provide planning level estimates of capital and maintenance costs for LID controls as part of new development or redevelopment; determine specific site constraints; and consider how runoff may vary based on historical weather and potential future climate conditions. The SWC can be used by anyone interested in reducing runoff from a property, including site developers, landscape architects, urban planners, community groups, and homeowners.

- The National Homeland Security Research Center (NHSRC) developed *Selected Analytical Methods for Environmental Remediation and Recovery (SAM)*, which identifies analytical methods to be used by laboratories performing analyses of environmental and building material samples following a Chemical, Biological, and Radiological (CBR) contamination event. SAM influences decision-making by allowing for pre-selected methods to be used during remediation and recovery activities, facilitating quick determinations of the nature and extent of contamination. SAM allows rapid evaluation of the effectiveness of decontamination activities to support consequence management decisions needed to minimize the health and economic impacts of an incident. SAM is designed for use by federal, state, and local agencies, incident responders, incident decision makers and laboratories responding to a CBR contamination incident. In Calendar Year 2017, the tool was accessed by users in all 50 states and 127 countries.

- EPA's Region 2 developed *Summary Report*, a tool that allows environmental results from laboratories to be rapidly compiled in a user-friendly format for EPA on-site decision makers. The tool allows users to select from over 100 federal and state criteria for known environmental contaminants and compares them to the concentrations found in site samples, highlighting those contaminants that exceed the criteria and require action.

Specific benefits of the Summary Report tool include increased efficiency (over 98% compared to manual processes), appreciable cost savings (over $250,000 for the past two years), improved quality and efficiency by automating the process using report-ready standardized formats, and the flexibility to process multiple electronic data formats. Users include all Region 2 Remedial Project Managers, On-Scene Coordinators, and contractors, and the tool has also been provided to Region 1.

Technical Assistance for Program Implementation

EPA's Laboratory Enterprise provides high-quality science support to a wide variety of customers, supports quality assurance of data used in decision-making, oversees grant and contract vehicles that support the Laboratory Enterprise functions, and performs risk assessments that support environmental decisions.

While technical assistance is a major product/service provided by Laboratory Enterprise staff, these efforts have not been formally or consistently tracked. FY 2017 data were collected on 10 types of technical assistance (Table 7. *Types and Instances of Technical Assistance Provided*). Due to the lack of corporate tracking systems, these data are estimates that indicate the frequency of assistance, but not the workload involved, which can be a considerable amount. For example, providing scientific expertise to workgroups that are developing regulations can be a considerable time commitment spanning across multiple years. Similarly, conducting audits of state, tribal, and local laboratories requires time and effort to prepare for, perform, and follow-up to resolve identified concerns.

Table 7. Types and Instances of Technical Assistance Provided

Description of Technical Assistance Provided	ORD	Regional*	Program	**Total**
Reference standards shipped to states, localities, and tribes	216 (2)	333 (3)	3,724 (2)	**4,273 (7)**
Technical inquiries/technical support/troubleshooting requests associated with measurement methods	3,314 (3)	304 (7)	294 (5)	**3,912 (15)**
Risk assessments performed or supported	2,262 (4)	225 (2)	6 (2)	**2,493 (8)**
Reviewed, interpreted, and validated data for other labs	43 (2)	71 (3)	1,693 (4)	**1,807 (9)**
Sampling and analysis plans reviewed for other labs	228 (2)	138 (4)	971 (1)	**1,337 (7)**
Regulatory implementation actions supported	33 (4)	4 (2)	32 (3)	**69 (9)**
Actions that support enforcement (e.g., case litigation, case support, testimony in court)	15 (3)	20 (4)	184 (3)	**219 (10)**
State, tribal and local labs EPA audits	7 (3)	56 (9)	204 (2)	**267 (14)**
Members on regulatory development workgroups (branch and division level)	87 (3)	8 (4)	39 (4)	**134 (11)**
State and local labs certified by EPA	3 (1)	71 (9)	5 (1)	**79 (11)**

Note. # of instances of technical assistance (# of org units that provided technical assistance).
*One Regional laboratory did not provide a response to the data call and therefore instances of technical assistance for Regional laboratories are not representative of all 10 Regional laboratories.

The data shown in Table 7 indicate a wide variation in the types and levels of technical assistance provided across the laboratory organizations. This is likely due to differences in customers and stakeholders, but the variation could also be due to the lack of standard definitions and a corporate tracking system. Respondents indicated that more than half (54%) of the instances of technical assistance were provided by Program laboratory organizations, followed by ORD (38%), and Regional (8%). While Program laboratory organizations provided more instances of technical assistance overall, ORD and Regional laboratory organizations had more instances of technical assistance in a few areas. ORD laboratory organizations performed or supported a vast majority (91%) of the risk assessments and also accounted for 65% of the technical experts on regulatory development workgroups. Regional laboratory organizations provided 90% of the state and local lab certifications by EPA. Program laboratory organizations provided 87% of the reference standards that were shipped to states, localities, and tribes (mainly pesticide standards from the Office of Chemical Safety and Pollution Prevention laboratory - OCSPP). Program laboratory organizations also provided most of the reviews, interpretation, and validation of data from other laboratories (94%) and support for regulatory and enforcement actions (96%). They also performed approximately three-fourths of the state, tribal, and local lab audits (76%).

Recognizing the essential nature of the work and substantial workload that technical assistance represents, in FY 2018 ORD implemented the online tool "TechTracker" to better characterize the variety of technical assistance provided by ORD staff. The tracked categories include participation in regulatory and other workgroups; review of technical documents; training on ORD products and tools; analysis of data and models; and explanation of scientific and engineering concepts. Data were collected quarterly and analyzed. During the first two quarters of FY 2018, ORD staff recorded 1,573 entries into the tool, representing over 20,000 work hours. Data collected thus far indicates that EPA Regions and Program Offices are the primary users of ORD technical expertise, although assistance is provided to a wide range of external partners, as well. This is the first system used by EPA to track the noteworthy level of technical support that the Laboratory Enterprise provides to its customers.

The ORD and OAR Technical Support Centers (TSCs), managed through their laboratories, are another avenue for technical support. ORD manages five TSCs dealing with a variety of highly technical issues:

- Site Characterization and Monitoring Technical Support Center
- Ground Water Technical Support Center
- Engineering Technical Support Center and Superfund Technical Assistance Response Team
- Superfund Health Risk Technical Support Center
- Ecological Risk Assessment Technical Support Center.

These five TSCs fill a critical gap in EPA's ability to provide efficient and timely assistance, as evidenced by the receipt of well over 50 requests per quarter in FY 2017, in support of EPA programs and regions, state agencies, and several international customers (e.g., Italy and Israel). The products and services provided through the TSCs are well documented and primarily consist of reviewing draft reports/products, planning, and providing advice on technical issues. For example, in the fourth quarter of FY 2017, the TSCs provided technical support at more than 47 Superfund sites and two contaminated non-Superfund sites, responding to requests in all 10 regions and in more than 24 states and Puerto Rico.

Highlights for that quarter included:

- Technical support to Region 6 for the Hurricane Harvey response in Houston, TX;
- Technical support at the Newtown Creek site in New York City, NY by reviewing data calculations that established remediation goals for sediments at the site; and
- Evaluating dredging options to clear a lake of migrated mine tailings in Fredericktown, Missouri.

OAR's NAREL provides analytical and technical support for the characterization and cleanup of complex Superfund and federal facility sites, such as those in Hanford, WA and Oak Ridge, TN and at Brookhaven National Laboratory. NAREL also provides data evaluation and assessment, document review, and field support.

Training and Education

The Laboratory Enterprise has a critical role in training and educating students, partner organizations, the regulated communities, and others. Fellowships, internships, and post-doc opportunities help prepare the next generation of scientists dedicated to environmental protection and public health. Training efforts help to create a greater consistency in conducting science throughout all levels of the Agency.

Respondents were asked about training and education opportunities provided in the form of internships, fellowships, and federal post-docs established or renewed during FY 2017, and the number of external trainings provided, such as webinars, career development trainings, formal trainings, or trainings at conferences. Trainings by audience were gathered for state, tribal, and local labs; regulated community; and others (e.g., research community and professional associations). Respondents were asked to include the total number of trainings for each category, regardless of the length of time for each training and if the same training was repeated, to count each occurrence of the training.

All respondents indicated that they provide some form of training and education. While all three laboratory types have a commitment to training and education, ORD provides the majority of the internships and fellowships and the training of our partners (e.g., state, tribal, local labs), the regulated community, and others, which could include training at professional meetings, peers from EPA and other federal agencies, etc. It is estimated that almost 68,000 people were trained by EPA's Laboratory Enterprise in FY 2017 (Table 8).

Table 8. Number of Training and Education Opportunities Related to Laboratory Enterprise.

Respondent Type	Internship, fellowship, post-doc	State, tribal, local labs	Regulated community	Others	# People trained
ORD	587 (6)	184 (6)	121 (3)	697 (6)	63,670 (5)
Regional	11 (4)	35 (7)	1 (1)	17 (5)	1,335 (9)
Program	20 (3)	14 (3)	6 (2)	46 (4)	2,991 (4)
Total	**618 (13)**	**233 (16)**	**128 (6)**	**760 (15)**	**67,996 (18)**

Note. # of training and education opportunities provided or people trained (# of org units that provided the training and education opportunities or trained people).

Scientific Excellence

The Laboratory Enterprise is dedicated to creating and supporting scientific excellence across the Agency, as well as through all extramural work (e.g., through contracts, interagency agreements, grants, etc.), and with our partners. This section discusses four scientific excellence components: quality assurance, accreditation, external review, peer review, and datasets. These components are integral to the Agency's commitment to produce the highest quality scientific information for environmental decision-making, and to increase transparency by making data more publicly available.

☑ *Quality Assurance*

All environmental data collected and used by or for EPA is to be of known quality, adequate for its intended use, documented, verifiable, and defensible. This includes data used for making scientific and regulatory decisions, and may be acquired through direct measurement activities, collected from other sources, or compiled from computer databases and other information systems.

EPA requires all 50 states, commonwealths, and territories, such as Puerto Rico and the U.S. Virgin Islands, funded by EPA to maintain EPA approved Quality Management Plans (QMP). QMPs are used by EPA organizations and EPA-funded external organizations to define an entity's quality-related policies and procedures and describe roles and responsibilities, authorities, and how the plan will be applied.

EPA also requires a Quality Assurance Project Plan (QAPP) to support federally-funded environmental projects involving the collection and use of environmental data. This project-level plan captures how and why a project will be conducted and assures the quality of the data for its intended purpose. Both QMPs and QAPPs are key to successful projects and ensure quality is considered throughout the organizations and for individual projects. QA planning documentation is required by agency policy (EPA Order 5360.1 A2) and by the Code of Federal Regulations (C.F.R.) for our contractors and grantees (48 C.F.R. § 46 for contracts and 40 C.F.R. §§ 30-31, 35 for assistance agreements) and are included in inter-agency agreements.

The Laboratory Enterprise has embedded these requirements into its operations. In a few cases, respondents noted that quality assurance is performed outside of their organizational structures, which made it difficult to provide data about the percent of projects with an approved QAPP. One organization that reviews data from others noted that QAPPs are not always done on the project generating the data. Most of the respondents indicated 100% of their QAPPS in place were approved. Respondents who indicated that less than 100% of their projects have approved QAPPs should evaluate what measures are needed to be in accordance with EPA policy.

Accreditation

In addition to QMPs and QAPPs, many of EPA's laboratories are accredited to national or international standards by external bodies. In FY 2017, EPA labs obtained a total of 19 accreditations by external bodies. See Table 9.

Table 9. *Number of External Accreditations obtained by EPA Labs*

Lab Type	Number of accreditations
ORD	3 (3)
Regional	10 (9)
Program	6 (4)
Total	**19 (16)**

Note. # of labs (# of org units responding to the number of accreditations obtained).

Several respondents noted that they comply with ISO 17025 although they are not formally accredited and at least one noted they are 17025-certified. This respondent's environmental management system is registered to ISO 14001:2015. Another Program lab is ISO forensic accredited for laboratory and field measurements and field sampling, with a separate ISO accreditation for bulk asbestos analysis. One laboratory has maintained Oregon Environmental Laboratory Accreditation Program (ORELAP) accreditation since 2010. Some of the Regional laboratories are accredited to the National Environmental Laboratory Accreditation Program (NELAP) standards.

External Program Review

ORD was the only laboratory type that had an external program review in FY 2017; ORD's five national research programs were reviewed by the Board of Scientific Counselors (BOSC). The charge questions and recommendations that resulted can be found at: https://www.epa.gov/bosc/review-us-epa-office-research-and-developments-research-programs-2017. In general, the subcommittees found that ORD's strategic research action plans were effective planning documents. The research programs were all on target with their strategic goals with a high likelihood of achieving these goals in the proposed timeframe. The BOSC Executive Committee, in reviewing these plans, commended the senior leadership of ORD and the National Program Directors for having moved so quickly to the newly organized matrix model that ORD has embraced. The BOSC noted an increased degree of integration across the various research areas, reducing the "silo effect." The BOSC review was intended to assist ORD in evaluating the strength and relevance of the research programs and aid in guiding future course adjustments to the program. While the BOSC review was not specific to any particular laboratory and the research is very integrated in nature, the positive feedback indicates that ORD is focused on the correct research to support to the mission of EPA.

Peer Review

Consistent with scientific practice, EPA's Laboratory Enterprise pursues external peer reviews of scientific products. Respondents were asked about external peer reviews conducted, including integrated risk assessments, Influential Scientific Information (ISI) or Highly Influential Science Assessments (HISA), and peer reviewed manuscripts. Respondents indicated that 1,400 scientific products were peer reviewed externally in FY 2017. Ninety-six percent (1,349 of 1,400) of these external peer reviews were reported by ORD, reflecting the number of journal articles prepared by the organization and the use of a robust tracking system for clearance of the articles.

Datasets

The Laboratory Enterprise provides a large amount of data to partners, clients, and the public. This section provides descriptions of some important datasets, information on efforts to make all journal articles and underlying data available, and efforts to increase access to datasets through the Environmental Dataset Gateway.

Highlighted below are six Laboratory datasets. Additional information on these datasets is available in *Appendix I: Detailed Description of Highlighted Datasets*

EPA Program and Regional Laboratories' Datasets:

- *RadNet* is the only nationwide radiation monitoring network in existence, consisting of 140 air monitors distributed throughout the U.S. RadNet provides real-time data: for radiological or nuclear emergency response assessments and activities to EPA, other federal agencies, states, and local governments following a major atmospheric release of radioactive contamination; to inform public officials and the general public of the impacts resulting from major radiological incidents/accidents; and on baseline levels of ambient radiation in the environment for comparative purposes.

  RadNet fulfills responsibilities assigned by the Department of Homeland Security (DHS) to EPA in the National Response Framework Nuclear/Radiological Incident Annex (DHS08). Following a major radiological or nuclear incident, RadNet data, in combination with data from other sources, are used to make public health decisions (e.g., evacuation, shelter in place, medical countermeasures) by EPA and other federal and state agencies. It is publicly available at: https://www.epa.gov/radnet.

- EPA's Office of Water (OW) manages the *Unregulated Contaminant Monitoring Rule (UCMR)*, under which EPA collects finished water data from 5,000-6,000 public water systems (PWSs) for up to 30 contaminants during each 5-year UCMR cycle. The data help the Agency understand the frequency and levels of contaminants in drinking water.

  States and PWSs may also use the data to support decision-making (e.g., regarding actions to reduce the concentration of particular contaminants in drinking water). The publicly available dataset allows consumers to better understand the quality of the water provided by their PWS (https://www.epa.gov/dwucmr/occurrence-data-unregulated-contaminant-monitoring-rule).

- The *Regional Environmental Monitoring and Assessment Program (REMAP)* is run by EPA's ORD labs and is used to describe, diagnose, and predict water quality and ecological conditions in the Everglades in years: 1995-1996, 1999, 2005, 2013, and 2014. REMAP documents the outcomes of multi-billion-dollar Florida and federal efforts to protect and restore the Everglades.

  EPA, Florida, the Department of Interior, tribes, and agriculture and environmental groups have used REMAP data to document the Everglades' response to efforts to control phosphorus from agriculture and mercury air emissions and to determine whether sulfur from agricultural areas should be controlled. REMAP enables periodic, unbiased descriptions of the Everglades for several performance measures in the Comprehensive Everglades Restoration Program (CERP), a joint Florida and Army Corps of Engineers program to restore the Everglades. The National Academies of Science use REMAP to describe conditions and to look for evidence of change in its federally mandated review of CERP (https://www.epa.gov/everglades/environmental-monitoring-everglades).

- The publicly available *Computational Toxicology datasets* are generated by EPA in collaboration with hundreds of stakeholders and provide critical human toxicity and exposure information on over 700,000 chemicals. These datasets are used by EPA, other federal agencies, state environmental and health agencies, international governmental agencies, and industry to make decisions regarding the safety of chemicals, their use, and permissible exposures to people.

  Computational Toxicology research efforts use both laboratory testing and computer models to evaluate a large number of chemicals for their chemical characteristics, potential health effects, and exposure routes, while limiting the number of animal tests required.

  Some of the methods and models used by researchers at EPA's National Center for Computational Toxicology to generate these large volume datasets are Toxcast, toxicokinetics, the Collaborative Estrogen Receptor Activity Prediction Project data (CERAPP), and virtual tissue computer models (https://www.epa.gov/chemical-research/downloadable-computational-toxicology-data).

- The *Cyanobacteria Monitoring Collaborative dataset* was developed by Region 1 with its states and other groups to establish a uniform and consistent approach to monitoring cyanobacteria (https://cyanos.org/cyanomonitoring/). This approach is being utilized by citizen scientists, state water quality staff, and others in Regions 1, 2, 3, 4, 5, 7, 8, 9, and is under consideration in

Region 10 to forecast upcoming bloom events and manage recreational waterbodies and drinking water sources. This collaborative effort includes:

  - BloomWatch: a crowdsourcing, citizen science smartphone app that the public can use to identify and report potential cyanobacteria blooms to assist in tracking frequency and spatial occurrence.
  - CyanoScope: developed for trained citizen scientists and professional water quality managers to collect water samples and upload microscope images to better understand the spatial distribution of potentially toxic cyanobacteria genera. Field monitoring kits with digital field microscopes and cyanobacteria samplers are provided to participants.

- *KCWaterBug* is an Android, Apple, and web-based application that provides historic and real-time data to the public and recreational stream users regarding stream conditions and potential hazards, including bacteria in the stream segment. The www.kcwaters.org website provides links to both real-time and historical data regarding urban stream conditions in the Kansas City metropolitan area.

In FY 2017, the Public Access Forum was established under the Science and Technology Policy Council (STPC) to develop new processes, procedures, and training on how to make EPA funded journal articles and the supporting data available free of charge. The goal of this Forum is to promote better tracking and greater consistency in how journal articles (posted on Pub Med Central) and the supporting data (related metadata accessible via EPA's Environmental Dataset Gateway [EDG]) are made available to the public.

In addition to scientific data available on lab-related websites, numerous datasets are available through EPA's EDG, with more uploaded regularly. At the time of writing, ORD laboratories had 2,045 datasets available through EDG. These datasets are primarily related to land use and population projections, geospatial visualization, and GIS or general mapping. Regional laboratories have shared 1,084 datasets though EDG. Most of the Regional datasets are GIS or geospatial data. The metadata for the data that supports journal articles will also be placed in EDG. However, the Lab Enterprise generates a great deal of data that is already being made available. Including metadata in EDG would help the public find data more easily.

The EDG is EPA's official open data catalog with dataset records from EPA and partners. EDG supports EPA's Open Government Plan and assists in implementing principles of transparency, participation, and collaboration by helping the Agency identify and publish valuable datasets. The Office of Environmental Information (OEI) is responsible for implementation and management of EDG. It provides users with a central access point to datasets that have been created by EPA Program Offices, Regions, and Labs.

Laboratory Enterprise Strategic Coordination

Respondents provided additional strategies for improving effectiveness and efficiency of the Laboratory Enterprise. These strategies focused on three key areas: personnel, equipment, and planning.

Personnel Expertise

Several respondents identified their researchers or scientists as key components of an effective enterprise. Having the personnel and equipment available to perform sample collection and in-house analysis was identified as a critical factor in the continued high performance of the Laboratory Enterprise. One respondent emphasized that "timely hiring" of qualified in-house scientists contributed to laboratory effectiveness. Another noted that retaining contract scientists with extensive expertise and recognition in the field was crucial, especially when weighed against the time and effort to train relatively short-term students or inexperienced technicians. ORD has developed workforce studies and strategies to maintain high performing scientific expertise and is now planning for the scientific workforce for the future. The ORD efforts may provide insight and tools that can be applied across the Enterprise. Coordination is needed to ensure the Laboratory Enterprise maintains critical expertise.

Coordination of Equipment Use & Purchase

Source: EPA

Several respondents describe practices related to equipment use. One described sharing lab equipment across organization units and locations to increase efficiency. A Program respondent indicated that annual equipment automation reviews and process flow improvements were key parts of maintaining efficiency. Another respondent indicated remote monitoring on some of its lab equipment, including refrigerators and freezers and compressed air systems has been implemented. In addition to providing data for quality control audit purposes, the system automatically notifies select staff if a device goes out of range.

In FY 2017, the Laboratory Enterprise Forum developed a tool to provide information to EPA staff regarding scientific equipment costing over $100,000. Users can determine whether EPA owns a specific piece of equipment, its location, and the equipment owner. The LEF is currently determining the availability and capacity of high-end equipment with the goal of increasing equipment usage. Best practices for improving equipment capacity sharing, increasing usage of any underutilized equipment, and improving equipment monitoring and maintenance could further improve the efficiency of the Laboratory Enterprise. Increased coordination when purchasing equipment could also allow the Laboratory Enterprise to prioritize which equipment should be purchased and promote greater equipment sharing.

Planning Science Activities

The third theme that emerged from the respondents was science activity planning. One respondent described a designated technician who prepares weekly analytical schedules to allow personnel to plan and prepare for the upcoming work. A Regional Lab reported planning analytical and fieldwork for the upcoming year to optimize their operations. Another respondent mentioned prioritizing workload by deadlines and noted that this was possible because all analysts were willing to assist as needed, even if a project was not specifically theirs. One group described engaging with other divisions for annual planning as well as quarterly updates. Coordinated planning may present an opportunity to improve effectiveness and efficiency of the Laboratory Enterprise.

Benchmarking Possibilities with EPA's Laboratory Enterprise

Benchmarking analysis in the laboratory space can be used to improve the quality of products and performance of services offered by a given lab, identify labs with unique capabilities to better understand those performing similar work, and inform laboratory operators of new technology innovations. Such information can be used to advise leaders on how to improve program efficiencies and develop collaborative relationships with internal and external organizations to further scientific discoveries and encourage advancements in research and development technologies. This presumes that other organizations performing sufficiently similar work can be identified for benchmarking.

Preliminary Benchmarking

ORISE evaluation members sought to lay the foundation for future benchmarking to be performed among EPA laboratory functions and other federal, state, university, and contractor labs that provide similar services related to environmental and public health research. Such analyses have the potential to inform the Agency as to how well its Laboratory Enterprise operates compared to other agencies and organizations in terms of products and services offered, ultimately informing EPA's strategic goals and missions to improve the performance and capabilities of the Laboratory Enterprise.

In total, ORISE identified 65 laboratories across the U.S. as potential benchmark comparisons to EPA's Laboratory Enterprise by reviewing web-based, publicly available information for comparable product and service functions. The non-EPA comparison laboratories consisted of 38 federal labs (representing seven different agencies), 15 state labs (representing all 10 of EPA's Regions), nine university labs (representing eight different states and seven different regions within EPA's Regional Lab network), and three contractor labs (representing all 50 states) (see *Appendix F: Potential Comparison Laboratories for Benchmarking*).

ORISE determined that a web-based comparison approach between EPA and non-EPA labs would not be useful as some organizations' websites were found to be out of date or severely lacking detail. Thus, when EPA's Laboratory Enterprise reconsiders benchmarking with comparable labs, a formal benchmarking agreement to share quantitative data regarding the functional products and services identified as most valuable to the Laboratory Enterprise's mission should be considered when applicable. In addition to comparing EPA labs to other facilities as whole, sometimes it might be more appropriate to compare only specific products or services to those of another facility.

Future Benchmarking Opportunities

To proceed with a complete, in-depth benchmark analysis between EPA and non-EPA labs, the EPA Laboratory Enterprise must first establish several foundational benchmarking requirements. To collect the latest and most accurate quantifiable data for functional products and services offered by EPA, the Agency must develop more consistent methods of data collection across the Laboratory Enterprise. This would allow more timely and robust assessments of product and service output by labs within the Enterprise.

A cooperative agreement with a non-EPA lab(s) would allow for a quantitative analysis, specifically the resources each agency devotes to a given laboratory function. In some cases, establishing a cooperative agreement may not be necessary. Should the EPA Laboratory Enterprise decide to conduct benchmarking after the requirements above are satisfied, sufficient resources must be identified to perform benchmarking activities.

Additional data collection would support more transparent information about the products and services from EPA's laboratories. At this time, however, sufficient information to fully characterize and evaluate trends in products and services has not been established. After data are collected using consistent methods over several years, the use of benchmarking should be reconsidered. In addition to the recommendations in this report, the workgroup anticipates that continued data collection will identify other areas that leaning efforts could be used for improvements in effectiveness and efficiency, in advance of any benchmarking.

Conclusions

Information collected through the data collection tool and other sources (e.g., highlighted tools) have provided information that characterizes most of the functional products and services from EPA's Laboratory Enterprise. While these data are only representative of FY 2017, it provides information about the breadth and quantity of the products and services that are provided to support environmental decision-making. The following conclusions can be drawn:

- Based on the information gathered, the organizational units that make up the Laboratory Enterprise have broad portfolios of work that can vary significantly. These variations are driven by the types of products and services that are needed by customers for decision-making. It is highly likely that there will be variations in these portfolios over time, as customers and customer needs change. Additional information will be needed to better understand trends. Given these variations, it is not appropriate to compare one lab to another lab in terms of, for example, the total number of samples analyzed during a specified time. Other metrics should be considered for comparison of labs. It may also sometimes be impractical to compare product and services provided by a lab between fiscal years due to the fluctuating needs of customers.

- Benchmarking the organizations in EPA's Laboratory Enterprise against other types of laboratories that perform similar work was also explored. At this time, benchmarking was not feasible since 1) EPA needs to collect additional data on the products and services that are provided by EPA's Laboratory Enterprise, particularly to see if there are large variations over time, 2) benchmarking may need to be done by product or service type rather than by facility, 3) agreements need to be established with other laboratory entities to ensure comparability of data, and 4) benchmarking is resource intensive and sufficient resources have not been identified.

- The storage and maintenance of data collected from the broad range of scientific activities conducted by EPA laboratories will need special attention to ensure that the technology and approaches keep pace with the amount and format of the data. ORD has played a leadership role in addressing data from research activities, in collaboration with the Office of Environmental Information. Corporate solutions will be needed that address data from all of the laboratories.

ORD's LIMS Pilot Project

The LIMS pilot project is a joint effort among NERL, NRMRL, and Office of Science Information Management (OSIM) to conduct a small-scale pilot project to demonstrate and evaluate the potential benefits gained from using a research-oriented laboratory information management system on laboratory operations. The anticipated benefits include:

- Decreasing sample turnaround time by improving sample management and tracking throughout the lab and reducing or eliminating the need for manual data entry during sample receipt,
- Centralize and standardize data, automatically transfer data from lab instrumentation, store data in centralized database in an electronic format for easy review and approval, streamline process for data validation, review, and release/reporting, and
- Improve customer service for clients to have access to their results via a secure web portal.

Extensive market research was conducted in order to identify a system for the pilot that could accommodate the various types of research/analyses conducted by our labs.

- There is wide variation in the types and number of sample analyses conducted across the Laboratory Enterprise. These variations are mainly attributed to changes in science issues, customer needs or emergencies, etc. Some organizations were still relying on spreadsheets, databases, and the analytical equipment itself to track sample analyses. Respondents to the data collection tool indicated that using a LIMS could provide a much more efficient and effective way to generate, distribute, search, and maintain these data. LIMS is already in use at certain labs and pilots have been initiated to evaluate LIMS use more broadly.

- Field activities, such as monitoring, are being conducted that result in billions of data points collected outside of a physical laboratory. The monitoring activities may occur regularly or be cyclical (e.g., every five years). Data collected from these activities are, in many cases, being managed at the branch level, which limits data accessibility, decreases efficiency, and increases the possibility that data will be in an irretrievable format or lost.

- EPA policy requires that metadata be put into the Environmental Dataset Gateway (EDG), which directs members of the public to where the data is stored. The Laboratory Enterprise produces datasets that are made available to customers and the public, but this may be done through websites and not a direct connection to EDG. When datasets are made available to the public, the Laboratory Enterprise needs to more consistently place metadata into EDG, so the public will have one place through which data can be located. For example, EPA developed a Public Access Plan that articulates how research articles and the underlying data will be provided to the public free of charge. Articles will be made available through PubMed and metadata will be placed in EDG that will direct members of the public to where the data are stored.

- Without appropriate analytical methods, it is difficult to detect and address environmental and public health concerns. Method development, validation, and evaluation are occurring across the Enterprise (as well as in other parts of EPA). However, because method development can consume a great deal of resources and method adoption in some parts of EPA has not kept pace with the need or with changes in technology, increased coordination across EPA is needed to leverage the investment that the Enterprise is making in analytical methods. Greater consistency in method development approaches could also lead to the development of methods that better meet customer needs.

- The Laboratory Enterprise provides a wide range of technical support on various topics. ORD has developed a system to track the technical assistance ("TechTracker"), to better understand the variety of technical assistance ORD staff provides and the amount of time used for technical assistance. In addition, five ORD Technical Support Centers provide services internally, as well as to external customers. Technical support is an important service that is provided, but has not been tracked formally and consistently across the Laboratory Enterprise. Deployment of a system like TechTracker would help other portions of the Lab Enterprise record and track these actions.

- Quality Assurance Project Plans (QAPPs) are used to help define quality-related policies and procedures that apply to a project and how they will be implemented. The Laboratory Enterprise organizations indicated that in a few instances projects are reviewed or conducted that did not have an approved QAPP. One respondent noted that the QAPPs are approved by another part of their larger organization and they could not provide data about the number of projects with approved QAPPs.

Recommendations for Improving the EPA Laboratory Enterprise

While EPA's Laboratory Enterprise produces world-class scientific results that inform decisions about our nation's most pressing environmental and public health concerns, there are always opportunities to increase effectiveness, efficiency, and collaboration within the Laboratory Enterprise.

Three categories of recommendations were identified for improving the effectiveness, efficiency, and collaboration of the EPA Laboratory Enterprise. These recommendations are based on data collected on products and services generated by the Laboratory Enterprise, and further informed by the collective experience of the workgroup members. Some of the recommendations could be implemented by making only minor changes to policy or business practices, while others would require due consideration before solutions could be identified and substantial resources needed to implement those solutions may not be readily available at the Agency. Thus, these recommendations will need to be prioritized by the LEF with input from the National Program Manager (NPM) in order to develop an action plan. All activities under the action plan should be coordinated with other ongoing activities of the LEF as well as other activities taking place across the agency.

Leadership

- In consideration of ongoing organizational realignments and the creation of the new Regional Laboratory National Program Manager, the LEF, with concurrence from the Science Advisor, NPM, and key decision makers, should refine the Agency's vision for the Laboratory Enterprise and strengthen intra-agency communication and coordination of laboratory management processes, to the extent feasible given the differences in focus and customers for the various organizational units in the Laboratory Enterprise.

- Consistent data collection facilitates the identification of areas that present opportunities to improve our business processes, our products and services, communication of the breadth and depth of the Laboratory Enterprise portfolio, and the value the portfolio provides to EPA. The LEF should lead the refinement of data collection techniques, as well as identifying other sources of relevant information that support this effort, and periodically collecting this data. A refined data collection tool, with detailed definitions and instructions, would improve the collection process and ensure data between organizational units are comparable. Webinars should be used to demonstrate how to accurately complete the data collection tool and to provide laboratory organizations the opportunity to ask questions and receive appropriate guidance. These periodic data collections would also allow the Laboratory Enterprise to identify trends and monitor its progress towards instituting change.

Data Management

- Due to the high volume of data being generated, managed, and stored by the Laboratory Enterprise (from laboratory and field activities), there are many opportunities where the Laboratory Enterprise could increase its effectiveness and efficiency in this area. While some organizational units within the Laboratory Enterprise have adopted a LIMS, greater use of automated systems would promote more consistent data collection, storage, and management. Advantages and disadvantages of options for implementing automated systems across the Laboratory Enterprise should be carefully considered to

determine the best approaches for the Enterprise long-term. The LEF needs to plan for and address this issue promptly. See pages 7-11.

- EPA policy requires the identification of publicly accessible datasets through the portal known as Environmental Dataset Gateway (EDG), however, most datasets in EDG are related to geographic information. It is important that the datasets generated by Laboratory Enterprise activities have metadata in the EDG to increase transparency and public accessibility. Regardless of where the data are stored or made publicly available, increasing the metadata on these datasets will increase public accessibility and foster further advancements and innovations with current and potential collaborators. The LEF should evaluate options for increasing metadata for these datasets in EDG. See pages 20 – 22 of the report.

Functional Areas

- For projects including components of the Laboratory Enterprise, a goal of approved QAPPs for 100% of projects is recommended by FY 2020. If QAPPs for these projects are approved by organizations outside the Laboratory Enterprise, this information needs to be recorded and tracked. If the Laboratory Enterprise is asked to review data from a project that does not have a QAPP, the reviewers need to document that a QAPP was not approved and why it was not approved if that information is known. See page 18 of the report.

- Planning for laboratory science activities was mentioned by several respondents regarding ways to improve efficiency across the Laboratory Enterprise and support management activities at EPA. The LEF should develop best practices and approaches for planning scientific activities that promote effectiveness and efficiency in laboratory and field work. This would be particularly useful when laboratory facilities are co-located or when similar analyses are needed. See page 24 of the report.

- The LEF should address how the Laboratory Enterprise can increase the sharing and reuse of equipment and coordination of equipment procurements. The Laboratory Enterprise can increase efficiency and reduce fiscal outlay by leveraging the use of existing equipment. The LEF developed the Lab Enterprise Equipment Tool for identifying laboratory equipment costing over $100,000 that allows users to determine equipment that might be available for specific uses. Further effort is needed to understand the capacity that exists for specific equipment. Some equipment has the potential for reuse by other units of the Enterprise. In addition, planning for and coordination of equipment procurements could also create efficiencies and facilitate strategic acquisition. See pages 10 and 23 of the report.

- The LEF, with input from the NPM, should develop concrete action items to maintain and promote an educated and well-trained scientific workforce. Suggestions were received through the data collection tool that workforce planning for the Laboratory Enterprise should be addressed. In addition to creating a nimbler Laboratory Enterprise that can execute its work efficiently and transition when new expertise is needed, internal succession planning and providing learning opportunities for current employees will position the Agency for future success. See page 23 of the report.

- Greater coordination and collaboration on sampling and analytical method development throughout the Enterprise is essential and offers several benefits. Different locations would be able to coordinate sampling activities and minimize redundant efforts. Increased communication, guidance, and coordination of analytical method development would promote data interoperability, greater confidence that the analyses were performed in a standard way and help prioritize efforts. A new standing group (Environmental Measurement Forum) has been established to address non-regulatory method-related issues and coordination. Prompt action is needed to promote greater coordination across the Agency's method development activities. See pages 11 - 12 of the report.

- Tracking and coordination of technical assistance is being performed within ORD using the TechTracker tool. Expanding use of this tool or a similar tool would allow the Enterprise to get a more accurate read of the types and quantity of assistance provided and could highlight opportunities to combine duplicative efforts. Maintaining accurate records of these efforts would help to inform decision-making. The LEF should evaluate the TechTracker tool and make a recommendation to the NPM on an approach to tracking technical assistance by the end of FY 2019. Information supporting this recommendation is provided on pages 15 - 17 of the report.

Appendices

Appendix A: Organizational Units within EPA's Laboratory Enterprise that were Queried

Twenty-three (23) laboratory organizational units were surveyed for this report. These included six ORD, ten Regional, and seven Program organizational units. Twenty-one organizational units provided responses (responses were not received from one Regional and one Program organizational units).

Research and Development Laboratories (ORD)	• National Center for Computational Toxicology • National Center for Environmental Assessment • National Exposure Research Laboratory • National Health and Environmental Effects Research Laboratory • National Homeland Security Research Center • National Risk Management Research Laboratory
Regional Laboratories	• Region 1's New England Regional Laboratory • Region 2's Laboratory at EPA's Edison (New Jersey) Environmental Center • Region 3's Laboratory and Field Services at EPA's Environmental Science Center • Region 4's Science and Ecosystem Support Division • Region 5's Chicago Regional Laboratory • Region 6's Environmental Services Branch Laboratory • Region 7's Science and Technology Center • Region 8's Central Regional Laboratory • Region 9's Central Regional Laboratory • Region 10's Manchester Environmental Laboratory
Program Laboratories	<u>Office of Air and Radiation labs and research centers</u> • National Analytical and Radiation Environmental Laboratory • National Center for Radiation Field Operations • National Vehicle and Fuel Emissions Laboratory <u>Office of Chemical Safety and Pollution Prevention labs</u> • Analytical Chemistry Branch &Microbiology Laboratory Branch <u>Office of Enforcement and Compliance Assurance</u> • National Enforcement Investigations Center (NEIC) Lab <u>Office of Land and Emergency Management</u> <u>Office of Water</u> • Office of Ground Water & Drinking Water Technical Support Center

Appendix B: LEF Essential Services Report Workgroup Members

Name	Position
Mary E. Greene, Co-Chair	Deputy Director, Office of the Science Advisor at EPA
Jeaneanne M. Gettle, Co-Chair	Region 4 Director at EPA
Danny France, Co-Chair	Chief, Environmental Investigations Branch at EPA
John Griggs	Director, National Analytical Radiation Environmental Laboratory
Dan Amon	Senior Energy Advisor at EPA
Joseph Greenblott	Associate Director, Analysis Division, Office of Planning, Analysis, and Accountability at EPA
Tim H. Watkins	Deputy National Program Director for the Air, Climate, and Energy Research Program, ORD at EPA
Sarah L. Mazur	Science Associate, Sustainable and Healthy Communities Research Program, ORD at EPA
Anahita Williamson	Director, Division of Environmental Science and Assessment at EPA
Support Provided By:	
Bobby Lewis	Field Quality Manager at EPA
Manisha Kumar	Science Policy Associate at EPA, Oak Ridge Associated Universities (ORAU) Contractor
Greg Susanke	Laboratory Enterprise Forum Coordinator, STPC at EPA
Bobbi Carter	Lead Region Coordinator, Regional Science and Technology (RS&T) Organizations at EPA
Anand Mudambi	STPC Coordinator at EPA
Mark Griesinger	Strategic Coordinator at EPA, ORAU Contractor
Linda M. Mauel	Science Integrity & Quality Assurance Manager at EPA
Erin Burr	Senior Evaluator and Assessment and Evaluation Section Manager, Scientific Assessment and Workforce Development (SAWD) at Oak Ridge Institute for Science and Education (ORISE)
Kelly Townsend	Evaluation Specialist, Assessment and Evaluation, SAWD, ORISE
Ann Gonzalez	Research Associate, Research Services, SAWD, ORISE
Jen Tucker	Research Associate, Research Services, SAWD, ORISE

Appendix C: Process Used to Determine Phase I and Phase II Products and Services for Mission Support and Scientific Excellence

The EPA LEF workgroup and ORISE met bi-weekly via conference calls, including two all-day, in-person meetings in Washington, D.C., to discuss and develop a list of products and services offered across the Laboratory Enterprise, as well as metrics reflecting the value and practical applications of each product and service offered. Leading up to and during the first in-person meeting in D.C., the workgroup and ORISE worked to narrow the final selection of metrics for each product and service category by creating selection criteria and rating the products and services in terms of their level of impact on audience and the availability of credible evidence. The products and services identified by the LEF workgroup were organized into two categories, supporting either the Agency's mission initiatives or its goal to maintain scientific excellence. Mission support products and services relate directly to activities that support research and discovery of data on environmental conditions used for decision-making by federal, state, and local government agencies. Scientific excellence products and services include processes, regulations, and practices which support the Agency's commitment to promote scientific integrity, credibility, transparency, and high-quality assistance. Products and services identified capture the breadth of the Laboratory Enterprise's capabilities and world-class expert service. The LEF business case workgroup then identified specific metrics for each of the products and services that effectively demonstrate the Laboratory Enterprise's value.

Prior to the second all-day meeting in D.C., a cluster analysis was performed by ORISE to reveal the Laboratory Enterprise products and services that a) had the highest level of impact on EPA's mission and b) represented those most readily available for data collection. Ultimately, during the second in-person meeting, LEF members determined to include the top eight products and services in a Phase I data collection (*Appendix D: Phase I Products and Services for Mission Support and Scientific Excellence*), while the remaining product and service category metrics were assigned to a Phase II data collection effort (*Appendix E: Phase II Products and Services for Mission Support and Scientific Excellence*). Additional Phase II metrics were identified after Phase I data collection was complete and are also included in *Appendix E*. The data collection methods deemed most efficient for gathering metric information in Phase I were data calls to Enterprise labs, regions, and offices, Google Analytics, and pulling data from the EPA Laboratory Information Management Systems (LIMS).

Appendix D: Phase I Products and Services for Mission Support and Scientific Excellence

Function	Collection Method	Mission/Impact	Customers
Mission Support			
1) Field Sampling, Field Measurements, & Monitoring			
# of samples related to support for programs (e.g., local-state-tribal agencies, emergency response, Superfund/brownfield sites, investigation, enforcement, QA*, & mission research)	• Lab information management systems (LIMS) • Data call (e.g., data from lab reports, lab records)	• Inform decision-making • Various health impacts	• State, local, tribal environmental authorities • EPA regulatory offices • Other federal agencies • Emergency responders • Research partners
# of samples by media (e.g., air, water, soil, & complex mixtures - unique capabilities)			
# of field measurements related to support for local-state-tribal agencies, emergency response, Superfund/brownfield sites, investigation, enforcement, QA, mission research			
# of field measurements by media (e.g., air, water, soil, complex mixtures - unique capabilities)			
# of sites and types of field measurements by source (e.g., program, regional, & research labs including EPA contractor supported labs)			
2) Sample Analysis (includes samples analyzed in the field)			
# of analyses related to support for programs (e.g., local-state-tribal agencies, emergency response, Superfund/brownfield sites, investigation, enforcement, QA, & mission research)	• LIMS • Data call	• Inform decision-making • Various health impacts	• State, local, tribal environmental authorities • EPA regulatory offices • Other federal agencies • Emergency responders • Research partners
# of analyses by media (e.g., air, water, soil, & complex mixtures - unique capabilities)			
# and types of analyses by source (e.g., program, regional, & research labs including EPA contractor supported labs)			
# of sample analyses performed at EPA, mobile, or contractor lab			
3) Method Development			
# of methods developed/validated/evaluated annually by EPA Labs & centers	• Data call (OPARM*, FEM* list, annual report data call)	• Various health impacts	• EPA regulatory offices • Research partners
# of methods that support regulatory mandates or programs	• Data call (e.g., data from lab records)	• Supports program mission, regulations, & partner agencies	
# of methods EPA developed collaboratively with external partners	• Data call	• Improves availability, quality, consistency, & comparability of data • Demonstrates need for developed methods; shows Agency impact	

Function	Collection Method	Mission/Impact	Customers
Mission support continued			
4) Top Tools			
# web page views (or average)/defined timeframe (e.g., #/year, average #/month in a year)	• Google analytics	• Shows impact of Agency effort • Improves the availability, quality, consistency, and comparability of data	• EPA intranet users • Public, including all decision- makers at federal, state, local, tribal, & private-sector levels
# unique web page views (or average)/defined timeframe			
# of tool downloads (if downloadable)			
5) Technical Assistance for Program Implementation			
# of members on regulatory workgroups (branch & division level)	• Data call (e.g., data from lab reports, records from technical support centers)	• Produce high quality science to support agency's mission • Overall quality assurance • Credibility/reliability of scientific data • Accountability • Promote transparency on all actions taken	• State, tribal, & local labs • Environmental authorities • Law enforcement • Emergency responders • Superfund and brownfield regulatory authorities
# of state, tribal and local labs EPA audits			
# of state labs that are certified by EPA			
# of reference standards shipped to states, localities, and tribes			
# of sampling and analysis plans reviewed (e.g., QA analysis plans)			
# of actions that support enforcement (e.g., case litigation/support, testimony in court)			
# of regulatory implementation actions supported			
# of grants and contracts overseen			
# of times lab/program office data are reviewed/interpreted/validated			
# of tech inquiries/tech support/troubleshooting requests associated with measurement methods			
# of risk assessments performed			
6) Training and Education related to the Laboratory Enterprise			
# of internships, fellowships, and federal post-docs	• Data call	• Prepares future generation of scientists, technicians, and engineers	• Next generation of scientists, academic partners; & federal, state, local, tribal agencies whose work is aided by the intern/fellow/post-doc
# of external trainings provided (e.g., webinars, career development trainings, formal trainings, training at conferences) by audience			• State, local, tribal audiences • Research community; professional associations • Regulated community

Function	Collection Method	Mission/Impact	Customers
Scientific Excellence			
7) Credibility/Transparency			
# of external peer reviews conducted (e.g. integrated risk assessments, ISIs*, HISAs*, and peer reviewed manuscripts)	• Data call (e.g., data from science inventory, SAB)	• Credibility/transparency of scientific data • High quality; scientific excellence	• Agency laboratories • Agency partners • Public (confidence in quality of EPA science)
# of external science program reviews (SAB*, FACA*)			
8) Quality Assurance			
% of projects and processes that have an approved QAPP* in place	• Data call (e.g., data from lab reports)	• Credibility/transparency of scientific data • High quality; scientific excellence	• Agency laboratories • Agency partners • Public (confidence in quality of EPA science)
# of EPA labs that are accredited by one or more external bodies (e.g., ISO*, TNI*)			
# of EPA labs that are audited internally and externally			

*QA: Quality Assurance; OPARM: Office of Program Accountability and Resource Management; FEM: Forum on Environmental Measurements; ISIs: Influential Scientific Information; HISAs: Highly Influential Science Assessments; SAB: Science Advisory Board; FACA: Federal Advisory Committee Act; QAPP: Quality Assurance Project Plan; ISO: International Organization for Standardization; TNI: The National Environmental Laboratory Accreditation Program (NELAC) Institute.

Appendix E: Phase II Products and Services for Mission Support and Scientific Excellence

Mission Support:
Expert consultation for regulatory development
Actions taken to support Air, Water, Children's Health, and Resource Conservation and Recovery Act (RCRA)
Emergency preparedness (pre/post event)
Emergency capabilities and capacity
Participation in joint exercises
Case studies (e.g., ORD Reach back, Water Infrastructure Protection)
Emergency operations supported
of emergency response actions supported
of methods developed and samples analyzed for specific events
Method Development (Phase 2)
of citations of a method
Total # of cumulative methods - Capture if method modification and/or updates increases # of users and capture satisfaction of users with models (e.g., existing survey/feedback data)
Tool Development (Phase 2)
of citations of a tool
Total # of cumulative tool - Capture if tool modification and/or updates increases # of users and capture satisfaction of users with models (e.g., existing survey/feedback data)
of external presentations or briefings on tools and to whom
Technical Assistance for Program Implementation (Phase 2)
of instances of technical assistance for field sampling or specialized monitoring projects (Ambient water quality surveys, Landfill and surface air monitoring investigations, Electroshocking fish sampling)
of instances of technical assistance for field measurement and monitoring
of instances of technical assistance for field analytical support
of instances of technical assistance for regulatory work groups
Training/Education (Phase 2)
of memberships in professional organizations
of calls to EPA scientists
of awards and certifications to EPA scientists
Credibility/Transparency (Phase 2)
of scientific datasets made publicly available
of co-authorships outside the agency
of peer-reviewed manuscripts
of collaborative external partnerships
of memberships in professional organizations
of patents
of Cooperative Research and Development Agreements (CRADAs)
List of unique facilities or equipment
Quality Assurance (Phase 2)
of QAPPs reviewed/approved
of QMPs reviewed/approved

Appendix F: Potential Comparison Laboratories for Benchmarking

Agency/Department	Lab/Facility	
NOAA		
	Atlantic Oceanographic and Meteorological Laboratory (AOML)	
	Air Resources Laboratory (ARL)	
	Earth System Research Laboratory (ESRL)	
	Geophysical Fluid Dynamics Laboratory (GFDL)	
	Great Lakes Environmental Research Laboratory (GLERL)	
	National Severe Storms Laboratory (NSSL)	
	Pacific Marine Environmental Laboratory (PMEL)	
Reclamation		
	Brackish Groundwater National Desalination Research Facility (BGNDRF)	
	Technical Service Center (TSC): Includes Water Treatment Engineering Research (WaTER) Laboratory	
	Water Quality Improvement Center (WQIC)	
USGS		
	Alaska	Pacific
	Midwest	Southeast
	Northeast	Southwest
	Northwest	National Water Quality Laboratory (NWQL)
FDA		
	Center for Food Safety and Applied Nutrition (CFSAN)	
	National Center for Toxicological Research (NCTR)	
DOE		
Office of Science	Argonne National Laboratory (ANL)	
	Brookhaven National Laboratory (BNL)	
	Fermi National Accelerator Laboratory (FNAL)	
	Lawrence Berkeley National Laboratory (LBNL)	
	Oak Ridge National Laboratory (ORNL)	
	Pacific Northwest National Laboratory (PNNL)	
National Nuclear Security Administration	Lawrence Livermore National Laboratory (LLNL)	
	Los Alamos National Laboratory (LANL)	
	Sandia National Laboratory (SNL)	
Office of Nuclear Energy	Idaho National Laboratory (INL)	
Office of Fossil Energy	National Energy Technology Laboratory (NETL)	
Office of Energy Efficiency and Renewable Energy	National Renewable Energy Laboratory (NREL)	
Office of Environmental Management	Savannah River National Laboratory (SRNL)	
Defense		
	Coastal and Hydraulics Laboratory (CHL)	
	USACE Environmental Laboratory	
USDA		
	Agricultural Research Service	
	NRCS Soil Research and Lab	

Agency/Department	Lab/Facility	
State Labs*		
	R1: Connecticut Dept. of Public Health - State Public Health Laboratory	
	R1: Rhode Island State Dept. of Health - Center for Environmental Sciences	
	R2: New Jersey Dept. of Health - Environmental & Chemical Laboratory Services	
	R3: Maryland Dept. of Health - Division of Environmental Sciences	
	R4: Florida Dept. of Environmental Protection (DEP) - DEP Laboratory	
	R4: Kentucky Dept. for Environmental Protection - Environmental Services Branch	
	R5: Minnesota Dept. of Health - Public Health Laboratory Division	
	R6: Texas Commission on Environmental Quality	
	R6: Oklahoma Dept. of Environmental Quality - State Environmental Laboratory Services	
	R7: University of Iowa - State Hygienic Laboratory Environmental Health Program	
	R8: Colorado Dept. of Public Health & Environment - Laboratory Services Division	
	R9: Hawaii Dept. of Health - Environmental Health Administration	
	R9: California Dept. of Toxic Substances Control - Environmental Chemistry Lab	
	R10: Idaho Dept. of Health and Welfare - Idaho Bureau of Laboratories	
	R10: Washington State Dept. of Ecology - Manchester Environmental Laboratory	
Contract Labs		
	Eurofins Environment Testing US (includes Lancaster site)	
	Pace Analytical	
	Test America	
University Labs		
	Duke University	Harvard University
	University of California, Davis	University of Maine
	University of California, Berkeley	University of Maryland
	New Jersey Institute of Technology	University of Northern Iowa
	Washington State University	

Note. R1-R10 = Regional Labs 1-10.
*State labs were selected by the EPA LEF based on knowledge of comparable labs within each of EPA's 10 regions.

Appendix G: Sample Analyses Performed, Field Samples Collected, and Field Measurements Taken by Media

Number of Analyses Performed by Medium

Respondent Type	Air	Water	Soil	Complex mixtures	Biological	Other analyses*
ORD	33,431 (3)	329,304 (4)	11,325 (3)	56,373 (3)	453,968 (5)	3,251 (2)
Regional	3,397 (7)	88,132 (9)	29,569 (9)	9,672 (7)	9,151 (6)	7,686 (3)
Program	10,356 (3)	1,961 (3)	357 (3)	40,776 (3)	45 (1)	20 (1)
Total	**47,184 (13)**	**419,397 (16)**	**41,251 (15)**	**106,821 (13)**	**463,164 (12)**	**10,957 (6)**

Note. # of analyses (# of org units that performed the analyses).
*Other analyses include: food samples, tire crumb rubber, house dust, wood, paint, fecal samples, geophysical soil sampling, soil texture, cation exchange capacity, extractable nitrate, extractable ammonia, total nitrogen, total carbon, total organic carbon, total inorganic carbon, filters, petroleum, wipes, fish tissue, and vegetation.

Field Samples Collected by Media

Respondent Type	Air	Water	Soil	Complex mixtures
ORD	4,753 (4)	63,236 (4)	3,849 (3)	13,959 (4)
Regional	565 (5)	6,005 (6)	4,185 (6)	5,114 (5)
Program	9,291 (2)	645 (2)	10 (1)	120 (1)
Total	**14,609 (11)**	**69,886 (12)**	**8,044 (10)**	**19,193 (10)**

Note. # of samples (# of org units that collected the field samples).

Field Measurements Taken by Media

Respondent Type	Air	Water	Soil	Complex mixtures
ORD	2,335 (4)	161,309 (4)	158,900 (3)	1,116 (3)
Regional	1,253 (4)	42,315 (5)	141 (2)	109 (2)
Program	12,100 (2)	40 (1)	0 (0)	45 (1)
Total	**15,688 (10)**	**203,664 (10)**	**159,041 (5)**	**1,270 (6)**

Note. # of measurements (# of org units that took the field measurements).

Appendix H: Detailed Description of Highlighted Tools

Definition from Data Call on Dec. 7, 2017:

- *Tool: A model/data/database/interactive user interface/process accessed via computer (website, download, web services) that is used to inform decision-making.*

Criteria for selecting tools (agreed upon from LEF Business Case Meeting on March 8, 2018):

- Developed or customized by EPA
- Simple, direct connection to environmental impact
- Contributes to decision-making for clients
- Usable by clients external to the Laboratory Enterprise

ORD-Water Security Test Bed

The USEPA's Water Security Test Bed (WSTB) facility is a full-scale representation of a typical municipal drinking water distribution system, designed in collaboration with the Department of Energy's Idaho National Laboratory. The WSTB facility is a unique, one-of-a-kind facility that provides a safe yet representative physical water system model to study a wide range of pathogens, chemicals and radionuclides of concern that may be introduced (accidentally or intentionally) into drinking water systems. Decision makers or first responders who use data generated from the WSTB can have confidence that the data was produced in a system that represents a real drinking water system.

The EPA is the lead federal agency responsible for working with water utilities to protect water distribution systems from contamination and to clean up systems that become contaminated. Intentional and unintentional contamination of distribution systems can result in large amounts of water and miles of infrastructure that must be cleaned to return the system to service. The WSTB allows researchers to contaminant a representative water distribution system with chemical, biological, radiological contaminants or surrogates and then monitor the fate and transport of contaminants within water infrastructure and determine efficacy of decontamination technologies. To date, most of the research conducted at the WSTB has been homeland security focused (e.g. infrastructure decontamination, wash water treatment). However, the WSTB facility can support water research on a variety of topics such as biofilms, sensors, and maintaining water quality within a distribution system.

The WSTB provides data at a realistic scale that informs decision-making by emergency response personnel, On-Scene Coordinators, water utility managers, and drinking water administrators. The WTSB research results are also used by water quality managers at municipal and private utilities to make informed decisions about emergency response planning (e.g., information about available decontamination technologies and equipment).

EPA is expanding the test bed research capability to additional potential collaborators such as agencies within the DOE, Department of Defense, the Department of Homeland Security, universities, water utilities, and foundations interested in water security research. EPA is also considering partners' needs as they build out the test bed to include complex network connections, cyber-security, and finished water from different source waters commonly found throughout the United States. EPA is reaching out to appliance manufacturers, portable treatment unit manufacturers, decontamination technology representatives among others to encourage collaboration and testing at the WSTB.

What is the name of the tool? What does it accomplish/do?

The USEPA's Water Security Test Bed (WSTB) facility is a full-scale representation of a drinking water distribution system. In collaboration with the Department of Energy's Idaho National Laboratory, USEPA designed the WSTB facility to support full-scale evaluations of water infrastructure, premise plumbing, and appliance decontamination. Currently, the WSTB replicates a section of a typical municipal drinking water piping system with roughly 450 feet of 8" cement mortar-lined ductile iron pipe and two fire hydrants laid out in an "L" shape connected by a 200-foot copper service line to household appliances. It also has a 28,000-gallon lagoon that supports mobile emergency water treatment system research. The test bed allows researchers to contaminant a representative water distribution system with chemical, biological, radiological contaminants or surrogates and then monitor the fate and transport of contaminants within water infrastructure and determine efficacy of decontamination technologies. To date, most of the research conducted at the WSTB has been homeland security focused (e.g. infrastructure decontamination, wash water treatment). However, the WSTB facility can support water research on a variety of topics such as biofilms, sensors, and maintaining water quality within a distribution system.

Why is it important?

The WSTB is important because it is a unique, one-of-a-kind facility that supports full-scale research on drinking water systems. The EPA researchers that use the facility are not aware of any other facility like the WSTB. For obvious reasons, contaminants cannot be injected into real water systems to perform fate and transport and decontaminations studies. The test bed provides a safe yet representative water system to study for a wide range of pathogens, chemicals and radionuclides of concern. Decision makers or first responders who use data generated from the WSTB can have confidence that the data was produced in a system that represents a real drinking water system.

What additional benefits does the tool provide? (e.g. reduced cost and/or timeframes, increased efficiency, etc.)

The primary benefit that WSTB provides is data from a real, full scale representation of a water distribution system. Multiple types and sizes of pipe, sensors, pumps, decontamination and rehabilitation technologies can be integrated and evaluated side-by-side. This includes research to evaluate promising and commercially available field-scale infrastructure decontamination technologies previously tested at the bench- and pilot-scale in real-time to assure first responders that decontamination technologies and approaches are practical and effective during an actual incident. Large volumes of potentially hazardous contaminated water generated from experiments can be applied to the large on site evaporative lagoon for disposal. The INL site is heavily protected and guarded due to its DOE mission which allows researchers to perform work with chemicals and radionuclides which may not be allowed at other facilities. The site can also provide large quantities of chlorinated groundwater to the test bed for experiments from their well fields.

How does it impact decision-making?

The EPA is the lead federal agency responsible for working with water utilities to protect water distribution systems from contamination and to clean up systems that become contaminated. Intentional and unintentional contamination of distribution systems can result in large amounts of water and miles of infrastructure that must be cleaned to return the system to service. EPA's discussions with stakeholders in the drinking water community emphasized the importance of testing water infrastructure decontamination methods and technologies on a large scale that is representative of an actual drinking water distribution system. Working at the WSTB provides data at a realistic scale that informs decision-making of emergency response personnel. The testing results from the WSTB are made available by EPA and used by water quality managers at municipal and private utilities to make informed buying decisions and emergency response planning concerning available decontamination technologies and equipment.

What types of information are needed to use the tool?

The user would need to have a plan (and preferably a QAPP) for how to conduct a field scale experiment. Familiarity with the WSTB site would be helpful in developing this type of plan. The user would need to work with the INL to make sure that site requirements are met. This could include issues such as health and safety training, INL site access, gaining clearance to bring chemicals on site, and disposal of contaminated water.

Who are the users of the tool?

Emergency response personnel, On-Scene Coordinators, water utility managers, and drinking water administrators are users. EPA is opening the test bed research capability to additional potential collaborators such as agencies within the DOE, Department of Defense, the Department of Homeland Security, universities, water utilities, and foundations interested in water security research. EPA is also considering partners' needs as they build out the test bed to include complex network connections, cyber-security, and finished water from different source waters commonly found throughout the United States. EPA is reaching out to appliance manufacturers, portable treatment unit manufacturers, decontamination technology representatives among others to encourage collaboration and testing at the INL Test Bed.

OLEM-VIPER

VIPER is a tool that provides acquisition, storage, analysis, and visualization for real-time sensor data related to EPA's Superfund program. The tool allows decision makers on site to make instantaneous decisions in the field as information streams in front of them and matches that information to identified data quality objectives. Eliminating the reliance on data loggers or manual recording of data thus ensures that the decisions are being made using the best information available without any delay.

Users of the tool include EPA On-Scene Coordinators, Remedial Project managers and their site support contractors. Due to VIPER's ability to accept and store data from other sources, it can be employed to visualize all sensor data being collected on a site. VIPER has successfully received data from other state and federal agencies, as well as potentially responsible parties, allowing it to provide a common operational picture for the field work by bringing in data from all involved parties.

What is the name of the tool? What does it accomplish/do?

Viper provides acquisition, storage, analysis and visualization for real-time sensor data related to EPA's Superfund program.

Why is it important?

By storing, analyzing and visualizing this field data in real-time it allows site decision makers to make decisions in real-time based on real-time observations in the field. It also solves the dilemma of how to manage and store high velocity, high volume sensor data. A single deployment can result in 100s of millions of readings and Viper project managers can rapidly distill that information and align it with their site-specific data quality objectives for real-time analysis.

What additional benefits does the tool provide? (e.g. reduced cost and/or timeframes, increased efficiency, etc.)

N/A

How does it impact decision-making?

By putting real-time sensor data directly in front of the site decision makers, without the need to use data loggers and manually record field observations, it enables those decisions to be made in real-time. Viper also provides real-time data processing and calculates time weighted averages, vector averages and correction factors to better align instantaneous sensor readings with the data quality objectives identified during the quality assurance planning process. Viper can check sensor data against those DQOs and provide automatic notifications to designated individuals visually within the system and via email.

What types of information are needed to use the tool?

Information related to the sensor reading (parameter, value, date, time, location) are formatted according to the common alerting protocol (CAP) XML data standard utilized by several crisis communication systems and then fed into the cloud environment via set control points.

Who are the users of the tool?

EPA Federal On-Scene Coordinators, Remedial Project managers and their site support contractors. Due to Vipers' ability to accept data from other sources, it can also serve as a common operational picture and data store for ALL sensor data being collected on a site and successfully receive data from other state and federal agencies, as well as potentially responsible parties.

ORD-National Stormwater Calculator

The National Stormwater Calculator (SWC) is an online tool that estimates the amount of stormwater runoff generated under different development and control scenarios over a long-term period of historical rainfall based on information about a site's location and land cover. The SWC helps site developers and property owners determine how to reduce stormwater runoff by decreasing the footprint of sites and using low-impact development (LID) controls. Reducing the amount of runoff going into storm drains and on roadways helps to prevent contamination of waterways, infrastructure degradation, and overwhelming water treatment plants.

Specific benefits of the tool include the ability to: provide planning level estimates of capital and maintenance costs for LID controls as part of new development or redevelopment; determine specific site constraints; and consider how runoff may vary based on historical weather and potential future climate conditions.

The SWC can be used by anyone interested in reducing runoff from a property, including site developers, landscape architects, urban planners, community groups, and homeowners.

What is the name of the tool? What does it accomplish/do?

The National Stormwater Calculator (SWC) https://www.epa.gov/water-research/national-stormwater-calculator. The SWC estimates the amount of stormwater runoff generated from any site (less than 12 acres) within the United States, including Puerto Rico, under different development and control scenarios over a long-term period of historical rainfall.

Why is it important?

The SWC allows users to incorporate low-impact development controls (LID), which include seven green infrastructure practices, into their runoff management plans. Green infrastructure promotes the natural movement of water, instead of allowing it to wash into streets and down storm drains. Having less water runoff into storm drains and roadways can help prevent contamination of waterways, infrastructure degradation, flooding, and overwhelming of treatment plants. This allows stormwater to be used as a resource rather than a waste product and can add aesthetic and economic value to a community.

What additional benefits does the tool provide? (e.g. reduced cost and/or timeframes, increased efficiency, etc.)

The SWC has a module that provides planning level estimates of capital and maintenance costs, which allows users to evaluate and compare the effectiveness and costs of LID controls. This includes whether the project is being applied as part of new development or redevelopment and if there are existing site constraints. It also allows users to consider how runoff may vary based on historical weather and potential future climate conditions.

How does it impact decision-making?

The SWC is most appropriate for performing screening level analysis of small footprint sites up to several dozen acres in size with uniform soil conditions. Its primary focus is informing site developers and property owners on how well they can meet a desired stormwater retention target. The SWC can help users determine whether to incorporate LID controls in their site development plans.

What types of information are needed to use the tool?

The user supplies information about a site's location and land cover and selects the LID controls they would like to use. The SWC uses several national databases to provide soil, topography, rainfall, and evaporation information.

Who are the users of the tool?

The SWC can be used by anyone interested in reducing runoff from a property, including site developers, landscape architects, urban planners, community groups, and homeowners.

NHSRC-SAM (Selected Analytical Methods for Environmental Remediation and Recovery)

The Selected Analytical Methods for Environmental Remediation and Recovery (SAM) identifies analytical methods to be used by laboratories performing analyses of environmental and building material samples following a contamination event. SAM influences decision-making by allowing for pre-selected methods to be used at laboratories during remediation and recovery activities, facilitating quick determinations of the nature and extent of contamination. The effectiveness of decontamination activities can also be evaluated in a timely manner to support consequence management decisions needed to minimize the health and economic impacts of an incident.

Specifically, following a chemical, radiochemical, and biological contamination incident SAM enables its user to identify a single selected method for each analyte/sample type pairing. Using the same sets of methods permits sharing of sample loads between laboratories, potentially increases the speed of analysis, improves data comparability, and simplifies the outsourcing of analytical support to commercial laboratories. Using SAM selected methods also improves the follow-up activities of validating results, evaluating data, and making decontamination and recovery decisions.

SAM is designed for use by federal, state, and local agencies, incident responders, incident decision makers and laboratories responding to a CBR contamination incident. In Calendar Year (CY) 2017, the tool was accessed by users in all 50 states plus 127 countries outside the U.S.

What is the name of the tool? What does it accomplish/do?

EPA's Selected Analytical Methods for Environmental Remediation and Recovery (SAM) identifies analytical methods to be used by laboratories performing analyses of environmental and building material samples following a contamination event. Laboratories may use this information to evaluate the nature and extent of contamination and assess decontamination efficacy. In addition to providing the SAM document in its entirety, this site contains a tool that allows users to easily query the SAM methods.

Why is it important?

The premise and purpose of SAM is to identify the analytical methods that will be used in cases when multiple laboratories are called on to analyze environmental samples following a homeland security-related intentional or accidental contamination incident. SAM is intended to support the Environmental Response Laboratory Network (ERLN) and Water Laboratory Alliance (WLA) and can be used as a tool to assist state and local laboratories in planning for and analyzing environmental samples and outdoor building material samples for chemical, radiochemical, and biological (CBR) contamination following such incidents requiring a large-scale laboratory response. The methods presented in SAM should be used to:

- Determine the extent of site contamination (assumes early responders have identified contaminants prior to EPA's remediation effort);
- Evaluate the efficacy of remediation efforts during site cleanup; and
- Confirm effectiveness of decontamination in support of site clearance decisions.

What additional benefits does the tool provide? (e.g. reduced cost and/or timeframes, increased efficiency, etc.)

Following a CBR contamination incident, it is vital to identify the nature and extent of contamination. Many laboratories would likely be needed to analyze the number and variety of samples taken from air, water, soil, or indoor and outdoor surfaces. SAM is unique in that it identifies a single selected method for each analyte/sample type pairing. Using the same set of methods would:

- Permit sharing of sample load between laboratories,
- Potentially increase the speed of analysis,
- Improve data comparability, and
- Simplify the task of outsourcing analytical support to the commercial laboratory sector.

Use of SAM selected methods would also improve the follow-up activities of validating results, evaluating data, and making decontamination and recovery decisions.

In addition to the tool, the website contains sample collection procedures and strategies, sample collection information documents, and information on the disposal of contaminated laboratory waste to facilitate a large-scale response. This additional information helps ensure that collected samples are of sufficient quality and quantity to be analyzed using the selected method and that laboratory waste is disposed of properly.

How does it impact decision-making?

Using SAM pre-selected methods at multiple laboratories during remediation and recovery activities will facilitate a quick determination of the nature and extent of contamination and evaluate the effectiveness of decontamination activities in a timely manner to support consequence management decisions needed to minimize the health and economic impacts of an incident.

What types of information are needed to use the tool?

Users will need to know the type of contaminated matrix (e.g. water, soil, air samples) and the contaminant that will be analyzed. The tool will identify the selected method to use to analyze the contaminated materials.

Who are the users of the tool?

The tool is designed for use by federal, state and local agencies, incident responders, incident decision makers and laboratories responding to a CBR contamination incident. In CY 2017, the tool was accessed by users in all 50 states plus 127 countries outside the U.S.

ORD-EPANET

EPANET is a tool that models drinking water distribution piping systems by performing extended period simulations of water movement in pressurized pipe networks. EPANET tracks the flow of water in each pipe, the pressure at each node, the height of water in each tank, a single chemical concentration throughout the network during a simulation period, the age of the water, and source tracing.

Analysis from EPANET increases the efficiency and accuracy of water system planning and maintenance by providing quantitative information necessary for decision-making without having to take actual field measurements. The tool provides insight about drinking water system planning, operations, and water quality, all of which ultimately impact public health.

The tool is a free public domain software that may be freely copied and distributed. It is used by EPA researchers, water utilities, consulting engineers, software developers, government agencies, students, and other researchers to solve drinking water problems. With over 50,000 downloads per year, EPANET is the most extensively used and downloaded model from the EPA website, and forms the basis of most of the widely used commercial modeling packages.

What is the name of the tool? What does it accomplish/do?

EPANET is software that models drinking water distribution piping systems. EPANET is public domain software that may be freely copied and distributed. EPANET performs extended period simulation of water movement and quality in pressurized pipe networks. Pipe networks consist of pipes, nodes (junctions), pumps, valves, and storage tanks or reservoirs. EPANET tracks the flow of water in each pipe, the pressure at each node, the height of the water in each tank, a single chemical concentration throughout the network during a simulation period, the age of the water, and source tracing. For more info, see https://www.epa.gov/water-research/epanet.

Why is it important?

EPANET is considered the gold standard for drinking water modeling and forms the basis of the most widely used commercial modeling packages. It is also the platform for innovation in the field, used by researchers, students, and others to develop new approaches to solving drinking water problems. The tool is used by the water industry to design and size new infrastructure, address water quality problems, plan for emergencies or disasters, and optimize operations. EPANET is the most downloaded model from the EPA website with over 50,000 downloads per year.

What additional benefits does the tool provide? (e.g. reduced cost and/or timeframes, increased efficiency, etc.)

The tool increases efficiency and accuracy for water systems, and provides quantitative information needed to support important decisions and supports State Revolving Fund applications.

How does it impact decision-making?

EPANET is used around the world to make decisions every day about water distribution system planning, operations, and water quality. These decisions ultimately impact public health.

What types of information are needed to use the tool?

Information about a water system's infrastructure, assets, operations, customers, and source water quality are needed to use EPANET.

Who are the users of the tool?

EPANET is used by EPA researchers, water utilities, consulting engineers, software developers, government agencies, students and other researchers.

Region 2-Summary Report

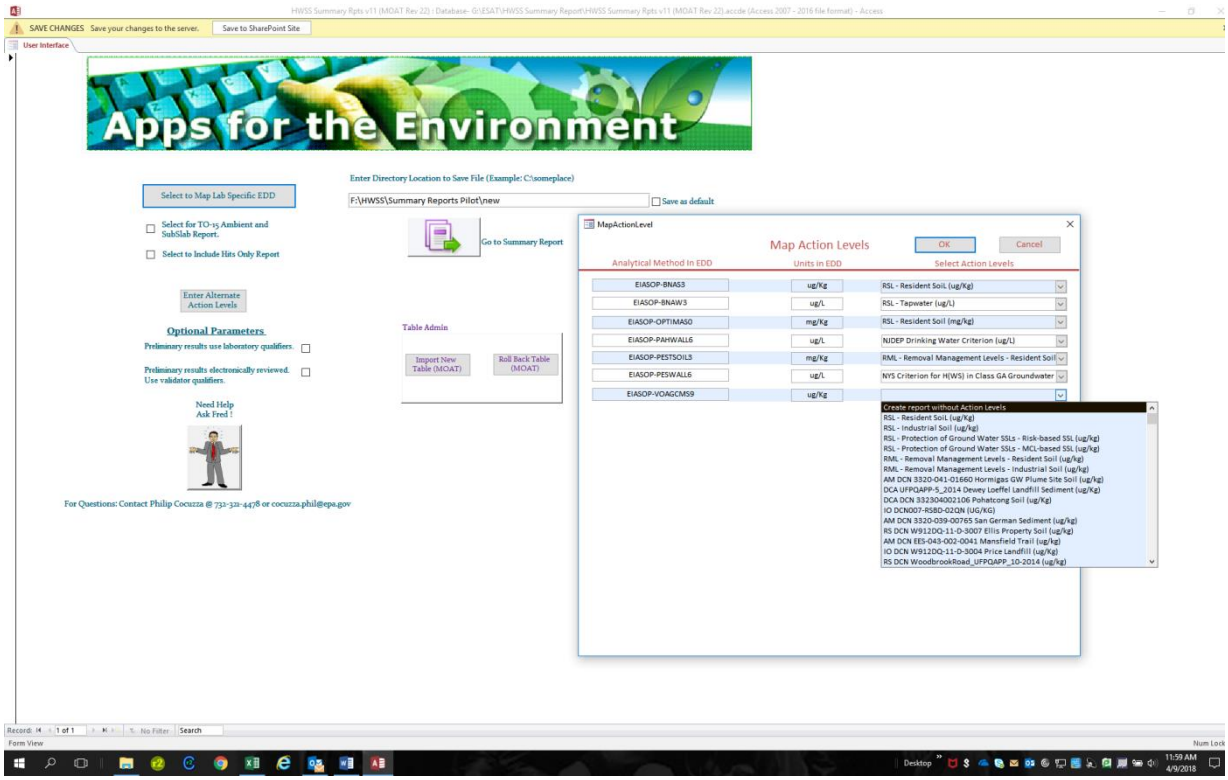
Summary Report is a tool that allows environmental results from laboratories to be rapidly compiled (less than one minute in most cases) in a user-friendly format for EPA onsite decision makers. The tool allows users to select from over 100 federal and state criteria for known environmental contaminants and compares them to the concentrations found in site samples. It then highlights those contaminants that exceed the criteria and require action to be taken.

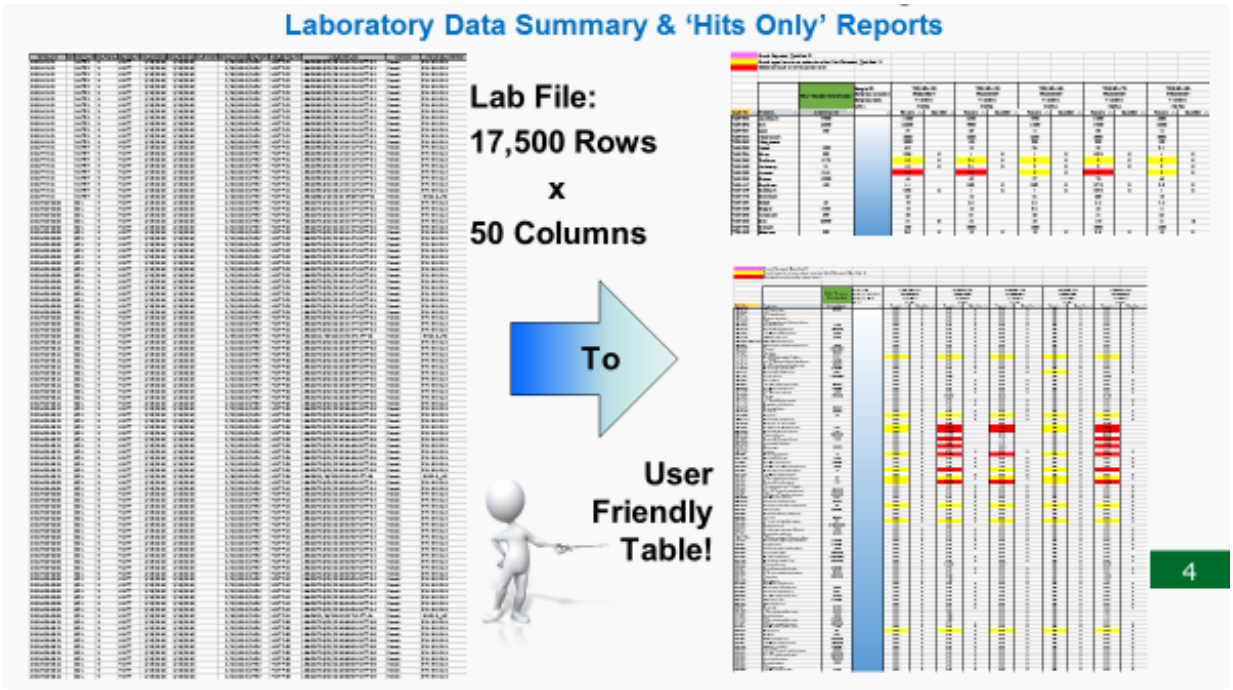
Specific benefits of Summary Report include increasing efficiency over 98% (compared to manual comparison processes), significant cost savings (over $250K for the past two years), improved quality and efficiency by automating the entire process using report ready standardized formats, and flexibility of being able to process multiple electronic data formats provided by laboratories.

Users include all Region 2 RPMs, OSCs and contractors and has also been provided to Region 1 to use.

What is the name of the tool? What does it accomplish/do?

The Summary Report Application tool takes the flat electronic data deliverable (EDD) MS Excel file from either a CLP, Region 2 DESA Lab, Region 2 subcontract TO-15 vapor intrusion lab, or any commercial lab and compiles it into: 1) a user friendly, report ready comprehensive table; and 2) a focused 'Hits Only' table in MS Excel. The application allows the user to select from ~145 federal and state criteria or known background values applicable to Region 2, or site-specific criteria that the user specifies, and compares it to the concentrations listed and highlights those red that exceed criteria or yellow for non-detects that are above criteria in the table, and pink if the value is rejected. The TO-15 option allows the user to compare both sub-slab and ambient samples to their respective criteria simultaneously. Also built in are options to select posting of lab qualifiers for preliminary data or to use the default for data validator qualifiers. The tool handles compiling and reporting multiple analytical fractions, methods and matrices within the same EDD, and allows the user to map any format EDD for input into the tool. Updates to the master criteria table are readily accomplished by an easy update button and a user-friendly 'help' link is incorporated (see attached screenshots below and supplementary material attached). To realize the full capability and benefits of the tool, it is best to see it operating live – Region 2 would gladly demonstrate it by using Adobe connect.


Apps for the Environment
Select to Map Lab Specific EDD
Select for TO-15 Ambient and SubSlab Report.
Select to Include Hits Only Report
Enter Alternate Action Levels
Optional Parameters
Preliminary results use laboratory qualifiers.
Preliminary results electronically reviewed. Use validator qualifiers.
Need Help Ask Fred !
For Questions: Contact Philip Cocuzza @ 732-321-4478 or cocuzza.phil@epa.gov
Enter Directory Location to Save File (Example: C:\someplace)
F:\HWSS\Summary Reports Pilot\new
Save as default
Go to Summary Report
Table Admin
Import New Table (MOAT)
Roll Back Table (MOAT)
MapActionLevel
Map Action Levels
OK
Cancel
Analytical Method In EDD
Units in EDD
Select Action Levels
EIASOP-BNAS3
EIASOP-BNAW3
EIASOP-OPTIMAS0
EIASOP-PAHWALL6
EIASOP-PESTSOIL3
EIASOP-PESWALL6
EIASOP-VOAGCMS9
ug/Kg
ug/L
mg/Kg
ug/L
mg/Kg
ug/L
ug/Kg
RSL - Resident SoiL (ug/Kg)
RSL - Tapwater (ug/L)
RSL - Resident Soil (mg/kg)
NJDEP Drinking Water Criterion (ug/L)
RML - Removal Management Levels - Resident Soil
NYS Criterion for H(WS) in Class GA Groundwater
Create report without Action Levels
RSL - Resident SoiL (ug/Kg)
RSL - Industrial Soil (ug/kg)
RSL - Protection of Ground Water SSLs - Risk-based SSL (ug/kg)
RSL - Protection of Ground Water SSLs - MCL-based SSL (ug/kg)
RML - Removal Management Levels - Resident Soil (ug/kg)
RML - Removal Management Levels - Industrial Soil (ug/kg)
AM DCN 3320-041-01660 Hormigas GW Plume Site Soil (ug/kg)
DCA UFPQAPP-5_2014 Dewey Loeffel Landfill Sediment (ug/Kg)
DCA DCN 33230402106 Pohatcong Soil (ug/Kg)
IO DCN007-RSBD-020N (UG/KG)
AM DCN 3320-039-00765 San German Sediment (ug/kg)
RS DCN W912DQ-11-D-3007 Ellis Property Soil (ug/kg)
AM DCN EES-043-002-0041 Mansfield Trail (ug/kg)
IO DCN W912DQ-11-D-3004 Price Landfill (ug/Kg)
RS DCN WoodbrookRoad_UFPQAPP_10-2014 (ug/kg)


Laboratory Data Summary & 'Hits Only' Reports
Lab File:
17,500 Rows
x
50 Columns
To
User Friendly Table!
4

Why is it important?

This application allows environmental chemistry data to be rapidly compiled (< 1 minute) into a user-friendly table that highlights all concentrations above Federal/State/Background or alternate criteria/levels and alerts the user if reporting limits are above criteria concentration limits. Significant time and contractor dollars are saved (see below) with no transcription errors.

Metric	Without Application	Using Application (actual)	Improvements
LOE to Compile & Compare	**1 Hour** per SDG	**<1 Minute** per SDG	**98.3%**
Report Quality	Transcription Errors Possible	No Transcription Errors	**0 transcription errors**
YEAR 1 LOE – 14,500 Fractions	**725 Hours**	**12.1 Hours**	**712.9 Hours Saved**
YEAR 1 Dollars – 14,500 Fractions	$ 126,875	$ 21,175	**$ 124,757.50 Saved**
YEAR 2 LOE – 15,000 Fractions	**750 Hours**	**12.5 Hours**	**737.5 Hours Saved**
YEAR 2 Dollars – 15,000 Fractions	$ 131,250	$ 2,187.50	**$ 129,062.50 Saved**

What additional benefits does the tool provide? (e.g. reduced cost and/or timeframes, increased efficiency, etc.)

- Increased efficiency over 98%
- Significant cost savings – $ 253,825 saved over two years
- Improved quality and efficiency by automating entire process using report ready standardized formats - no transcription errors
- Flexibility built in to process multiple electronic data formats
- Visually highlighted comparative tables to federal and/or state regulatory criteria or background values – data above criteria/background automatically highlighted
- Notification and delivery via SharePoint workflow 24/7/365
- No specialized software or training required and no development costs – developed in-house by EPA HWSB staff using standard MS Office elements
- Positive user feedback

How does it impact decision-making?

It allows RPMs, OSCs or other recipients of the tool's outputs (i.e., contractors, states, tribes, etc.) to know immediately if they have an environmental problem or concern, or an issue with analyte reporting limits that are above criteria concentrations.

What types of information are needed to use the tool?

Very little – information needed to run the tool are as follows:

1. **Criteria or Alternate Concentration for Comparison**
   - None – can run the application without a comparative level to just get summary and 'hits only' tables
   - Pre-loaded federal & state or background – select from pull down list (criteria and background levels updated and maintained by EPA DESA personnel)
   - QAPP Specific – option to load any criteria level for any chemical constituent
2. **Lab EDD Type**
   - CLP R2 SEDD
   - CLP Universal SEDD
   - Region 2 Lab EDD
   - Option to map non-standard EDD
3. **Preliminary Non-validated or Validated**
   - Select to have either lab or data validators qualifiers posted
4. **TO-15 Data**
   - Select which samples are sub-slab and which are ambient

Who are the users of the tool?

All Region 2 RPMs, OSCs and contractors who get chemistry data via the CLP, DESA Regional Laboratory or Basic Purchase Agreement (BPA) for TO-15 analysis use the outputs from the tool.

The tool is maintained and run by EPA DESA personnel, and the summary and 'hits only' reports are posted to SharePoint, where analytical requestors are notified via workflows 24/7/365 that their chemistry data is available for download.

A version of the tool (i.e., loaded with R1 States criteria) was provided and demonstrated to Region 1, but it is unknown if they are using it.

Appendix I: Detailed Description of Highlighted Datasets

Definition of a dataset: *A meaningful collection or grouping of similar or related data*:

- (Directly) generated by or vetted through EPA's Laboratory Enterprise
- Used to support:
  - High-level EPA decision-making regarding human health and/or the environment;
    - Journal articles;
    - Reports
- May or may not be publicly available

OAR RadNet Dataset Summary

RadNet is the only nationwide radiation monitoring network in existence. RadNet provides real-time data 1) for radiological or nuclear emergency response assessments and activities to EPA, other federal agencies, states, and local governments following a major atmospheric release of radioactive contamination; 2) to inform public officials and the general public of the impacts resulting from major radiological incidents/accidents; and 3) on baseline levels of radiation in the environment. The data are generated by analysis of air particulate collected on filters at 140 air monitors distributed throughout the United States.

RadNet fulfills responsibilities assigned by the DHS to EPA in the National Response Framework Nuclear/Radiological Incident Annex (DHS08). Following a major radiological or nuclear incident, RadNet data in combination with data from other sources are used to make public health decisions (e.g., evacuation, shelter in place, medical countermeasures) by EPA and other federal and state agencies.

RadNet data are also used to place additional temporary air sampling in appropriate locations and are used to refine the modeling of atmospheric plumes of radioactive contamination. During routine operations, RadNet data serve as a source of background or ambient radiation levels for comparative purposes.

What is the name of the dataset? What does it accomplish/do?

The dataset is called RadNet and is hosted on CDX and Envirofacts. RadNet is the only nationwide radiation monitoring network in existence.

The RadNet real-time data and associated laboratory filter analyses accomplishes the following:

- Provide data for radiological or nuclear emergency response assessments and activities to EPA, other federal agencies, states and local governments following a major atmospheric release of radioactive contamination.
- Inform public officials and the general public of the impacts resulting from major radiological incidents/accidents.
- Provide data on baseline levels of radiation in the environment.

Why is the dataset important to EPA's Laboratory Enterprise?

The dataset provides the data necessary to fulfill many of responsibilities assigned by the Department of Homeland Security (DHS) to EPA in the National Response Framework, Nuclear/Radiological Incident Annex (DHS08). These responsibilities include:

- Provide nationwide environmental monitoring data from the RadNet air network for assessing the national impact of a major radiological or nuclear incident.
- Estimation of the effects of radioactive releases on human health and the environment.
- Provides data on baseline or ambient levels of radiation in the environment for comparison to elevated levels.

How does the dataset impact decision-making internally/externally?

Following a major radiological or nuclear incident, RadNet data in combination with data from other sources are used to make public health decisions (evacuation, shelter in place, medical countermeasures, etc.) by EPA and other federal and state agencies. RadNet data are also used to place additional temporary air sampling in appropriate locations and are used to refine the modeling of atmospheric plumes of radioactive contamination.

During routine operations, RadNet data serve as a source of background or ambient radiation levels for comparative purposes.

Who are the users of the dataset?

Users of the dataset following a major radiological or nuclear incident include: Several offices in EPA, other federal agencies (e.g. DHS, DOE, CDC, FDA, etc.), states, local governments, radiological emergency responders and assessors, Emergency Operation Centers, public officials and the public.

Users of the dataset during routine operations include: several offices in EPA, other federal agencies, states, and the public.

What collaboration(s) does EPA engage in to generate this dataset?

The data are generated by analysis of air particulate collected on filters at 140 air monitors distributed throughout the United States. Federal, state and local governments and academic organizations volunteer their time and effort to perform routine filter exchanges and return the filters to the laboratory for analyses.

RadNet is classified as a High Value Asset by DHS and as such there is collaboration between DHS and EPA on the IT infrastructure of RadNet as well as the network itself.

Additionally, the U.S. EPA has entered into a data sharing arrangement with the International Atomic Energy Agency for the exchange of these data with participating nations, thereby increasing the scope and scale of data available for U.S. decision makers.

OW UCMR Dataset Summary

EPA's Office of Water (OW) manages the Unregulated Contaminant Monitoring Rule (UCMR), under which EPA collects data from 5,000-6,000 public water systems (PWSs) for up to 30 contaminants during each 5-year UCMR cycle. The data helps the Agency understand the frequency and levels at which particular contaminants occur in drinking water.

States and PWSs may also use the data to support decision-making (e.g., regarding actions to reduce the concentration of particular contaminants in the drinking water) and risk communication. The publicly available dataset also allows consumers to better understand the quality of the water being provided by their PWSs.

EPA leads the "direct implementation" of UCMR, support by states who volunteer to partner with the Agency. Large PWSs collect their samples and hire commercial laboratories (approved by EPA) to analyze them. Small PWSs collect their samples and send them to laboratories contracted by (and overseen by) EPA.

What is the name of the dataset? What does it accomplish/do?

The National Contaminant Occurrence Database (NCOD) hosts data collected by EPA on the occurrence of emerging contaminants in drinking water. Results from the Unregulated Contaminant Monitoring Rule (UCMR) are posted to (https://www.epa.gov/dwstandardsregulations/national-contaminant-occurrence-database-ncod#unreg).

Why is the dataset important to EPA's Laboratory Enterprise?

OW manages the Unregulated Contaminant Monitoring Rule (UCMR), under which EPA collects data from 5,000-6,000 public water systems (PWSs) for up to 30 contaminants during each 5-year UCMR cycle (https://www.epa.gov/dwucmr/occurrence-data-unregulated-contaminant-monitoring-rule). The data help the Agency understand the frequency and levels at which particular contaminants occur in drinking water.

How does the dataset impact decision-making internally/externally?

The UCMR data collection is called for by the Safe Drinking Water Act. The primary purpose is to support Agency decisions as to whether to regulate particular contaminants of emerging concern (with priorities generally driven by the Agency's Contaminant Candidate List). That decision-making is made per the Regulatory Determination process (https://www.epa.gov/ccl/basic-information-ccl-and-regulatory-determination) as prescribed by SDWA.

Who are the users of the dataset?

EPA is the primary user of the dataset; it supports the aforementioned Regulatory Determination process for contaminants of emerging concern.

States and Public Water Systems may also use the data to support decision-making (e.g., regarding actions to reduce the concentration of particular contaminants in the drinking water) and risk communication.

The publicly available dataset also allows consumers to better understand the quality of the water being provided by their PWS.

What collaboration(s) does EPA engage in to generate this dataset?

EPA leads the "direct implementation" of UCMR, supported by states who volunteer to partner with the Agency. Large Public Water Systems collect their samples and hire commercial laboratories (approved by EPA) to analyze them. Small PWSs collect their samples and send them to laboratories contracted by (and overseen by) EPA.

UCMR samples are analyzed using prescribed methods (most of which developed by ORD and OW; some of which are developed by consensus method organizations and others).

Labs post results to EPA's web-based reporting system, SDWARS (https://www.epa.gov/dwucmr/safe-drinking-water-accession-and-review-system-sdwars4-instructions-public-water-systems-and). The results undergo QC checks, are compiled by OW, and are posted to NCOD approximately quarterly.

Region 4 Everglades REMAP Dataset Summary

Everglades REMAP (Regional Environmental Monitoring and Assessment Program). It is used to describe, diagnose, and predict water quality and ecological conditions in the Everglades. The Program also documents responses to multi-billion-dollar Florida and federal efforts to protect and restore the Everglades. It is produced through the largest in-house effort of the Agency and provides information consistent with Administrator Pruitt's priority for ensuring sound science and research. The dataset describes conditions in the Everglades in 1995-1996, 1999, 2005, 2013 and 2014.These EPA data have been used or cited in hundreds of publications and reports by dozens of authors in the private and public sectors, including the state of Florida, agriculture, federal agencies, and the National Academies of Science.

EPA, Florida, the Department of Interior, agriculture, and environmental groups have used REMAP data to document the Everglades' response to efforts to control phosphorus from agriculture and mercury air emissions, and to determine whether sulfur from agricultural areas should be controlled. REMAP enables periodic, unbiased descriptions of the Everglades for several performance measures in the Comprehensive Everglades Restoration Program (CERP), a joint Florida - Army Corps of Engineers program to restore the Everglades. The National Academies of Science uses REMAP to describe conditions and as evidence of change (or lack thereof) in their federally mandated review of CERP.

Environmental managers, leaders, scientists and others in agriculture, the Miccosukee and Seminole Indian Tribes, many Florida and Federal Government (including EPA) agencies, universities, environmental groups, and consultants.

What is the name of the dataset? What does it accomplish/do?

Everglades REMAP (Regional Environmental Monitoring and Assessment Program). It is used to describe, diagnose, and predict water quality and ecological conditions in the Everglades. The Program also documents responses to multi-billion-dollar Florida and federal efforts to protect and restore the Everglades. https://www.epa.gov/everglades/environmental-monitoring-everglades

Why is the dataset important to EPA's Laboratory Enterprise?

It is produced through the largest in-house effort of the Agency and provides information consistent with Administrator Pruitt's priority for ensuring sound science and research. The dataset describes conditions in the Everglades in 1995-1996, 1999, 2005, 2013 and 2104. These EPA data have been used or cited in hundreds of publications and reports by dozens of authors in the private and public

sectors, including the state of Florida, agriculture, federal agencies, and the National Academies of Science.

How does the dataset impact decision-making internally/externally?

EPA, Florida, the Department of Interior, agriculture, and environmental groups have used REMAP data to document the Everglades' response to efforts to control phosphorus from agriculture and mercury air emissions, and to determine whether sulfur from agricultural areas should be controlled. REMAP enables periodic, unbiased descriptions of the Everglades for several performance measures in the Comprehensive Everglades Restoration Program (CERP), a joint Florida-Army Corps of Engineers program to restore the Everglades. The National Academies of Science uses REMAP to describe conditions and as evidence of change (or lack thereof) in their federally mandated review of CERP.

Who are the users of the dataset?

Environmental managers, leaders, scientists and others in agriculture, the Miccosukee and Seminole Indian Tribes, many Florida and Federal government (including EPA) agencies, universities, environmental groups, and consultants.

What collaboration(s) does EPA engage in to generate this dataset?

EPA collaborates with many partners: Florida Department of Environmental Protection for laboratory support and funding; Florida International University for logistics and laboratory analyses; Everglades National Park and Big Cypress National Preserve for funding and access and removal of water, plant, and fish samples from public lands; the Miccosukee Tribe of Indians of Florida for access to sample the Everglades within their Federal Reservation; the U.S. Department of the Interior and the Park for helicopter contracting and safety; and the U. S. Army Corps of Engineers for funding.

ORD NCCT Computational Toxicology Datasets Summary

The Computational Toxicology datasets provide critical human toxicity and exposure information on over 700,000 chemicals. These datasets are used by EPA, other federal agencies, state environmental and health agencies, international governmental agencies and industry to make decisions regarding the safety of chemicals, their use and permissible exposures to people. The datasets are publicly available at no cost to anyone (including states, industry and the general public) for both commercial and non-commercial use.

The datasets are generated by EPA in collaboration with hundreds of stakeholders ranging from industry, academia, and trade associations to other federal agencies, state government and non-governmental organizations.

Computational Toxicology research efforts use both laboratory testing and computer models to evaluate a large number of chemicals for their potential health effects and exposure routes, while limiting the number of laboratory animal tests that need to be performed. The process of evaluating potential health effects involves generating data that investigates the potential harm, or hazard of a chemical, the degree of exposure to chemicals as well as the unique chemical characteristics.

Some of the methods and models used by researchers at EPA's National Center for Computational Toxicology to generate these large volume datasets are given below:

- Rapid tests called high-throughput screening assays quickly and efficiently test thousands of chemicals for potential health effects. The dataset generated by these tests is called Toxcast. These results help to narrow the number of chemicals that may need to be tested further.

- It is important to link the external exposure of a chemical to an internal blood or tissue concentration. This process is called toxicokinetics. The critical factors that determine the distribution and metabolic clearance for hundreds of chemicals in blood or tissue are measured and this data is incorporated into computer models to generate large volumes of toxicokinetic data. The high-throughput toxicokinetic data are paired with the Toxcast data (high-throughput screening data) to estimate real-world exposures of the chemicals.

- Chemistry data such as chemical structures and physicochemical property information are also used to evaluate chemicals for potential health effects. The Collaborative Estrogen Receptor Activity Prediction Project data (CERAPP), a large-scale modeling project, predicts estrogen receptor activity of a common set of 32,464 chemical structures using *Quantitative structure-activity relationship models.*

- Virtual tissue computer models, one of today's cutting-edge methods, are used to simulate how chemicals may affect human development. The models are used to determine the "Tipping Point", the point when biological systems are unable to recover from or adapt to chemical exposure. When these systems are unable to recover, chemical exposures could lead to adverse outcomes such as cancer. The models help reduce dependence on animal study data and provide much faster assessments (evaluation) of chemical risk.

What is the name of the dataset? What does it accomplish/do?

Computational Toxicology Data -EPA's computational toxicology research efforts evaluate the potential health effects of thousands of chemicals. The process of evaluating potential health effects involves generating data that investigates the potential harm, or hazard of a chemical, the degree of exposure to chemicals as well as the unique chemical characteristics.

As part of EPA's commitment to share data, all the computational toxicology data is publicly available for anyone to access and use. EPA's computational toxicology data is considered "open data," and thus all the data below are free of all copyright restrictions, and fully and freely available for both non-commercial and commercial use.

High-throughput Screening Data

EPA researchers use rapid chemical screening (called high-throughput screening assays) to limit the number of laboratory animal tests while quickly and efficiently testing thousands of chemicals for potential health effects.

ToxCast Data: High-throughput screening data on thousands of chemicals.

Rapid Exposure and Dose Data

EPA researchers develop and use rapid exposure estimates to predict potential exposure for thousands of chemicals.

High-throughput toxicokinetics data: It is important to link the external dose of a chemical to an internal blood or tissue concentration; this process is called toxicokinetics. EPA researchers measure the critical factors that determine the distribution and metabolic clearance for hundreds of chemicals and incorporate these data into computer models. The high-throughput toxicokinetic data can be paired with the high-throughput screening data to estimate real-world exposures.

Sustainable Chemistry Data

EPA researchers use chemistry data such as chemical structures and physicochemical property information to evaluate thousands of chemicals for potential health effects.

Collaborative Estrogen Receptor Activity Prediction Project Data: Data and supplemental files from CERAPP (A large-scale modeling project). CERAPP combined multiple models developed in collaboration with 17 groups in the United States and Europe to predict estrogen receptor activity of a common set of 32,464 chemical structures. *Quantitative structure-activity relationship* models and docking approaches were employed, to build a total of 40 categorical and 8 continuous models for binding, agonist, and antagonist ER activity.

Chemistry Dashboard Data: Data from the Chemistry Dashboard including the mappings between the DTXSIDs and the InChIStrings and Keys, SDF files containing all chemical structures and relevant information, and a file containing CAS Number, Preferred Chemical Name and DTXSID file.

Virtual Tissues Data

EPA researchers develop virtual tissue computer models to simulate how chemicals may affect human development. Virtual tissue models are some of the most advanced methods being developed today. The models will help reduce dependence on animal study data and provide much faster chemical risk assessments.

Tipping Point Data: EPA researchers develop mathematical models to predict perturbation of biological systems and determine when cellular systems are no longer able to recover. EPA researchers use these models to determine the "Tipping Point," the point when biological systems are unable to recover from or adapt to chemical exposure. When cellular systems are unable to recover, chemical exposures could lead to adverse outcomes such as cancer.

Why is the dataset important to EPA's Laboratory Enterprise?
Dataset provides toxicity, exposure and chemistry information on thousands of chemicals.

How does the dataset impact decision-making internally/externally?
Under different federal statutes, EPA makes a broad range of decisions to protect public health and the environment from unintended consequences of using chemicals. Decisions about chemicals are also made by other federal agencies, state environmental and health agencies, international governmental agencies and industry. As examples, there are specific federal laws for pesticides, drinking water contaminants, commercial and industrial chemicals, chemicals found on contaminated sites and endocrine disrupting chemicals. These laws give EPA the authority to gather health, safety and exposure data on chemicals, require necessary testing, and control human and environmental exposures. EPA's computational toxicology researchers are integrating available chemical information including chemistry, toxicity and exposure information to help decision-makers quickly and efficiently evaluate chemicals.

Who are the users of the dataset?
Those making decisions about the safety of chemicals including EPA Program Offices and Regions, Other federal agencies, state environmental and health agencies, international governmental agencies and industry.

What collaboration(s) does EPA engage in to generate this dataset?
Collaborates with hundreds of stakeholders ranging from industry, academia, trade associations, other federal agencies, state government and non-governmental organizations. EPA exchanges knowledge and materials including chemicals, software, chemical data, animal toxicity study results, new high-throughput screening assays and more with these stakeholder groups.

Region 1 Cyanobacteria Monitoring Collaborative Dataset Summary

The Region 1 Cyanobacteria Monitoring Collaborative dataset was developed by Region 1 with its states and other groups to establish a uniform and consistent approach to monitoring cyanobacteria. The Program approach is being utilized by citizen scientists, state water quality staff, and others in Regions 1, 2, 3, 4, 5, 7, 8, 9, and is under consideration in Region 10.

BloomWatch is a crowdsourcing, citizen science smart phone app that the public can use to identify and report potential cyanobacteria blooms to assist in tracking frequency and spatial occurrence. BloomWatch not only educates people but promotes the use of quality assured data submitted by the public to address the cyanobacteria issue.

CyanoScope was developed for trained citizen scientists and professional water quality managers to collect water samples and upload microscope images to better understand the spatial distribution of potentially toxic cyanobacteria genera. Field monitoring kits complete with digital field microscopes and cyanobacteria samplers are provided to interested participants through Region 1's Equipment Loan Program.

Cyanomonitoring engages environmental professionals and trained citizen scientists in monitoring using a field fluorometer to test for blue-green phycocyanin and chlorophyll pigments in water samples. Samples are analyzed utilizing handheld field fluorometers (loaned by Region 1) to track the progression of chlorophyll and phycocyanin concentrations through the course of the sampling period, helping in the ability to forecast upcoming bloom events and manage recreational waterbodies and drinking water sources.

What is the name of the dataset? What does it accomplish/do?

Name: Region 1 Cyanobacteria Monitoring Collaborative

Developed by Region 1 with its states and other groups to establish a uniform and consistent approach to monitoring cyanobacteria.

Why is the dataset important to EPA's Laboratory Enterprise?

Three components are BloomWatch, CyanoScope, and Cyanomonitoring:

- BloomWatch - a crowdsourcing, citizen science smart phone app that the public can use to identify and report potential cyanobacteria blooms to assist in tracking frequency and spatial occurrence. The time and location of a potential bloom, accompanied by georeferenced photo documentation, are directly uploaded to the citsci.org webpage and can be relayed immediately to a state specialist for follow up. BloomWatch not only educates people but promotes the use of quality assured data submitted by the public to address the cyanobacteria issue.
- CyanoScope – Developed for trained citizen scientists and professional water quality managers to collect water samples and upload microscope images to better understand the spatial distribution of potentially toxic cyanobacteria genera. Field monitoring kits complete with digital field microscopes and cyanobacteria samplers are provided to interested participants through Region 1's Equipment Loan Program. The data collected is uploaded to the inaturalist.org webpage at http://www.inaturalist.org/projects/cyanoscope.
- Cyanomonitoring component engages environmental professionals and trained citizen scientists in monitoring using a field fluorometer to test for blue-green phycocyanin and chlorophyll pigments in water samples. Samples are analyzed utilizing handheld field fluorometers (loaned by Region 1) to track the progression of chlorophyll and phycocyanin concentrations through the course of the sampling period, helping in the ability to forecast upcoming bloom events and manage recreational waterbodies and drinking water sources.

Collaborative's webpage (http://cyanos.org/) provides detailed information and links each of the three components.

How does the dataset impact decision-making internally/externally?

N/A

Who are the users of the dataset?

The Program approach is being utilized by citizen scientists, state water quality staff, and others in Regions 1, 2, 3, 4, 5, 7, 8, 9, and is under consideration in Region 10.

What collaboration(s) does EPA engage in to generate this dataset?

Region 1's new mobile biology laboratory is used to conduct on-site training for engaged watershed protection and citizen science groups around the region and EPA staff have:

- Held trainings at more than 25 different locations around New England and trained in person more than 300 individuals, including state and local water quality staff and boards of health, municipal drinking water suppliers, and citizen associations, academic researchers, lake & River associations, and others.
- Held numerous national webinars and in-person training sessions to spread the word on the success of the Collaborative. Hundreds have been trained via webinar.
- Numerous positive articles, news clips, blog posts, tweets, and Facebook posts about the program.

Region 7 KCWaters/KCWaterBug Dataset Summary

An android telephone and web-based application named KCWaterBug provides real time data to recreational stream users regarding stream condition and the potential for contact with bacteria in the stream segment. The www.kcwaters.org website provides links to both real-time and historical data regarding urban stream conditions in the Kansas City metropolitan area.

The KCWaterBug application and sensor system demonstrates the utility of how real-time in-situ measurement of stream conditions can be used to inform the public of potential hazards in recreational streams. KCWaterBug employs a network of real-time water quality sondes whose hourly data are telemetered by the Geostationary Operational Environmental Satellite (GOES) to a central server where data are posted to the web and Android app. Additionally, the KCWaters.org web page provides easy access to stream condition historical data by simply clicking on a map location instead of having to query the Water Quality Exchange. This dataset has been used to classify a Kansas City area stream as impaired under 303D.

What is the name of the dataset? What does it accomplish/do?

The dataset is found on the web at www.kcwaters.org. The website provides links to both real-time and historical data regarding urban stream conditions in the Kansas City metropolitan area. An android telephone and web-based application named KCWaterBug provides real time data to recreational stream users regarding stream condition and the potential for contact with bacteria in the stream segment.

Why is the dataset important to EPA's Laboratory Enterprise?

The KCWaterBug application and sensor system demonstrates the utility of how real-time in-situ measurement of stream conditions can be used to inform the public of potential hazards in recreational streams. KCWaterBug employs a network of real-time water quality sondes whose hourly data are telemetered by GOES satellite to a central server where data are posted to the web and Android app. Additionally, the KCWaters.org web page provides easy access to stream condition historical data by simply clicking on a map location instead of having to query the Water Quality Exchange

How does the dataset impact decision-making internally/externally?

This dataset has been used to classify a Kansas City area stream as impaired under 303D. Additionally, this dataset empowers Kansas City area citizens to make informed decisions about the potential effects of pollutants in their recreational streams.

Who are the users of the dataset?

Regulators, academia, and public users all access parts of this dataset that are pertinent to their particular application and interest.

What collaboration(s) does EPA engage in to generate this dataset?

There are a large number of partners including EPA Region 7, University of Missouri – Kansas City, U.S. Geological Survey, U.S. Army Corps of Engineers, U.S. Geological Survey, Mid America Regional Council, Lakes of MO Volunteer Program, Central Plains Center for BioAssessment, World Water Monitoring Day, Blue River Watershed Association, Missouri Stream Team, Missouri Department of Natural Resources, Kansas Department of Health and Environment, Johnson County, Wyandotte County, Park University, City of Leawood, City of Lenexa, City of Overland Park, and City of Riverside.