

Overlap of Technology and Environmental Monitoring and Compliance

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Technology plays an important role in monitoring compliance, and some specific technologies have been employed by the Environmental Protection Agency (EPA) specifically to ensure compliance with environmental statutes such as the Clean Water Act, the Clean Air Act, and the Safe Drinking Water Act. This blog will explore how a statute of this kind is constructed and how some of these technological systems play an important role in monitoring compliance.

“Compliance monitoring is one of the key components EPA uses to ensure that the regulated community obeys environmental laws and regulations. It encompasses all regulatory agency activities performed to determine whether a facility . . . is in compliance with applicable law.”¹ The EPA utilizes on-site compliance monitoring including inspections, evaluations, and investigations, as well as off-site compliance monitoring including data collection, reporting, and oversight.²

A key example of EPA compliance monitoring and enforcement is the Clean Water Act (CWA). The CWA originated in 1948 as the Federal Water Pollution Control Act, but was amended in 1972, when the “Clean Water Act” became the common name.³ The CWA lays out the general structure for the regulation of pollutant discharge into water in America, as well as regulation of water quality standards.⁴

Under the CWA, the EPA oversees pollution control programs, including “wastewater standards for industry and water quality standards for all contaminants in surface waters.”⁵ The EPA also regulates pollutant discharge from point sources into navigable waters under the National Pollutant Discharge Elimination System (NPDES).⁶ NPDES was created by CWA in 1972, and lays out basic permit, administrative, and enforcement requirements.⁷ Under NPDES, parties must obtain permits in order to discharge pollutants from point sources into the water.⁸ These permits specify the acceptable level of a pollutant, and may also contain some management practices that permit holders can employ to protect U.S. waters.⁹ The EPA authorizes state, tribal, and territorial governments to perform many NPDES program aspects.¹⁰

¹ *Monitoring Compliance*, EPA (Dec. 19, 2024) <https://www.epa.gov/compliance/monitoring-compliance> [<https://perma.cc/ZH8P-G2M2>].

² *Id.*

³ *Summary of the Clean Water Act*, EPA (June 12, 2024) <https://www.epa.gov/laws-regulations/summary-clean-water-act> [<https://perma.cc/77AA-4X23>].

⁴ *Id.*

⁵ *Clean Water Act*, DUKEHEALTH, <https://www.safety.duke.edu/environmental-compliance/clean-water-act> (last visited Feb. 2, 2025) [<https://perma.cc/56PV-QX2U>].

⁶ *Summary of the Clean Water Act*, *supra* note 3.

⁷ *About NPDES*, EPA (March 14, 2024) <https://www.epa.gov/npdes/about-npdes> [<https://perma.cc/79KZ-PNFM>].

⁸ *NPDES Permit Basics*, EPA (Nov. 26, 2024) <https://www.epa.gov/npdes/npdes-permit-basics> [<https://perma.cc/UG28-3NET>] (defining a point source as “any discernible, confined and discrete conveyance, such as a pipe, ditch, channel, tunnel, conduit, discrete fissure, or container. It also includes vessels or other floating craft from which pollutants are or may be discharged” and a pollutant as anything that “includes any type of industrial, municipal, and agricultural waste discharged into water.”).

⁹ *Id.*

¹⁰ *About NPDES*, *supra* note 7.

Under the NPDES, there are two main types of monitoring: self-monitoring and compliance monitoring.¹¹ Self-monitoring is common, and the permitting authority will perform compliance monitoring at times to evaluate the permit holder's efforts and to deter any violations.¹²

The permits granted lay out the specifics of how a permit holder needs to monitor their water.¹³ "40 CFR 122.48(b) requires that permits must specify the type, intervals, and frequency of monitoring sufficient to yield data representative of the monitored activity."¹⁴ The location, type of sample, and frequency of sampling are important for permit writers to consider, and they are assessed on a case by case basis, depending on the future permit holder.¹⁵

The EPA has a list of approved analytical methods that can be used to measure pollutants in the water. The chemical test method list contains over 60 analytical methods, including measurements of conductance by conductivity meter, pH by pH meter, hardness by spectrophotometer, sulfate by automated colorimetry, and volatile organic compounds by isotope dilution GC/MS, among many others.¹⁶

In addition to information regarding analytical methods, the EPA provides a lot of information about using water sensors.¹⁷ Among the listed uses for water sensors are monitoring water quality, detecting contaminants, measuring surface waters nutrients levels, and monitoring distribution systems.¹⁸ These sensors can be used for measuring water quality parameters like pH, temperature, and conductivity.¹⁹ The EPA also published the NPDES Electronic Reporting Rule in 2015, which requires regulated parties to electronically report information including Discharge Monitoring Reports and "Notices of Intent to discharge in compliance with a general permit" among other reports.²⁰ This reported information allows the EPA to monitor for compliance and determine violations.²¹

In addition to the water sensors, the EPA utilizes Geographical Information Systems (GIS). GIS "is a computer system that analyzes and displays geographically referenced information. It uses data that is attached to a unique location."²² According to National Geographic, some formats of data used for GIS include cartographic data, photographic interpretation such as analysis of aerial photography, digital data like locations of cities or properties, and spreadsheet information

¹¹ *Monitoring and Reporting Requirements in NPDES Permits*, EPA, https://www.epa.gov/sites/default/files/2021-01/documents/monitoring_and_reporting_requirements_in_npdes_permits.pdf (last visited Feb. 2, 2025).

¹² *Id.*

¹³ *Id.*

¹⁴ *Id.*

¹⁵ *Id.*

¹⁶ *Approved CWA Chemical Test Methods*, EPA (Nov. 20, 2024) <https://www.epa.gov/cwa-methods/approved-cwa-chemical-test-methods> [<https://perma.cc/Q8LB-F62P>].

¹⁷ *Water Sensors Toolbox*, EPA (Jan. 22, 2025) <https://www.epa.gov/water-research/water-sensors-toolbox#:~:text=The%20Water%20Sensors%20Toolbox%20provides,the%20use%20of%20water%20sensors> [<https://perma.cc/KR8H-TSW5>].

¹⁸ *Id.*

¹⁹ *Id.*

²⁰ *NPDES eReporting*, EPA (Dec. 31, 2024) <https://www.epa.gov/compliance/npdes-ereporting> [<https://perma.cc/5KV9-FNQ6>].

²¹ *Id.*

²² *What is a geographic information system (GIS)?*, USGS (Jan. 29, 2025) <https://www.usgs.gov/faqs/what-a-geographic-information-system-gis> [<https://perma.cc/F9NQ-MWAW>].

like population demographics.²³ Users can then combine all of this information overlaid on a single map using GIS.²⁴ The EPA makes use of GIS. One specific example of how this technology is used is in analyses showing “regional patterns of dependence on intermittent, ephemeral and headwater streams for water to supply public drinking water systems in the United States, using the most recent, valid data available.”²⁵ Studies such as this provide information that helps both federal and state governments to effectively manage their watersheds.²⁶

Technologies like those mentioned above aid the EPA in planning and compliance efforts. Water sensors and approved analytical methods are very impactful tools that allow for permitholders and other parties to collect and share their data with the EPA to demonstrate compliance. GIS systems allow for geospatial information to be reviewed and considered in environmental matters. Technology continues to play a vital role in establishing and maintaining the standards set for environmental matters, and, as technology develops, it seems likely that specific uses such as these will also develop to accommodate new methods and instruments.

²³ *GIS (Geographic Information System)*, NAT'L GEOGRAPHIC (Nov. 14, 2024)

<https://education.nationalgeographic.org/resource/geographic-information-system-gis/> [https://perma.cc/35SZ-AA9S].

²⁴ *Id.*

²⁵ *Geographic Information Systems Analysis of the Surface Drinking Water Provided by Intermittent, Ephemeral, and Headwater Streams in the U.S.*, EPA (June 24, 2024) <https://www.epa.gov/cwa-404/geographic-information-systems-analysis-surface-drinking-water-provided-intermittent> [https://perma.cc/W32E-7VM9].

²⁶ *Geographic Information Systems Analysis of the Surface Drinking Water Provided by Intermittent, Ephemeral and Headwater Streams in the U.S.*, EPA (July, 2009) https://www.epa.gov/sites/default/files/2015-04/documents/2009_12_28_wetlands_science_surface_drinking_water_surface_drinking_water_study_summary.pdf