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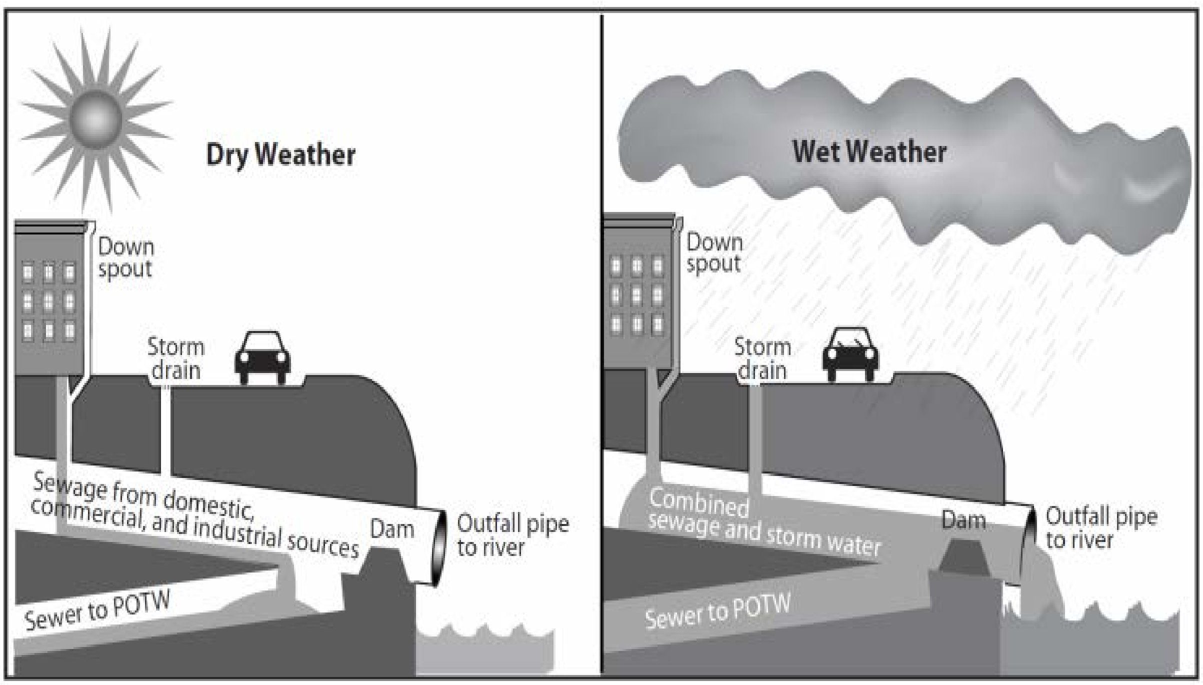
Office of Superfund Remediation and Technology Innovation

Sediment Assessment and Monitoring Sheet (SAMS) #4

A Primer for Remedial Project Managers on Water Quality Standards and the Regulation of Combined Sewage Overflows under the Clean Water Act



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1. Introduction

Efforts to restore impaired water bodies have relied on two distinct laws. The Clean Water Act (CWA) regulates discharges of pollutants to surface water, while the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) provides a mechanism for the assessment and cleanup of surface water and sediment contamination resulting from the release of hazardous substances that presents unacceptable risks to human health or the environment. The CWA and CERCLA are inherently linked when sediment sites are considered, because surface water discharges can be sources of contamination to sediment, and contaminated sediment can be an ongoing source of contamination to surface water. Surface water discharges with storm water components, especially combined sewer overflows (CSOs), can be challenging to control and regulate under the CWA, and their potential impacts to sediment may complicate Superfund cleanups under CERCLA, especially in urban waterways.

The purpose of this fact sheet is to provide Superfund Remedial Project Managers (RPMs) with brief summary information on how CSOs and other discharges are regulated under the CWA, emphasizing the objectives of the legislation and how it is often applied in practice, and some significant challenges in employing those controls to meet the objectives of the CWA. Similarities and differences in objectives between the CWA and CERCLA and how they may affect remediation of contaminated sediment are also highlighted. There is a great deal of information about CWA regulations, guidances, and policies on the website of the U.S. Environmental Protection Agency Office of Water[1]. This fact sheet only summarizes some of the key components as they might apply to Superfund sites. RPMs with sediment sites in areas with permitted discharges should familiarize themselves with the CWA guidances and policies and work closely with regional staff in the Office of Water throughout the remedial investigation and feasibility study (RI/FS) and remedy selection processes. Additional information on how RPMs should consider sections of the CWA regulations at their sites can be found in the *CERCLA Compliance with Other Laws Manual, Volume I*, EPA/540/G89-006, August 1988.

This document provides guidance to regions and others regarding how the Agency intends to interpret and implement the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), which provides the framework for CERCLA implementation. However, this document does not substitute for those provisions or regulations, nor is it a regulation itself. Thus, it cannot impose legally binding requirements on EPA, states, or the regulated community and may not apply to a particular situation based on specific circumstances. Any decisions regarding a particular situation will be made based on the statute and regulations, and EPA decision-maker retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance where appropriate.

This fact sheet was prepared by EPA's Office of Superfund Remediation and Technology Innovation. Drafting and revisions were provided by LimnoTech under subcontract to TetraTech EM Inc., (Prime Contract Number EP-W-07-078).

[1] www.epa.gov/npdes. This and other web addresses cited in this document are current as of December 2013.

2. What are the Clean Water Act (CWA) Goals and Requirements?

The Federal Water Pollution Control Act (FWPCA) was enacted in 1948 and amended in1956 and 1972 and is more commonly known as the CWA. The amendments established a framework for restoring surface waters under the CWA. The CWA includes the national goals listed below, which have a direct impact on establishing water quality standards (WQS). The WQS play a significant role in setting effluent limits for discharges to surface waters of the United States. These discharges are regulated under the CWA's National Pollutant Discharge Elimination System (NPDES) program. Currently, EPA delegates authority for implementing the NPDES program to 46 states and one territory.

2.1 Goals

The overall objective and specified goals of the CWA are as follows:

> "The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. In order to achieve this objective it is hereby declared that, consistent with the provisions of this Act --
>
> (1) It is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985.
>
> (2) It is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983.
>
> (3) It is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited.
>
> (4) It is the national policy that Federal financial assistance be provided to construct publicly owned waste treatment works.
>
> (5) It is the national policy that area-wide waste treatment management planning processes be developed and implemented to assure adequate control of sources of pollutants in each state.
>
> (6) It is the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into the navigable waters, waters of the contiguous zone, and the oceans.
>
> (7) It is the national policy that programs for the control of nonpoint sources of pollution be developed and implemented in an expeditious manner so as to enable the goals of this Act to be met through the control of both point and nonpoint sources of pollution."

Congress recognized that the elimination of pollutant discharges would take time and set goal #2 above as an interim goal of water quality. This interim water quality goal is still the object of vigorous regulatory effort. The CWA goal of water quality, defined in terms of supporting specific activities and uses of water bodies, complements yet differs in important ways from CERCLA's goal of reducing risks to human health and the environment posed by exposure to hazardous substances. Many of the differences between CWA and CERCLA regulation of water bodies are rooted in the differences in their goals.

2.2 Requirements

Several requirements of the Clean Water Act play an important role in the regulation of combined sewer overflows, including water quality standards, assessing attainment of water quality standards and total maximum daily loads; technology-based standards; ambient water quality criteria; and the National Pollution Discharge Elimination System (NPDES) program. The following sections discuss these requirements.

2.2.1 Water Quality Standards

Consistent with the above goals, the CWA provides for states to establish WQS. WQS are reviewed and approved by EPA. Often cited as applicable or relevant and appropriate requirements (ARARs) at Superfund sites, a water quality standard is not just a single criterion or metric describing a chemical concentration. The standard has three distinct parts:

- A designated waterbody use;
- Criteria to protect the designated use (generally referred to as ambient water quality criteria and often expressed as chemical-specific concentration values); and
- An antidegradation policy and implementation method.

It is important to recognize that each water quality criterion is specific to water bodies having the associated designated use (such as bacteria limits for recreational uses), and that the full list of numeric criteria for 126 priority pollutants and 44 non-priority pollutants may not always be applied uniformly to all water bodies in a state.

The **designated water body uses** are established by the state based on data available and are expected to be consistent with the goals (listed above) set by Congress. These designations must take into consideration

- The use and value of water for public water supplies;
- Protection and propagation of fish, shellfish and wildlife;
- Recreation in and on the water; and
- Agricultural, industrial, and other purposes including navigation.

In practice, each state establishes a set of designated uses for each water body in that state, consistent with its character and setting, and the lists of designated uses vary across states. Designated uses typically include protection of recreation and aquatic life. Some states include fish consumption as a designated use. States may also designate the waters for industrial use in cooling or product make-up water. The WQS regulations provide that, in setting designated uses, states must consider the WQS of downstream waters and ensure their WQS provide for the attainment and maintenance of the downstream waters. There is no single prescriptive methodology that states must follow to establish designated uses, but they must specify the designated use. It is important that EPA RPMs know the designated uses and the water quality criteria of the water body under investigation.

EPA's implementing regulations for the CWA distinguish between designated and existing uses. Specifically, the regulations clarify that a designated use can be changed if data exist to support the change, but if the designated use is also an existing use it cannot be removed. To remove a designated use, the state must present data detailing why the designated use is not attainable. This process is referred to as a "use attainability analysis." The process requires the state to demonstrate that it is infeasible to attain the use based on one of several allowable factors, such as some natural or physical condition, or modification to dams or other human-caused condition that cannot be changed. From a Superfund perspective, there may be interest in encouraging the state to add a more protective designated use, such as fish consumption for a site where protection is currently limited only to fish survival. The state can make such a change with the approval of EPA, and with notice and opportunity for a public hearing.

Criteria protecting recreational uses rely primarily on fecal indicator bacteria levels to prevent an unacceptable level of illnesses during recreation on or in the water. Criteria for aquatic life uses, such as cold water fishery or areas designated as habitat for specific sensitive species can include temperature, dissolved oxygen, and toxic pollutant limitations designed to ensure healthy populations of organisms that are expected to be present in those areas. Criteria for aquatic life uses may also be based on biological indices. States may also designate water bodies for agricultural water supply to ensure that water quality is appropriate for irrigation of crops.

To assist the states in establishing appropriate criteria, Section 304 of the CWA requires the EPA to develop water quality criteria in the form of guidance. EPA maintains a website that provides a list of pollutants for which it has developed criteria under Section 304 of the CWA, along with documentation and guidance.[2]

States may adopt these recommended criteria directly as part of the WQS, or they may adopt different criteria based on other scientifically defensible methods, where supported by data, that are more appropriate to the conditions of specific waterbodies. The criteria established by the EPA include three components: magnitude (allowable level of pollutant or pollutant parameter usually expressed as a concentration), duration (the averaging period), and frequency (how often the criteria may be exceeded without causing an adverse impact on the use). In most cases, these criteria are applied in the water column, rather than to sediment or biota. One exception is the criterion of 0.3 milligrams of methyl mercury per kilogram of fish tissue that the EPA established in January 2001. The EPA's approach for developing human health criteria that are based on methodologies to estimate bioaccumulation in fish are available on an EPA website.[3] The EPA has not developed water quality criteria for levels of pollutants in sediment; i.e., there are no promulgated federal ARARs to use as sediment cleanup levels.

The purpose of the **antidegradation policy** is to protect existing uses and the level of water quality necessary to support these uses, to protect high quality waters, and to provide a transparent analytic

[2] water.epa.gov/scitech/swguidance/standards/criteria

[3] water.epa.gov/scitech/swguidance/standards/criteria/aqlife/upload/2003_01_23_criteria_alcg_sab_draft.pdf.

process for states and tribes to use to determine whether limited degradation of high-quality waters is appropriate and necessary.

2.2.2 Assessing Water Quality Standard Attainment

In addition to addressing state requirements to develop water quality standards, Section 303 of the CWA requires states to periodically assess whether waters are attaining water quality standards and provide a list to EPA detailing the locations of nonattainment and the suspected reasons for impairments. States submit this list for EPA approval every two years, and it is referred to as the "impaired waters list" or Section 303(d) list. States are also required to develop a total maximum daily load (TMDL) for waters placed on the list. A TMDL calculates the maximum pollutant load that the water body can receive and still attain water quality standards. The CWA requires that the "load shall be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality." Superfund does not generally consider TMDLs as ARARs for Superfund cleanups, although the water quality standards used as the basis for the TMDLs may be ARARs (EPA 2005).

The CWA categorizes pollutant sources as either point sources or nonpoint sources. A point source is defined as any discernible, confined, and discrete conveyance, such as a pipe, ditch, channel, tunnel, conduit, or container. Control of point sources is handled primarily through the NPDES permit program. In the CWA, point sources are clearly the focal point to be controlled, as the legal prohibition against pollutant discharge without an NPDES permit or other specific allowance applies only to point source discharges.

A nonpoint source is not specifically defined in the CWA, but is any source that is not a point source. Typical nonpoint sources include runoff from rural areas, including farming, animal grazing, and timber harvesting. The CWA does not establish a control program for nonpoint sources, as it did for point sources. Nonpoint sources are primarily addressed through voluntary programs that include grant funding to States, territories, and tribes for assistance and training, as well as for demonstration and monitoring of reductions in pollutant loads. Releases to the water column from contaminated sediments at a Superfund site would be considered a nonpoint source. Significant differences between the two approaches to source control can be problematic for states as they develop TMDLs for waterbodies with both point sources and nonpoint sources.

The TMDL establishes a ceiling for the sum of individual waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, natural background sources, seasonal variations, and a margin of safety. The state is required to develop a TMDL for the pollutant of concern, designed to attain water quality standards, for each water-quality-limited water body identified on the 303(d) list. EPA has issued numerous guidance documents and policy memoranda to assist states (and stakeholders) in developing TMDLs.[4]

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[4] water.epa.gov/scitech/swguidance/standards/upload/2005_05_06_criteria_humanhealth_method_complete.pdf

2.2.3 Technology-Based Standards

Section 301 of the CWA also establishes how pollutants from point sources are to be controlled. It describes a framework of increasingly more stringent technology-based standards to be developed by the EPA to limit the amount of pollutants from the various categories of point sources. In the case of industrial point sources, these standards are often referred to as "effluent guidelines." In most cases, these are effluent limitations expressed as a pollutant mass of concentration not to be exceeded at the end of the pipe. The EPA usually tries to establish the limitations as mass limits linked to production (for example, pollutant parameter X shall not exceed Y pounds for Z pounds of product produced).

Congress' expectation for requiring these standards was that, over time, technology would advance to the point that there would be no discharge of pollutants, meeting one of the CWA goals discussed above. The initial step required EPA to develop standards based on *Best Practicable Control Technology Currently Available* (BPT) and these standards were to be achieved by 1977. BPT standards addressed toxic [such as, polycyclic aromatic hydrocarbons (PAHs), metals, polychlorinated biphenyls (PCBs)], conventional [such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal indicator bacteria (FIB), and pH], and non-conventional pollutants (such as floatables, which consist of trash and other visible floating debris). To establish the level of pollutant control under BPT, the CWA directed EPA to consider the average of the best existing performance by well-operating plants within each industrial category or sub-category.

In the next phase of CWA implementation, EPA was required to develop standards based on Best Available Technology Economically Achievable (BAT) and Best Conventional Pollutant Control Technology (BCT) with a compliance deadline of 1983, which was extended to July 1, 1984, and extended again to March 31, 1989. BAT standards addressed toxic pollutants and non-conventional pollutants, such as may be generated by industrial facilities, while BCT addressed conventional pollutants, more typical of pollutants treated by publicly owned treatment works (POTWs). BAT considers the performance associated with the best control and treatment measures that have been, or are capable of being achieved, and the cost of attainability, but does not balance the cost of implementation against the pollutant reduction benefit. For BCT, however, the Act directs EPA to consider the relationship between costs and benefits, as well as characteristics of specific POTW facilities, including age, process, energy requirements, and cost and difficulty of control as compared with industrial facilities. These BPT, BAT, and BCT standards are applicable to existing discharges, and the deadlines for compliance with these standards have all passed.

Congress also required EPA to establish New Source Performance Standards (NSPS). These standards are applied to any discharge where construction began after the standard for the specific industry category was promulgated. Generally, NSPS are more stringent than standards for existing sources. These standards are based on the state-of-the-art technology available at the time of construction, and the assumption is that the standard can be planned for and the necessary controls can be installed in the facility.

2.2.4 Ambient Water Quality Criteria

The term "water quality standard" is often incorrectly used to refer to ambient water quality criteria. Water quality criteria, however, comprise a key component of the three-part WQS for establishing effluent limitations. The CWA generally requires states to adopt numeric water quality criteria for a list of 65 classes of "toxic" pollutants, which the EPA has developed into a list of 126 specific "priority" pollutants. States often adopt the EPA ambient water quality criteria values at which time they become a state water quality standard. The CWA directs EPA to develop, publish, and, from time to time, revise water quality criteria, accurately reflecting the latest scientific information for these priority pollutants. EPA's numeric water quality criteria are designed to be protective of plants and animals when applied in the water (not at end of pipe), and to address short-term (acute) and long-term (chronic) effects on freshwater and saltwater species. For example, criteria for protection of fisheries typically include minimum aqueous concentrations of dissolved oxygen. It is important to note that the criteria are not expressed in the same terms as an effluent limitation. Effluent limitations include a magnitude and an averaging period (usually daily, weekly, or monthly); therefore, a conversion step is necessary to be able to back-calculate effluent limits consistent with water quality criteria.

2.2.5 The National Pollutant Discharge Elimination System Program

A major component of the 1972 amendments to the CWA was creation of the NPDES permit program. The NPDES program regulates all types of point source discharges to water bodies of the United States. Since its creation, it has significantly reduced the discharge of pollutants from point sources. Any discharge of pollutants from a point source is prohibited unless authorized by a NPDES permit. This includes permits for combined and separate sewer overflows and non-agricultural storm water outfalls.

For most situations, NPDES permit limits are developed following these steps:

- Apply technology-based limits based on secondary treatment standards for POTWs, and limits based on effluent limitation guidelines for non-POTWs. If, however, effluent limitation guidelines do not exist for the specific industry discharge, the limits are based on a best professional judgment (BPJ) calculation. Assess whether the technology-based limitations are stringent enough to protect WQS.

- If there is reasonable potential for a pollutant in the discharge to cause or contribute to a violation of the applicable WQS, and the technology-based effluent limit is not stringent enough to protect the WQS, then set a limit for the pollutant at a level to ensure the numerical standards contained in the WQS are not exceeded.

- If the receiving water body is on the list of impaired waters and a TMDL has been issued, use the WLA from the TMDL to develop the effluent limit.

- Include monitoring and reporting in the permit to demonstrate compliance with an effluent limit. If there is no limit, data collection may be required to determine whether a limit is necessary during the next permit cycle.

During the early years of the NPDES program, the focus was on the discharge from continuously discharging POTWs and industrial wastewater treatment plants. More recently, additional attention has been paid to wet weather sources, such as municipal storm water, industrial storm water, and combined sewer overflows (CSOs). In 1994, EPA issued the CSO Control Policy that outlined how the NPDES program would regulate CSOs. CSOs are discussed in more detail below. The issue common to all of these wet-weather discharges is that they are highly unpredictable and highly variable in volume and duration. In light of this high level of variability, numeric effluent limits would be difficult to calculate; therefore, permit limits in the form of best management practices (BMPs) have a much larger role in CSO and storm water permitting than they do for other point source discharges.

3. What are CSOs?

In the early 1900s, many developing cities constructed combined sewer systems (CSSs), instead of separate sanitary and storm water sewer systems, to conserve resources. By the mid-1900s, construction of combined sewers was prohibited by state and local governments. Figure 1 shows that most of the CSSs are located in the Northeast, Great Lakes region, and Pacific Northwest (adapted from EPA 2004), in core areas of older communities of all sizes.

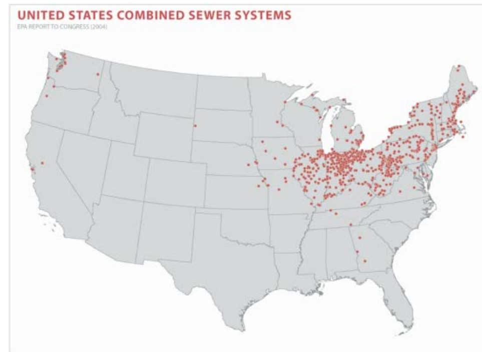

Figure 1 – Combined Sewer System Locations

As POTWs were built, CSSs were sized to convey all of the combined sewage to the POTW for treatment during periods of no rain (dry weather) or for smaller storms when the connecting sewers leading to the POTW (interceptor sewers) were not full. In many CSSs, the city or utility owns the interceptor sewers but does not own the private laterals that connect houses or businesses to the interceptor sewer, which can make control of CSOs difficult. CSSs were designed to discharge directly to receiving water bodies from an outfall pipe during large rainfall or snowmelt events exceeding the capacity of a POTW. These conditions are illustrated in Figure 2 (EPA 2004). According to EPA's Office of Water, there are 772 communities with CSSs that serve 40 million people in the United States.[5] The sizes and magnitudes of CSSs and their impacts on surface waters vary significantly. Small communities may have only one or two outfalls, or in some cases many outfalls (for example, Defiance, Ohio, has 44 outfalls and serves 3,000 people). Larger communities, such as New York City or Cleveland, Ohio, can have multiple POTWs, each with its own CSS and number of overflow locations.

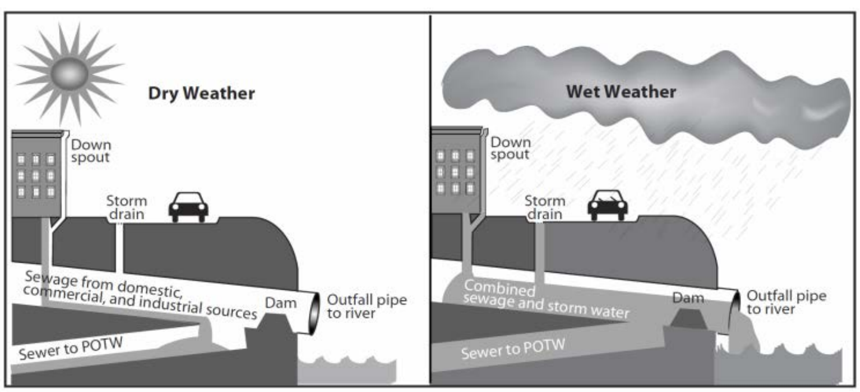

Figure 2 – Schematic of Combined Sewer Structure and Performance

As cities grew, new separate sewer systems were built often tied into the existing CSS. In a separate sewer system, the city constructs a separate sanitary sewer system (SSS) to convey sanitary sewage to the CSS or POTW, and a separate storm

[5] http://cfpub.epa.gov/npdes/cso/demo.cfm?program_id=5

sewer system to convey storm water runoff directly to the receiving water bodies. As both CSSs and SSSs aged, and cities often failed to maintain infrastructure, infiltration of groundwater and inflow of runoff that was not intended to reach the sewer system resulted in increased wet weather flow within both the CSS and SSS. CSS capacity is therefore exceeded more frequently than originally designed. Some cities experience CSO discharges nearly every time it rains. Infiltration can also lead to overflows of SSSs, even though the purpose of separation is to avoid overflows.

3.1 Impacts of CSOs on Water Bodies

The impacts of CSOs on water quality are site-specific and highly variable and are a function of volume discharged, discharge frequency, and pollutant concentrations. CSO volumes often correlate with the intensity and duration of rain or snowmelt events. They also depend on antecedent moisture conditions, groundwater levels, and land use. Antecedent moisture conditions and land use determine what portion of the rainfall infiltrates into the ground and how much becomes runoff that would enter the CSS. Groundwater levels also affect how much infiltration can enter the CSS through cracks or leaks in the pipes.

Pollutants can enter the CSS from a variety of sources. These sources include sanitary waste from residences and from public and commercial buildings; industries that discharge directly to sewers; storm water runoff that picks up pollutants from soils and paved surfaces; and from contaminated groundwater that infiltrates the sewers. The National Pretreatment Program regulations at 40 Code of Regulations (CFR) Section 403 require POTWs to control the level of pollutants from industrial discharges to sanitary sewers to ensure the wastewater treatment plant is not adversely affected and that pollutants from the industry do not pass through the plant to the receiving water. CSO Control Policy requires review and modification of pretreatment requirements to assure CSO impacts from industrial sources are minimized. Storm water contaminant loads to combined sewers can be a legacy of industrial activity and materials storage and handling. Pollutants can also build up in solids that accumulate and deposit in the sewers and may be flushed out of the CSO with higher-intensity rain events. Because of their diverse sources and the effects of flow, pollutant concentrations in CSOs are highly variable and difficult to predict.

The EPA has focused on limiting releases of conventional pollutants such as fecal indicator bacteria (FIB), 5-day biochemical oxygen demand (BOD5), and total suspended solids (TSS). The hazardous substances often found at Superfund sites are typically not addressed unless it has been shown that the CSO discharge causes or contributes to violations of the ambient water quality criteria or equivalent state standard. With respect to toxics, however, EPA stated in its Report to Congress that “toxics in wastewater can be a concern in industrialized areas or where monitoring data indicate potential toxicity” (Moffa 1997). Storm water contributions to CSOs in urbanized areas can also contain significant concentrations of hydrocarbons and metals” (EPA 2004). Table 1 shows EPA’s reported ranges of pollutant concentrations in CSOs and demonstrates how widely effluent concentrations can vary (EPA 2004).

Table 1. Range of Pollutant Concentrations in Combined Sewer Overflows (EPA 2004)

Pollutant	Units	Range	Median
Fecal coliform bacteria	Colonies per 100 ml	3 – 40,000,000	215,000
BOD_5	mg/L	3.9 – 696	43
TSS	mg/L	1 – 4,420	127
Cadmium	µg/L	0.16 – 30	2
Copper	µg/L	10 – 1,827	40
Lead	µg/L	5 – 1,013	48
Zinc	µg/L	10 – 3,740	156

BOD_5 – 5-day biochemical oxygen demand
TSS – total suspended solids
ml – milliliters
µg/L – microgram per liter
mg/L – milligram per litre

The contribution of the CSO discharges to water quality impairments can vary because other sources (stormwater and nonpoint sources) upstream of the CSS often contribute the same pollutants as the CSOs, particularly during rain events. Depending on the nature of the waterway, CSO impacts can be dispersed quickly, whereas in slow-moving waters the pollutants from the CSOs can build up in the sediments. In some instances, sludge deposits form mounds near the CSO outfalls. EPA has published three comprehensive reports on the occurrence and impacts of CSOs, which were all prepared primarily from a water column exposure perspective (EPA 2002a, 2004, 2007).

3.2 How are CSOs and CSSs Regulated?

CSOs are regulated as point sources under the CWA and the CSO Control Policy of 1994 (59 Federal Register [Fed. Reg.] 18688-18698, April 19, 1994). The 1994 CSO Policy is also included in Section 402(q) of the CWA, as explained later in this section. The Policy was negotiated among representatives from states, environmental groups, municipal organizations, and EPA. The impetus was that effective implementation of CSO controls through NPDES permits was lagging because of a lack of a common and consistent framework. The Policy included four key principles to ensure that CSO controls are cost-effective and meet the objectives of the CWA. These principles are:

1. Clear levels of control presumed to meet appropriate health and environmental objectives;
2. Flexibility to consider the site-specific nature of CSOs and find the most cost-effective means to reduce pollutants and meet CWA objectives and requirements;
3. Phased implementation of CSO controls, considering a community's financial capability; and
4. Review and revision of state water quality standards to reflect the site-specific wet weather impacts of CSOs.

The Policy includes consideration of both technology-based controls and water quality-based controls. The technology-based controls are called the Nine Minimum Controls (see text box below) and are essentially BMPs that a community should be able to implement immediately and without significant capital cost. The water quality-based controls consist of developing and implementing a Long Term CSO Control Plan (LTCP) that should result in compliance with applicable water quality standards.

EPA has developed memoranda and guidance documents to help states and CSO permittees implement the Policy.[6] In response to criticisms that little progress was being made in accomplishing the objectives of the CSO Policy, EPA began to develop and implement a national enforcement strategy in the mid-1990s. This strategy was formalized in an April 2000 memorandum (EPA 2000) from EPA's Office of Enforcement and Compliance Assurance (OECA).

In December 2000, the Wet Weather Water Quality Act of 2000 was enacted. The purposes of the legislation are:

- To prevent and reduce water quality impacts of CSOs and sanitary sewer overflows (SSOs), by authorizing grants to municipalities and states for CSO/SSO control projects;
- To authorize grants for a wet weather pilot program; and
- To codify the EPA's CSO Control Policy of 1994 as part of the CWA, although it is still commonly referred to as a "Policy" in CSO control planning.

The bill also directs the EPA Administrator to "issue guidance to facilitate the conduct of water quality and designated use reviews for municipal combined sewer overflow receiving waters."

While current statistics have not been updated since the 2004 Report to Congress, many CSO communities have entered into either federal or state enforcement agreements or are in the process of negotiating an agreement. Often, the enforcement action addresses not only CSOs but also SSOs. For CSOs, the agreements are either to develop and implement an LTCP or to implement an already agency-approved LTCP that ensures that water quality standards are met during a "typical" or average year (discussed below). Thus, it is important to recognize that a LTCP does not ensure controls meet WQS in every year, but rather that they are met under "typical" year conditions.

For SSOs, the enforcement action typically requires the community to set forth a sewer overflow reduction plan that effectively "eliminates" all SSOs.[7] For perspective on the range of agreement costs, a review of federal consent decrees from EPA's news releases and the Federal Register revealed that, for 2011, eight communities had agreed to implement long-term control plans for CSO or SSO control ranging in cost from $4.2 million (Elkins, West Virginia) to $4.7 billion (St. Louis, Missouri).

3.3 How is a Long-Term Control Plan Developed?

Under the CSO Control Policy, communities are required to characterize the CSS and the impacts of CSOs on the receiving waters. They are typically characterized by conducting monitoring and computer

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[6] For EPA policy memoranda and guidance documents on CSO control see http://cfpub.epa.gov/npdes/docs.cfm?document_type_id=1&view=Policy%20and%20Guidance%20Documents&program_id=5&sort=name

[7] As noted in the 2004 Report to Congress (EPA 2004), SSOs that reach waters of the United States are point source discharges, and, like other point source discharges from municipal SSSs, are prohibited unless authorized by an NPDES permit. EPA has attempted draft policy for addressing SSOs, however so far to date EPA has not produced a final policy.

modeling of current conditions. The models are then used to evaluate the effectiveness of possible CSO controls in meeting water quality standards assuming a typical year.

Under the Policy, communities are provided with significant flexibility in selecting the typical year. In some instances, the community selects a typical period that might include representative wet and dry weather precipitation or stream flow conditions. This period is different than what is considered for developing TMDLs, which must address “critical,” reasonable worst-case, conditions.

Recognizing there is no single control technology for achieving water quality standards, the community is expected to identify alternative CSO control technologies that could be used to reduce or eliminate CSOs under typical-year conditions. As stated in the Policy, “EPA expects the long-term CSO control plan to consider a reasonable range of alternatives. The plan should, for example, evaluate controls that would be necessary to achieve zero overflow events per year, and an average of one to three, four to seven, and eight to twelve overflow events per year. Alternatively, the long-term plan could evaluate controls that achieve 100% capture [of combined sewage], 90% capture, 85% capture, 80% capture, and 75% capture for treatment.” EPA also expects communities to evaluate alternatives to maximize treatment of combined sewage at the POTW by upgrading conveyance or wet-weather treatment capacity. Furthermore, EPA states that “[t]he analysis of alternatives should be sufficient to make a reasonable assessment of cost and performance” known as a “knee-of-the-curve” analysis using the typical year (EPA 1994).

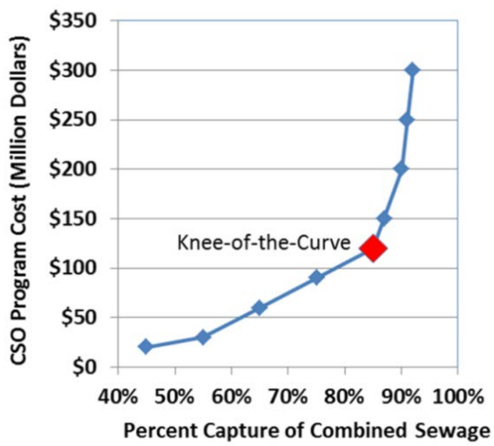

Figure 3 – Hypothetical Cost Curve for Knee-of-the-Curve Analysis

A hypothetical knee-of-the-curve analysis is shown in Figure 3, where the percent capture and treatment of combined sewage and storm water through a combination of technologies is compared with capital program cost. The “knee” represents the point “where the increment of pollution reduction achieved in the receiving water

Combined Sewer Overflows Nine Minimum Controls

1. Proper operation and regular maintenance programs for the sewer system and the CSOs
2. Maximum use of the collection system for storage
3. Review and modification of pretreatment requirements to assure CSO impacts are minimized
4. Maximization of flow to the publicly owned treatment works for treatment
5. Prohibition of CSOs during dry weather
6. Control of solid and floatable materials in CSOs
7. Pollution prevention
8. Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts
9. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls

diminishes compared to the increased costs” (EPA 1994). EPA expects communities to use the knee-of-the-curve analysis to help guide selection of controls.

Under the CSO Policy, communities can pursue either the “presumption” approach or the “demonstration” approach to evaluate the level of CSO control that is needed to meet water quality standards. These approaches focus on conventional sanitary pollutants (such as bacteria, BOD_5, or TSS). Toxics receive much less attention. The Policy lists the following criteria for a community to consider when pursuing a presumption approach, all based on the typical year:

- No more than an average of four (possibly up to six) overflow events;
- Elimination or capture for treatment of at least 85 percent of combined sewage by volume; or
- Elimination or removal of no less than the mass of pollutants causing the impairment using the 85 percent volume criterion.

The CSOs meeting these criteria are expected to receive, at a minimum:

- Primary clarification,
- Solids and floatables disposal, and
- Disinfection (if necessary to meet water quality standards).

Under this presumption approach, controls are “presumed to provide an adequate level of control to meet the water quality-based requirements of the CWA, provided the permitting authority determines that such presumption is reasonable in light of the data and analysis conducted in the characterization, monitoring, and modeling of the system and the consideration of sensitive areas” (EPA 1994).

The **demonstration** approach was included in the Policy in the event that the controls required under the presumption approach went beyond what was needed to comply with water quality standards. Under this approach, the community must demonstrate that each of the following are met:

- CSOs alone will not violate water quality standards;
- If other sources will cause violations after the control program is implemented, there is a TMDL or other plan to allocate loads;
- The plan provides the maximum pollution reduction benefits reasonably attainable; and
- The plan can be cost-effectively retrofitted if additional controls are ultimately needed to meet water quality standards or designated uses.

As discussed previously, it is important to keep in mind that water quality standards apply only to designated uses, which often are linked only to conventional sewage pollutants, and not to toxic contaminants addressed at Superfund sites.

Regardless of whether the community chooses a presumption or demonstration approach, it is required to conduct post-construction compliance monitoring. The purpose of the monitoring is to ensure that the CSO controls provide the planned level of control and to confirm that CSOs are not causing or contributing to water quality standards violations. Details of EPA’s expectations for CSO post-construction compliance monitoring are identified in recent guidance (EPA 2012).

With respect to CSOs causing or contributing to water quality standards violations, the CSO Control Policy also directs that EPA and the states work with communities to "review and revise" water quality standards as appropriate. They must be revised and reviewed because it is recognized that some standards were established many years ago without a complete use attainability analysis, and it also recognizes that achieving zero discharge (which might be needed to prevent violations of some existing water quality standards) can be cost-prohibitive, as shown by the knee-of-the-curve analysis. EPA issued guidance to facilitate these reviews and revisions, stating: "[g]iven local resource constraints, CSO communities need clear guidance on how they should implement the CSO control and other wet weather water pollution control programs to attain water quality standards. Water quality standards reviews are an important step in integrating the development and implementation of affordable, well-designed and operated CSO control programs with the requirements of the Clean Water Act (CWA)" (EPA 2001). In practice, reviews and revisions of water quality standards have been few.

3.4 Implementation Schedules for CSO Plans

The CSO Control Policy requires that permits issued to CSO communities include construction and financing schedules. EPA indicated that these schedules "may be phased based on the relative importance of adverse impacts upon WQS and designated uses, priority projects identified in the long-term plan, and on a permittee's financial capability." EPA issued guidance on developing schedules, which includes a scoring system to determine whether a community would experience a low, medium, or high burden implementing the CSO control program (EPA 1997).

The scoring system includes socioeconomic factors and debt and financial indicators and also establishes 2 percent of median household income (MHI) as an indicator of high burden. In the same guidance, the EPA indicates that communities with a low burden are expected to implement controls within normal engineering and construction guidelines; while those with medium burdens should receive up to a total of 10 years; and high burden communities should receive up to a total of 15 years with "[s]chedule up to 20 years based on negotiation with EPA and state NPDES authorities" (EPA 1997, p, 44). This guidance is often cited as a basis for setting a maximum implementation schedule in consent decrees at 20 years.

3.5 Recent Developments in CSO Control Planning

In 2007, EPA published a memorandum concerning the use of green infrastructure in NPDES permits and enforcement (EPA 2007). Green infrastructure, which includes green roofs, permeable pavement, and grassy swales to capture runoff, reduces storm water peaks through storage and infiltration, improving capture for the CSS as a whole. EPA stated that permitting authorities could "encourage permittees to utilize green infrastructure approaches, where appropriate, in lieu of or in addition to more traditional controls" and encouraged EPA and state personnel to consider using green infrastructure as a component of consent agreements in enforcement activities. The permittees would still be required to meet the limits necessary to achieve water quality standards, but would be allowed to use different approaches from the more conventional gray infrastructure (such as build more off-line storage or expand POTW capacity). Greater reliance on green infrastructure might require additional flexibility such as lengthening compliance schedules. EPA recognized that green infrastructure could be used to "down-size" gray infrastructure such as tunnels and would provide additional water quality and aesthetic benefits for communities. EPA also recognized that communities would need time to construct, test, and assess the benefits of green infrastructure, which is a relatively new technology. Despite this recognition, the early consent decrees that included green infrastructure provided limited flexibility to communities for adaptive implementation of green infrastructure and re-assessment of controls or implementation schedules. This approach is now being re-assessed with EPA's initiative to allow communities to use integrated planning to achieve CWA compliance.

In June 2009, the U.S. Conference of Mayors (USCM) held a plenary session at its 77th annual meeting contending that EPA was requiring unnecessarily costly solutions to limit wet weather overflows. Several mayors wrote to the EPA Administrator and the Attorney General expressing their concern. In response, EPA and DOJ began meeting with the USCM Water Council to explore these issues further. In November 2009, the USCM transmitted its paper, titled "Local Government Recommendations to Increase CSO/SSO Flexibility in Achieving Clean Water Goals," which identified the key areas where it was argued that EPA was not providing cities with sufficient flexibility, and proposed ways that EPA might change implementation of the program without requiring any changes to regulations or the CWA. The USCM and EPA continued meeting, and EPA also began discussions with other stakeholders, including the state regulatory agencies, about these issues.

In June 2012, EPA issued an Integrated Municipal Stormwater and Wastewater Planning Approach Framework. Under this framework, a municipality may develop an integrated plan incorporating the following elements:

- Description of the water quality, human health, and regulatory challenges to be addressed;
- Characterization of existing wastewater and storm water systems and performance;
- Provision for stakeholder involvement in planning;
- Process for evaluation of alternatives and selection of an alternative;
- Monitoring to measure performance; and
- Adaptive improvement to the plan over the course of its implementation.

The alternative evaluation element of the framework allows cities to consider cost and benefit as factors in the phasing and sequencing of controls, to most effectively achieve the requirements of the CWA based on factors local to the CSO community. These include costs of alternatives, potential disproportionate financial burdens on portions of the community, projected pollution reductions, benefits to receiving waters, and other environmental and public health benefits. A systematic approach to evaluating green infrastructure is also a component of the framework.

4. CWA Implementation and Possible Implications for Sediment Remediation under Superfund

Contaminated sediment sites are commonly located in urban water bodies where CSOs and separate storm water discharges are regulated under the CWA. Because of the potential for continuing impacts of those discharges on sediment contamination, it is important to appreciate and understand relevant CWA regulatory drivers and processes, and how they may affect Superfund remedial action objectives and processes. This section discusses the commonalities and differences between the two regulatory approaches. Because of some of these differences, the effectiveness of Superfund remedies at urban sites may depend on successful coordination between the regional CWA and CERCLA programs, throughout the entire RI/FS and remedy selection and implementation processes.

4.1 Programmatic Goals

Under the CWA, discharges to surface waters are regulated with the objective of protecting designated uses (such as recreation, cold water fisheries, or drinking water supply) of water bodies. States are responsible for establishing water quality standards, including designated uses for each water body and setting numerical and narrative water quality criteria to protect those uses. Depending on the designated uses, these state standards may or may not include toxic pollutants typically found at Superfund sites. Point sources (wastewater treatment plant discharges, CSOs, and storm water discharges) are regulated through NPDES permits with effluent limits established as necessary using these numerical and narrative water quality criteria, with the goal of maintaining or restoring water quality standards. Allowance is made for the state of wastewater treatment technology where discharges are subject to technology-based limits.

Both the CWA and CERCLA aim to protect wildlife populations and people who are potentially exposed through recreation, but their goals and resulting approaches differ in important ways. Where the CWA seeks water quality conditions consistent with Act's definition of protection and restoration of fishing, swimming, and other designated uses, CERCLA is explicitly risk-based, implementing remedies that reduce exposures to people and biota to protective levels; e.g., cancer risk not to exceed 1×10^{-4}. Because of the difference in objectives, CWA metrics of success may not be sufficient to meet CERCLA cleanup objectives, even when both are site-specific.

4.2 Media, Contaminants, and Cleanup Objectives

Metrics for developing a successful LTCP for CSOs include reducing the frequency that bacterial counts, nutrients, or solids exceed threshold values to protect recreation, preventing depletion of dissolved oxygen, and protecting fisheries. An LTCP for a specific CSS may presume that other sources of pollutants in the watershed will also ultimately be addressed.

In contrast, contaminated sediment cleanups target existing contamination, typically including a major component of legacy contamination previously released to the water body over a period of years. Exposures via sediments and pathways originating in sediments are targeted by CERCLA, with the intent of protecting human health and the environment. This intent focuses CERCLA remedies on a different set of contaminants, often those having persistent and bioaccumulative toxicity to human health and the environment, commonly including polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), heavy metals, pesticides, and dioxins and furans. In contrast to presumptive measures that may be imposed under the CWA, CERCLA controls are demonstrative: a CERCLA remedy is not complete until the achievement of remedial action objectives and contaminant-specific remediation goals is demonstrated through long-term monitoring results.

While persistent bioaccumulative contaminants may also be regulated under the CWA, they are rarely the primary drivers for regulatory compliance for CSOs, and may not even be monitored. In these situations, CSOs and separate storm water could result in recontamination of Superfund sites. There is also a greater emphasis under CERCLA on the ecological risks to benthos living in or on the sediment, in contrast to the direct water column exposure that is the key exposure pathway evaluated under the CWA.

4.3 Sources, Controls and Site Management

Under the CWA, the regulatory process to achieve WQS typically includes a sequence of shorter and longer-term controls. In the case of CSOs, permittees are first required to demonstrate the use of best management practices, in the form of addressing the nine minimum controls. Permittees are then required to develop and implement LTCPs, which incorporate more substantial and time-consuming public works investments, targeting ultimate attainment of specific water quality criteria or state-specific standard consistent with the designated uses of the water body. For larger communities, these controls can cost from hundreds of millions to billions of dollars, depending in part on the financial capability of the community. CSO controls are implemented over a period of up to 20 years, so the timing of CSO controls may not coincide with the timing of CERCLA remedies.

Furthermore, it is anticipated that there will continue to be some level of CSO discharges, even after the LTCPs are fully implemented. It is therefore possible for a community to continue to discharge contamination that constitutes a source from the perspective of sediment contamination. Under the CWA, controls are typically established with the intent of meeting water quality standards over time, and not to prevent recontamination of a sediment site or to help meet sediment cleanup levels at the time of the Superfund remediation.

CSOs controls are designed to minimize wet-weather overflows, and not to eliminate them in a “typical year.” Water quality impairments may consist of transitory problems, such as dissolved oxygen depletion or elevated bacterial levels, in the sense that impairments are removed when pollutant loads are effectively controlled. In contrast, contamination of sediments by metals and persistent hydrophobic chemicals is typically a long-term problem. This makes it imperative that sources be controlled to the maximum extent practicable for effective sediment remediation.

CERCLA risk management actions consider 11 principles (EPA 2002b), the first of which is to “Control sources early.” As compared with CWA management actions, there is greater priority and urgency assigned to the cessation of contaminant releases under CERCLA. CERCLA also takes more of a once-and-for-all approach to remediation, as compared with the phasing of controls under the CWA. While the CERCLA framework provides for removal and interim actions, the typical course of response culminates in a final remedy, attaining and demonstrating a reduction in risk to acceptable levels. Because of these differences in goals and timing of remedies, more attention is being paid to the potential for the recontamination of sediment sites by CSOs and storm water discharges.

After controls have been implemented, the methods of demonstrating regulatory compliance also differ between remedial actions for CERCLA sediment sites and LTCPs. The success of CSO controls is most commonly evaluated in terms of achieving target reductions in the frequency of overflow events and in overflow volume, and not in terms of reduction in risks. Success of a LTCP may be demonstrated based on water quality modeling that shows CSOs no longer are predicted to be causing or contributing to violations of WQS during the typical period being simulated. These demonstrations may also assume other reductions in watershed contaminant loads. Although EPA has indicated that water quality sampling should also be performed for CSO post-construction monitoring programs, the evaluation of WQS typically relies instead on modeling overflows and predicting their impacts on water quality. In contrast, post-construction and long-term monitoring of sediment is typically required after contaminated sediments have been remediated under CERCLA. These data are collected to confirm both remedy effectiveness and risk reduction and whether any additional remedial action is needed as part of the CERCLA five-year review process.

4.4 Cost Considerations

Remedies and controls to address contaminated sediments, CSOs, and other permitted discharges can be costly: costs for large sediment site remedies and for CSO controls for major cities can both total hundreds of millions and even billions of dollars. These costs are considered somewhat differently under CWA regulation of CSOs and storm water than under CERCLA.

Cost and affordability are taken into account in negotiating LTCPs, especially with respect to timing. Cost can also affect the extent of load reduction through the knee-of-the-curve analysis. Funding for CSO activities comes from the public via payments for water and sewer services. Rate payers are assessed fees over the life of the project to finance the development and implementation of required controls and to pay for long-term debt obligations for the water and sewer infrastructure. The ability of a community to pay for these controls is considered during the LTCP process and is an important reason why the time to implement new source control actions can be up to 20 years.

In contrast, costs for Superfund sediment sites (with the exception of orphan sites) are borne by one or more parties deemed to be responsible for the contamination. Cost is considered as a balancing criterion under CERCLA in evaluating a remedial action, but only after the level of risk reduction to be attained by an alternative adequately satisfies the threshold evaluation criterion of overall protection of human health and the environment. Affordability by the responsible parties may affect the allocation of costs for each party, but is not explicitly considered in remedy selection.

In practice, both CWA- and CERCLA-based actions consider that technologies may not be sufficiently advanced to allow for achievement of desired endpoints (immediate attainment of water quality standards under the CWA, or achievement of risk-based protective levels under CERCLA). Remedies can still result in concentrations that achieve substantial risk reductions for sediment sites, where existing technologies are unable to meet a risk-based target concentration. Likewise, where complete control of discharges is infeasible under the CWA (such as in CSO control), long-term control plans are often developed to minimize CSO discharges under a “typical year,” allowing greater discharges to continue during the largest storm events and more extreme years.

4.5 Contamination/Recontamination by CSOs and Storm Water Outfalls

Because the CWA does not require complete control of CSO or storm water loadings to surface waters, the potential for these loadings to contaminate sediments or to recontaminate them after a remedy is implemented can be significant. The crucial elements to consider are what contaminants are present in discharges, what mass loadings occur prior to expected CSO and storm water controls, and what are the extent and timing of load reductions that are expected under planned controls.

If there is a CSO LTCP in place, its documentation is likely to provide much of the information needed by the Superfund site manager to understand the potential for sediment contamination and consider these impacts in remedy selection. LTCPs usually include estimates of typical year flows and loads of target contaminants, before and after implementation, although RPMs may need to request additional information about Superfund contaminants. Target contaminants for the LCTP may differ from the set that is targeted for Superfund remediation, in which case CSO loading data for the latter may not exist. If so, to estimate wet weather loadings of those contaminants under current conditions, additional monitoring of CSOs may be necessary as part of the RI performed under CERCLA. That information can then be used, in combination with projected capture rates under the LTCP remedy, to estimate future CSO loads of sediment contaminants. LTCPs also provide a time line of improvements, which can be used to estimate timing of source control in relation to the timing for the Superfund remediation. In general, it is more challenging to predict future contaminant loads for storm water outfalls than for CSOs for two reasons: first, because storm water controls rely more heavily on BMPs than on modeling-based engineering controls; and second, because storm water controls are more fragmented than CSO controls. A solution would be to monitor representative outfalls for contaminants of concern under varying wet-weather conditions as part of the RI, to establish baseline loads, and then model watershed reductions through the application of BMPs, based on any available values from published literature.

4.6 Need for Improved Coordination and Integration of CWA Regulation of Waterbodies and CERCLA Remediation at Sediment Sites

This fact sheet highlights some commonalities and differences within both the CWA and CERCLA frameworks as they relate to contaminated sediment sites. It is not intended to provide resolution or specific recommendations where different objectives or approaches may make it challenging to achieve success from either regulatory perspective. However, it is reasonable that where CERCLA and CWA have similar objectives, agency staff carrying out their mandates seek greater consistency in approaches between the two legislative frameworks, to the extent allowable by law and regulation.

Coordination between programs can be challenging, and to date CSO long-term control planning has proceeded without substantial regard to CERCLA concerns. However, the CWA and CERCLA domains are intersecting with increased frequency on contaminated sediment sites, offering the opportunity for improved integration, including increasing collaboration between EPA and state CWA program managers, CWA permittees, and responsible parties under CERCLA. Superfund site managers are encouraged to work with their counterparts in the state and EPA water programs to consider the need for conducting one of more of the following activities pertaining to the site waterbody:

- Change the designated use in the WQS to one that is more protective with respect to food chain exposures; for example, risks from fish consumption. This change would require the state to “review and revise” the WQS and develop additional decreases in discharges.
- Develop waterbody-specific water quality criteria as part of a revised WQS.
- Provide access to responsible party and EPA contractors to collect end-of-the-pipe monitoring data from NPDES-permitted outfalls.

In the event of success in changing the designated use and waterbody-specific water quality criteria to reflect the mitigation of risks that drive the Superfund process, then it becomes possible for management actions under the CWA to support attainment of CERCLA goals through activities like the following:

- Require NPDES permittees to monitor their discharge for the key contaminants of concern that are driving the need for a Superfund cleanup.
- When TMDLs are developed or revised, give priority to those TMDLs for waterbodies containing Superfund sediment sites.
- For outfalls found to be discharging a potentially significant load of one or more hazardous substances, issue a new NPDES permit with stricter controls.

As stated previously, this document provides a brief synopsis of the key EPA guidances and policies describing the implementation of CWA requirements that may affect the success of sediment cleanups under Superfund. Agency-wide efforts are under way to increase the level of coordination and collaboration between regulatory programs. Superfund site managers are encouraged to work closely with their EPA and state counterparts in the water programs.

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