wef Stormwater Institute

2020 National Municipal Separate Storm Sewer System (MS4) Needs Assessment Survey Results

February 2021

Water Environment Federation
the water quality people

PARTICIPANTS

The WEF Stormwater Institute (SWI) gratefully acknowledges the following individuals for their contribution to the development and the deployment of the survey, as well as the analysis of the results. The survey would not have been possible without their generous support. The individuals below, through numerous work team meetings, gave generously of their time and expertise. Any errors, omissions, or differences of opinion are the sole responsibility of WEF. SWI would like to thank and acknowledge the SWI Subscribers, whose funding made this survey and report possible. A complete list of Subscribers can be found at the back of this report.

SWI MS4 SURVEY WORK TEAM

- Scott Taylor, P.E., D.WRE (Chair), National Municipal Stormwater Alliance
- Fernando Pasquel, Arcadis
- James Gibson, Jr., Sanitation District No. 1 of Northern Kentucky
- John Kosco, P.E., U.S. Environmental Protection Agency
- Fatemeh Babakhani, Ph.D., P.E., Hubbell, Roth & Clark, Inc.
- Michael Beezhold, CPM, Kansas Department of Health and Environment
- Garrett Bergey, SDE, Inc.
- Tyler Carson, Arcadis
- Zach Henderson, Woodard & Curran
- Matthew Jones, Ph.D., P.E., Hazen and Sawyer
- Adrienne Nemura, P.E., Geosyntec Consultants
- Dan Radulescu
- Andrew Sauer, P.E., ENV SP, Burns & McDonnell
- James Schlaman, P.E., ENV SP, Black & Veatch Corporation
- Andrew Smith, P.E., CFM, ENV SP, Black & Veatch Corporation
- Mark Van Auken, P.E., ENV SP, Arcadis

SWI PROJECT TEAM

- Rebecca Arvin-Colon, SWI Senior Manager
- Adriana Caldarelli, SWI Director
- Seth Brown, Ph.D., P.E., SWI Senior Advisor

SWI MS4 NEEDS ASSESSMENT DATA DASHBOARD

- Powered by 2NDNATURE

SWI ADVISORY COMMITTEE

- Fernando Pasquel (Chair), Arcadis
- Scott Taylor, P.E., D.WRE (Vice-Chair), Michael Baker International, National Municipal Stormwater Alliance Appointment
- Vaikko P. Allen II, Contech Engineered Solutions, LLC
- Kevin Boesch, Logan Simpson
- Chein-Chi Chang, Ph.D., P.E., WEF Watershed Management Committee Appointment
- Karlee Copeland, Fairfax County, VA
- Brian Currier, P.E., Office of Water Programs at Sacramento State
- Kimberly L. Grove, P.E., Baltimore City Department of Public Works
- Hamidreza (Kasra) Kazemi, Ph.D., P.E., University of Louisville
- Daniel Lillis, Public Works Department, City of Kearney, NE
- John Sullivan, P.E., Boston Water & Sewer Commission
- Wesley Sydnor, Louisville & Jefferson County Metropolitan Sewer District, WEF Stormwater Committee Appointment
- Anil Tangirala, P.E., MS Consultants, Inc., WEF Program Committee Appointment
- Kurt Woolford, P.E., Lake County Stormwater Management Commission, IL

Executive Summary

In 2018, the Water Environment Federation's (WEF) Stormwater Institute (SWI) conducted the first national survey of municipal separate storm sewer system (MS4) permittees and received 622 responses from 47 states as well as the District of Columbia. WEF conducted a second survey in 2020 and received 804 responses also from 47 states as well as the District of Columbia and Puerto Rico.

The primary objectives of these surveys are

- to better understand MS4 program challenges,
- to identify the information and resource needs of MS4 permittees, and
- to approximate current funding levels and estimated funding needs in the MS4 sector.

For both surveys, approximately 90% of responses came from Phase I and Phase II MS4s; approximately 25% from Phase I and 65% from Phase II. The remaining balance of responses came from non-traditional MS4 Phase II permit holders and state departments of transportation (DOTs). Respondents were generally representative of the geographic distribution of MS4s across the United States for both surveys.

The survey was comprised of questions to gather basic information on stormwater programs (size, type of permittee), yes/no-based questions on various aspects of stormwater issues and topics, and several multiple-choice questions focusing on stormwater program challenges and needs. Weighted average scores using a 1 through 5 rating system were used in the report to efficiently capture respondent ratings in a single metric. Responses of 4 or higher reflect strong interest or support for topics. The percentage of responses at this level were identified for topics throughout the survey and highlighted along with weighted average scores.

MS4 PROGRAM CHALLENGES AND NEEDS

Based upon the weighted scores, the top three challenges for all permittees, as shown in Table 1, are aging infrastructure, lack of funding or availability of capital, and increasing or expanding regulations. These three topics were rated as challenging or very challenging by more than 50% of all respondents, while no other topics exceeded this level. The survey also revealed the greatest need for informational/technical resources for funding and financing, asset management, and watershed-based stormwater planning, as shown in Table 2.

Overall, challenges and needs vary by permittee type as well as geography/region. Phase I and Phase II permittees have clear needs and challenges associated with the topics listed in Tables 1 and 2. Specifically, the issues of funding and financing in stormwater programs as well as evolving regulations are consistently listed as areas of high need and interest by Phase I and II MS4 programs. While the issue of aging infrastructure was prominent in the previous survey, the levels of interest and need for this topic as well as for asset management have increased.

Water quantity related topics, including climate change, are not ranked highly, but this is likely due to this topic being broken into a variety of topics. When viewed collectively, this issue of water quantity management is still considered significant.

DOT stormwater programs are unique, which is reflected in the survey results showing the high level of interest in total maximum daily loads (TMDLs) and relatively low interest in funding and financing issues. The results in U.S. Environmental Protection Agency (EPA) Region 3 are driven heavily by the MS4 permit compliance related to the Chesapeake Bay TMDL, while EPA Region 5 has challenges and needs focused on aging infrastructure. EPA Region 9 employs asset management programs at a relatively high rate, and communities in this region have strong needs for information and technical resources focused on green infrastructure.

A significant finding from the survey analysis is that approximately one-third of MS4s do not think the federal stormwater program has the ability to meet Clean Water goals in the long term. The remaining two-thirds of respondents split between a response

Table 1 - Top MS4 Program Challenges for All Permittee Types

Rank	Topic	% Challenging or Very Challenging
1	Aging infrastructure	66%
2	Funding or availability of capital	64%
3	Increasing or expanding regulations	56%

Table 2 - Top MS4 Program Information/Technical Resource Needs for All Permittee Types

Rank	Topic	% High or Very High Need
1	Funding and financing	62%
2	Asset management	49%
3	Watershed-based stormwater planning	47%

of "yes" and "unsure." These results may reflect that consideration should be made to revisit the current federal stormwater program. Alternatively, it could indicate that community and other non-regulatory goals, such as flood resilience in the face of climate change, should be better aligned with Clean Water goals and the federal stormwater program.

MS4 BUDGETARY AND FUNDING NEEDS

The survey included an inquiry on current budgets for stormwater programs as well as estimated funding gaps.

The survey indicates that between an estimated total of $18 billion and $24 billion is spent annually by municipal governments on stormwater programs and infrastructure investments nationwide. Only 30% of respondents stated that they did not need funding beyond existing budgets. This illustrates the strong need for additional funds.

The 2020 survey analysis estimates the annual funding gap to be $8.5 billion for all MS4s across the U.S. This figure is a 10% increase over the inflation-adjusted 2018 funding gap estimate of $7.7 billion. The identified funding gap in this survey underpins the recommendation of the 2020 EPA report on stormwater funding and financing stating that there is a need to "increase federal investment in stormwater infrastructure, including additional grants and loans to local governments".[1]

Additionally, the funding gap for the stormwater sector is a key piece of data highlighted by the *ASCE 2021 Infrastructure Report Card.* This report card marks the first time that this well-known and highly respected product will include stormwater as a new and separate infrastructure sector. This recognition signifies a major step forward for the stormwater sector as a legitimate and mature infrastructure.

MS4 NEEDS ASSESSMENT DATA DASHBOARD

A new feature of the 2020 MS4 Needs Assessment is the SWI MS4 Needs Assessment Data Dashboard. This online tool enables stormwater professionals to utilize the data collected in the 2020 survey. The dashboard lets users filter data by permittee type, geographic region, and other similar data aspects as well as generate outputs that can lead to an increase in understanding of the challenges, needs, and drivers for MS4 programs.[2]

[1]https://www.epa.gov/sites/production/files/2020-04/documents/efab-evaluating_stormwater_infrastructure_funding_and_financing.pdf
[2]The SWI MS4 Needs Assessment Data Dashboard and additional online resources are available on the SWI MS4 Survey webpage: https://wefstormwaterinstitute.org/programs/ms4survey/

INTRODUCTION

Stormwater is one of the fastest growing sources of water pollution in many waterways across the United States. Pressure on stormwater systems and water infrastructure overall will continue to grow as urban populations grow to nearly 70% of the total population by 2050 and shifting precipitation patterns lead to an increase in droughts in some areas and more frequent and intense storms in others. Urban runoff is a leading environmental challenge now and will be in the years to come.

Based on input from leading stormwater professionals, the Water Environment Federation (WEF) Stormwater Institute (SWI) developed *Rainfall to Results: The Future of Stormwater.* This report details the challenges, opportunities, and pathways to improving the nation's stormwater systems to make them more efficient, effective, and sustainable.

The report also developed a vision for the future of stormwater:

In the future, all stormwater will be considered a resource and managed through an optimized mix of affordable and sustainable green, gray, and natural infrastructure. Pollutant source control and management of runoff volume will be pursued aggressively as a complement to traditional stormwater controls. Stormwater infrastructure will be funded fully and managed by a true utility with a comprehensive asset management plan that benchmarks for future success. Management techniques will improve continually through new science, experiences, technical innovations, and responsive regulations. Stormwater management will be part of doing business and part of community resiliency and quality of life. The community will value and understand the many benefits of stormwater infrastructure.

The report also identified six objectives that are central to supporting the future of stormwater vision:

- Work at the Watershed Scale – All communities will have integrated, watershed-scale assessments of water resources needs and challenges.
- Transform Stormwater Governance – Communities will catalyze further formation of stormwater utilities and stormwater regulations will stimulate stormwater control innovation and performance improvement by focusing on program outcomes.
- Support Innovation and Best Practices – A broad suite of verified stormwater controls and best practices will support confident planning and maintenance.
- Manage Assets and Resources – Stormwater systems will be maintained through robust asset management programs and supported by innovative information technology.
- Close the Funding Gap – Communities will align stormwater management efforts with broader community goals to garner funding options and have access to innovative financing opportunities.
- Engage the Community – Communities will understand and value the contribution stormwater management makes to flood risk reduction, clean and safe water, climate resiliency, and other benefits.

To begin working toward these objectives, the SWI conducted national assessment surveys of municipal separate storm sewer system (MS4) permittees in 2018 and again in 2020. These surveys sought

- to better understand MS4 stormwater program challenges
- to identify the information and technical resource needs of MS4 permittees, and
- to capture budgetary investments in the stormwater sector along with an estimate of additional funding needs.

This report focuses on the 2020 survey and will contrast and compare data with the 2018 survey findings to confirm consistent findings and/or illustrate longitudinal trends where these trends may be developing.

Because of the short time between surveys, the SWI anticipated a minor shift in findings. The results from the 2020 survey are generally consistent with the 2018 survey results, which confirms this expected outcome.

Note: Dollar figures from the 2018 survey report have been adjusted to account for inflation and reflect 2020 dollar values.

SURVEY CONSTRUCTION

The 2020 survey was similar with the 2018 survey with two exceptions. First, the 2018 survey used secondary questions based upon initial answers. For instance, if a respondent rated a topic of high interest or need, they would be asked a set of follow-on questions to obtain more in-depth information. The 2020 survey, in contrast, did not use this approach.

Second, the 2018 survey included a set of questions focused on "Preferred Information Sources." This focused on such topics as periodicals used or conferences attended to gain technical and sector information. The 2020 survey did not include these questions. These changes were made to simplify the survey and reduce the time required for completion.

Both surveys included questions on

- the nature of respondents' organizations and communities in the context of permit type,
- population serviced,
- the presence of co-permittees, and
- the coverage by statewide or regional general permits.

In addition, both surveys focused on three categories — information on programmatic challenges, information on needs for technical products, and existing budgetary information along with additional budgetary needs.

This last category is a particular focus of this document and is used to estimate an annual funding gap for the MS4 sector. The questions in the 2020 survey were similar to the 2018 survey with only minor differences in wording. Questions in the budgetary section were slightly reworded for clarity and details of these differences will be discussed in the section focusing on budgetary and funding information.

OVERVIEW OF SURVEY RESPONDENTS AND NATURE OF SURVEY DATA

During the 2020 survey process, a total of 1,023 responses were received. A robust effort was made to review these responses and eliminate responses that were either duplicative, significantly incomplete, or otherwise unusable. This review eliminated 219 responses, leaving a total of 804 responses appropriate for survey analysis. For context, the 2018 survey included 622 qualified responses for survey analysis.

As with the 2018 survey, the 2020 survey received responses from 47 states and the District of Columbia. The 2020 survey data also includes responses from Puerto Rico. As shown in Table 3, approximately 23% and 67% of respondents represented Phase I and II MS4 permittees, respectively. Non-traditional Phase II permittees, like universities, and state transportation departments (DOT) accounted for 7% and 3% of the survey sample, respectively.[3] This breakdown by permittee type is very similar to the 2018 survey effort. This statistically significant sample[4] also is representative of the geographic distribution of MS4s across the United States, as illustrated in Table 4, which also shows consistency with the 2018 survey as well.

To provide users with as much data as possible, a significant amount of information reflecting the details of the survey responses have been provided in additional online resources on the WEF SWI website.[5] This information does not include raw data to protect the anonymity of survey takers. Further, including this extra data here would make it difficult for users to quickly and easily review and analyze results presented.

This extra information is provided as a summary as well as by permittee type. The specific contexts include Phase I, Phase II, non-traditional Phase II, state DOT, Phase I and Phase II combined, and EPA Regions 3, 5, and 9. The purpose of grouping Phase I and Phase II permittees together is due to the disproportionately significant role these permittee types play in the overall MS4 program. Also, the grouping of all permittee types by EPA Regions is to illustrate differences between geographies, climates, and regulatory programs. These three regions were chosen to compare and contrast because of their divergent geographies and climates, significant urban areas, and significant MS4 program dynamics.

The additional online resources specifically include a summary of metrics and expressions of the raw data set that can be used to compare and contrast the survey results given by a specific permittee type within a

[3]Non-traditional MS4s cover county, state, or federally owned separate sewer systems operated by such entities as universities, airports, hospitals, or prisons. State DOT responses are reported separately from other non-traditional MS4s because of their unique nature.
[4]Sample of municipal respondents is statistically significant at the 95% confidence interval, with a 5% margin of error.
[5]The additional online resources can be found on the WEF SWI MS4 Survey webpage: https://wefstormwaterinstitute.org/programs/ms4survey/

category or question as well as across varying permittee types. These metrics include a weighted score for responses using the 1 through 5 rating criteria utilized in several question frameworks, a ranking of each response based upon weighted score, and a percentage of respondents who express strong to very strong support for the response score of 4 or 5.

Table 3 - Breakdown of 2018 and 2020 Survey Respondents by Permittee Type Populations and Percentage

MS4 Permittee Type	2018 Population by Permittee Type	2018 % by Permittee Type	2020 Population by Permittee Type	2020 % by Permittee Type	MS4 Population by Permittee Type	MS4 Percentage Permittee Type
Phase I	155	25%	186	23%	855	11.3%
Phase II	404	65%	540	67%	6040	80.0%
Phase II Non-traditional	44	7%	55	7%	605	8.0%
State DOT	19	3%	23	3%	50	0.7%
Total	622	100%	804	100%	7,550	100%

Table 4 - Breakdown of 2018 and 2020 Survey Respondents by EPA Region

EPA Region	States in EPA Region	2018 Percent of survey respondents	2020 Percent of survey respondents	Percent of all MS4 permittees within region
1	CT, ME, MA, NH, RI, VT	7%	9%	6%
2	NY, NJ, PR, VI	4%	4%	7%
3	DE, MD, PA, VA, WV, DC	12%	9%	12%
4	AL, GA, KY, MS, NC, TN, FL, SC	12%	19%	13%
5	IL, IN, MI, MN, OH, WI	32%	25%	31%
6	AR, LA, OK, NM, TX	7%	7%	12%
7	IA, MO, KS, NE	5%	11%	4%
8	CO, MT, ND, SD, UT, WY	7%	6%	3%
9	AZ, CA, HI, NV Guam, Samoa	7%	5%	5%
10	AK, ID, OR, WA	7%	10%	7%

The 2018 survey report used the last of these three metrics but did not use the weighted score. The reason for using this method is to provide a more granular measure of support, as the use of percentage supporting at a strong or very strong level may not capture the level of strength of support for the response. More information is available in the additional online resources on how the weighted scores were determined and how the scores provide more insights on the level of support of a given response.

Survey data about the breakdown and nature of respondents respondents include the type of organization, if the community is part of a state or regional general permit, if the community has co-permittees (and how many), and population in the community. 2020 survey responses reveal that nearly half of all respondents work within a public works department except for non-traditional Phase II MS4s who are predominantly academic institutions. Question 7 of the survey asks respondents if their permit is a

statewide or regional permit. As expected, a higher number of Phase II MS4s are covered by a general permit than other permittee types, as shown in Table 5.

The use of statewide or general permits also is higher in EPA Region 9 than EPA Regions 3 and 5 per the results of this survey.

Table 5 – Responses to Inquiry on Communities Covered by a Statewide or Regional General Permit by Varying Permittee Type and Grouping (Question 7)

Permittee Group/Type	Yes (%)	No (%)
All Permittees	54%	46%
Phase I and Phase II	54%	46%
Phase I	39%	61%
Phase II	60%	40%
Phase II Non-traditional	46%	54%
State DOT	48%	52%
All Permittees – EPA Region 3	46%	54%
All Permittees – EPA Region 5	47%	53%
All Permittees – EPA Region 9	60%	40%

It is not uncommon for MS4 permittees to be part of a larger group of other permittees – or co-permittees, as illustrated in Table 6. This table lists responses by Question 8 on the presence and number of co-permittees in MS4 programs. It is not surprising that Phase I communities have lower incidents of co-permittees compared to Phase II communities, 90% of whom have co-permittees. The variation of co-permittees by region illustrates the differing regulatory landscape across the country. For instance, 93% of survey respondents in EPA Region 3 have co-permittees compared with only 71% in EPA Region 9.

These differences may be explained by state and local governance structures as well as urbanization patterns in these varying regions. More than 80% of MS4s overall have co-permittees; the average number of co-permittees is 14. This suggests that there is significant potential for coordinated or pooled resource sharing programs for a large majority of MS4s.

Lastly, as illustrated in Table 7, the distribution of 2020 survey respondents by population groupings is similar to the 2018 survey.

Table 6 – Responses to Inquiry on the Presence and Number of Co-Permittees by Varying Permittee Type and Grouping (Question 8)

Permittee Group/Type	Yes (%)	Total Count	Total Permittees
All Permittees	82%	141	2041
Phase I and Phase II	81%	131	1975
Phase I	65%	63	1167
Phase II	87%	68	808
Phase II Non-traditional	89%	6	45
State DOT	78%	4	21
All Permittees – EPA Region 3	93%	3	41
All Permittees – EPA Region 5	84%	31	373
All Permittees – EPA Region 9	71%	11	374

Table 7 – Responses to Inquiry on the Population Served by Communities for All Permittees in the Survey (Question 9) Including 2018 Survey Data

Population Group	2018 Survey by Population Group	2020 - All Permittees	
		Count	Percentage
Less than 10,000	18%	142	18%
10,000 to 49,999	38%	346	43%
50,000 to 99,999	17%	121	15%
100,000 to 499,999	15%	142	18%
500,000 to 999,999	11%	25	3%
1 million to 1,999,999		14	2%
2 million or greater		14	2%
Total	100%	804	100%

Findings for Survey Topic Areas

MS4 PROGRAM CHALLENGES

Question 10 in the survey focused on stormwater program challenges. Table 8 shows a summary of responses. In reviewing the summary of responses provided for this question provided in the additional online resources, a number of conclusions can be drawn.

The response option of "Other" is the top ranked option. This suggests that the options provided may not capture completely the universe of responses needed. These responses suggest a wider array of response options should be provided in future surveys for policy/regulatory challenges that go beyond the existing options available ("Increasing or expanding regulations" and "Permit requirements are unclear").

The SWI informally reviewed and categorized the nearly 100 responses provided in the "Other" category. A majority of the responses were focused on policy/regulations (40), with other response categories such as resources/funding (33), programmatic challenges (16) and education/training (10) filling out the balance.

While it is not appropriate to provide all the individual responses, consistent themes emerged. For instance, several responses reflect challenges between existing permitting programs and the ability to fit local programs to meet regulatory requirements. These responses also

indicate issues related to consistency of enforcement or application of permit conditions and the threat of third-party lawsuits.

Another consistent theme in the "Other" responses is the significant challenges surrounding lack of human resources and/or the ability to fund adequate staffing levels in stormwater programs. Lastly, education/training appearing in the "Other" category illustrates the challenge associated with a general lack of education/training for consultants, contractors, internal staff, and regulators in a way that would meet the goals of stormwater programs. The response option "Information/training on best practices" is ranked last when viewing all permittees (and when viewing Phase I and Phase II data combined). This ranking may reflect that training is a relatively small challenge in comparison to others considered here. The term "best practices" may specifically connote technical topics, so perhaps challenges in training is more specifically needed in less technical areas, such as programmatic issues or asset management.

Table 8 - MS4 Program Challenges for All Permittee Types (Question 10)

Rank	Weighted Score	Topic	% Challenging or Very Challenging
1	4.46	Other	89%
2	3.85	Aging infrastructure	66%
3	3.82	Funding or availability of capital	64%
4	3.58	Increasing or expanding regulations	56%
5	3.22	Public awareness and support	39%
6	2.99	Political support for program	33%
7	2.90	Cross-departmental coordination	31%
8	2.69	Aging workforce	24%
9	2.62	Technical expertise	20%
10	2.61	Permit requirements are unclear	24%
11	2.59	Information/training on best practices	19%

Beyond the "Other" category, the top ranked MS4 challenges by all permittees as well as in the context of Phase I and Phase II communities are (in order of rank)

- aging infrastructure,
- funding or available capital, and
- increasing regulations.

All of these responses ranked in the top three in the 2018 survey as well. However, the clearly higher ranking and percentage of significant challenge associated with aging infrastructure highlights this topic being one of particular significance as a challenge in the 2020 survey. The high number of responses on policy/regulations and resources/funding in the "Other" category illustrates that these may be equally, if not more, significant challenges in the MS4 sector as aging infrastructure.

After these three topics, weighted scores and percentage of significant challenge drop dramatically for all topics. Aging workforce, technical expertise, unclear permit requirements, and information/training on best practices emerged as the least critical challenges in the 2020 survey.

It should be noted that there are some permittee and regional differences in challenges prioritized. For instance, DOTs ranked funding as a lower challenge while cross-department coordination is listed higher. Neither of these deviations from other permittee types are surprising considering the unique nature of DOTs in the context of stormwater. EPA Region 3 expresses more urgency in the challenges of aging infrastructure and funding compared to all permittees, and EPA Region 9 ranks aging infrastructure significantly lower than all

others in this analysis. This likely reflects the later stage of urbanization in this region compared to the rest of the country.

DRIVERS FOR MS4 PLANNING AND INVESTMENT DECISIONS

Table 9 shows the top drivers for planning and investment for all permittee types as well as Phase I and Phase II permittees for the 2020 survey.

The top three drivers are aging infrastructure, water quality, and land development. In fact, these three response options are the only ones that garnered more than 50% support as an important or very important driver. The input provided for "Other" in Question 11 was relatively limited and did not follow any discernable or consistent themes.

These 2020 findings somewhat differ from the 2018 survey results, which found top drivers for MS4 programs to be regulatory/TMDL compliance, local flooding, water quality, and habitat restoration. Only water quality is in the top tier for both surveys.

The finding that local flooding and habitat restoration have dropped in importance significantly while aging infrastructure and land development have increased represents potential shifts in the priorities within the stormwater sector. This shift may be related to a relatively flat new residential construction rate between 2015 and 2018 based upon the number of residential unit starts, with a significant increase between early 2019 and early 2020.[6] The issue of localized flooding may have been a stronger driver in the stormwater sector as highly-publicized flooding events such as Hurricane Harvey and the Ellicott City, Maryland floods of 2016 and 2018 were fresh in the memory of many in the sector. There also might be a higher level of interest in flooding issues if the topics of localized street flooding, climate change, and coastal/riverine/lake flooding were combined into a single topic of "water quantity" to mirror the existing topic of "water quality".

Lastly, the rising topic of asset management in the stormwater sector may increase the awareness of aging infrastructure thus enhancing this topic as a driver in stormwater programs. It is difficult to make determinations on the exact reasons for these shifts, but these are issues that should be monitored in future survey efforts to capture any trends that may develop over time.

Regarding differences between permittee types and regions, DOT stormwater programs appear to be highly driven by TMDL compliance and water quality issues. EPA Region 3 permittees are also highly driven by TMDL compliance — likely associated with the Chesapeake Bay TMDL implementation targets set for many communities in this region — with a lower focus on land development as a driver. The relatively low importance associated with aging infrastructure in EPA Region 9 is consistent with the challenges identified in that region and the significance of regional compliance needs in this EPA Region may reflect the high amount of regional-based permits in this region, especially in California.

[6] https://www.census.gov/construction/nrc/pdf/newresconst.pdf

Table 9 – Drivers for MS4 Planning and Investment Decisions for All Permittee Types (Question 11)

Rank	Weighted Score	Topic	% Important or Very Important
1	3.63	Aging infrastructure	60%
2	3.51	Water quality	57%
3	3.43	Land development	51%
4	3.23	Watershed management	42%
5	3.18	Illicit discharges	41%
6	3.16	Other	47%
7	3.14	Localized street flooding	42%
8	3.06	Regional compliance needs	39%
9	3.00	TMDL compliance	39%
10	2.61	Habitat restoration	22%
11	2.49	Climate change	21%
12	2.22	Coastal/riverine/lake flooding	19%
13	2.20	Sanitary sewer overflows	20%
14	1.99	Water supply requirements (source water)	11%
15	1.78	Combined sewer overflows	14%

INFORMATION AND TECHNICAL RESOURCE NEEDS

Survey respondents indicated their need for additional information and technical resources related to six broad stormwater topic areas. These topics generally reflect the priorities outlined in Rainfall to Results. Respondents also were asked about information and technical resource needs related to the six minimum control measures (MCMs) and other aspects of permit compliance.

As with the 2018 survey, the greatest need for information and technical resources among the 2020 survey respondents was funding and financing by a wide margin Table 10 illustrates the relatively high need for information related to funding and financing compared to all other topics. This finding is consistent with the results of the 2018 survey as well. However, DOTs are the only MS4 permittee type in the 2020 survey analysis that diverges from this need for information on funding and financing. This is consistent with other responses in the 2020 survey results and is consistent with the unique nature of DOT stormwater programs, which face fewer funding and financing challenges than municipal MS4 programs.

Consistent with the 2018 survey results, the remaining topics in the 2020 survey show a consistent level of need — 43% to 49% — with the exception of TMDL compliance, which scored 38% in high or very high need. The level of need for the middle-tier topics (ranks 2-5 in Table 10) is generally higher in the 2020 survey results compared with the 2018 results, which suggests that needs across the board are increasing.

Asset management is identified as a need in both the 2018 and 2020 surveys, but shows a higher level of need in 2020. This suggests that MS4 program leaders are increasingly interested in asset management. However, in both 2018 and 2020, Phase I communities identified asset management as a less significant need compared to Phase II communities. This divergence suggests Phase II communities could benefit greatly from more information and technical resources focused on asset management.

Lastly, compared to 2018, green infrastructure is not identified in 2020 as a topic of relatively high need by MS4 permittees. The exception to this trend is Phase II non-traditional MS4s and those located in EPA Region 9, which identified this topic as a need. Planning topics,

Table 10 – MS4 Level of Need for Technical/Information Resources for All Permittee Types (Question 12)

Rank	Weighted Score	Topic	% High or Very High
1	3.73	Funding and financing	62%
2	3.37	Asset management	49%
3	3.37	Watershed-based stormwater planning	47%
4	3.30	MS4 program planning	45%
5	3.28	Green infrastructure and innovative practices and policies	43%
6	2.95	TMDL compliance	38%

such as watershed based and MS4 program planning, remain topics of significant need across the board with a slightly more need identified for the former.

The next question in the 2020 survey asks which topics listed in the previous question (Table 10) require the most labor and capital to operate. As listed in Table 11, MS4 program planning, asset management, and funding and financing require the most resources by wide margins for all permittee types included in the survey. This finding is consistent with the results for each permittee type and grouping included in the survey analysis.

Because this question was not included in 2018, there is no comparison to draw; however, with the issues of asset management and funding and financing being highly ranked in both Tables 10 and 11, it is clear that technical resources on these topics will help MS4 program managers in areas where resources are most significant.

Two additional observations also can be drawn: DOTs are requiring greater resources for asset management than other permittee types and EPA Region 3 communities are placing significant resources in TMDL compliance. (EPA Region 3's focus again is likely due to the unique nature of the Chesapeake Bay TMDL in stormwater programs in this region.)

Table 11 – Resources Required for Various Topics for All Permittee Types (Question 13)

Rank	Topic	Total Population Ranking Topic as Most Significant in Terms of Resources	% of Population Ranking Topic as Most Significant in Terms of Resources
1	MS4 program planning	353	44%
2	Asset management	169	21%
3	Funding and financing	105	13%
4	TMDL compliance	61	8%
5	Watershed-based stormwater planning	58	7%
6	Green infrastructure and innovative practices and policies	50	6%

The next question asks about the level of need for information or technical resources related to the six minimum control measures (MCMs) or other programmatic aspects. Table 12 provides the ranking and related information results based upon input from all permittee types. Of the options provided in the question, MCM 5 (post-construction runoff control) ranked as the highest need for all permittees as well as within each permittee type in the analysis, except for EPA Region 3, which ranked this topic fourth overall while ranking monitoring and evaluation as the top need. It is likely that the Chesapeake Bay TMDL requirements influence this ranking for EPA Region 3 MS4s. Another deviation of note is the relatively high ranking (2) by DOTs for needs associated with MCM 4 (construction site runoff control). None of the options provided in Question 14 received greater than 50% for high or very high need, which suggests that the need for information/technical resources based upon MCM/program aspects may be limited. Topics ranked 2 through 7 received similar weighted scores and level of need (high or very high), while needs for technical information for industrial programs were far below all other options available.

Table 12 – MS4 Level of Need for Technical/Information Resources for Minimum Control Measures and Other Stormwater Program Aspects for All Permittee Types (Question 14)

Rank	Minimum Control Measure (MCM) Number	Topic	Weighted Score	% High or Very High
1	5	Post-construction runoff control	3.16	44%
2	N/A	Monitoring and Evaluation	3.09	40%
3	6	Good housekeeping/pollution prevention	3.00	34%
4	3	Illicit discharge detection and elimination	2.99	33%
5	2	Public involvement and participation	2.94	35%
6	4	Construction site runoff control	2.92	32%
7	1	Public education and outreach	2.87	31%
8	N/A	Industrial/commercial facilities oversight	1.80	18%

Tables 13 and 14 focus on planning aspects within stormwater programs. Specifically, Question 15 asks respondents if watershed-based stormwater planning is used in programs while Question 16 provides a series of topics associated with planning and innovative strategies in stormwater programs and asks respondents to rate the level of need for information and/or technical resources. Table 13 shows that more than half of municipal MS4s (Phase I and Phase II) utilize watershed-based planning, while non-traditional and DOT MS4s are less likely to do so. Regionally, programs located in the Midwest/Great Lakes area (EPA Region 5) are more likely to use watershed-based planning than those located on either the West Coast or Mid-Atlantic areas (EPA Regions 9 and 3, respectively).

Table 13 – Responses to Inquiry on the Use of Watershed-Based Planning in Stormwater Programs by Varying Permittee Type and Grouping (Question 15)

Permittee Group/Type	Yes (%)	No (%)	Unsure (%)
All Permittees	54%	34%	12%
Phase I and Phase II	55%	33%	11%
Phase I	61%	28%	11%
Phase II	53%	35%	12%
Phase II Non-traditional	41%	41%	18%
State DOT	41%	46%	13%
All Permittees – EPA Region 3	48%	42%	10%
All Permittees – EPA Region 5	61%	29%	10%
All Permittees – EPA Region 9	47%	37%	10%

Table 14 lists the rank by weighted score for technical resources and information related to planning and unique or innovative strategies used by stormwater programs. The top ranked option chosen by all respondents is connecting stormwater investments to community priorities and plans. The second ranked topic is the incorporation of co-benefits of stormwater controls into decision making. Topics ranked 3 through 7 have similar weighted scores and percentages of high or very high need. The options of water quality trading programs and stormwater capture for water supply planning (Topics 8 and 9) ranked significantly lower than all others.

The top ranked topics highlight a desire for MS4s to understand and express the broader value of stormwater investments beyond water quality and quantity control and management by capturing the benefits of stormwater infrastructure investments in social and community contexts. Unsurprisingly, DOTs expressed a higher need than other permittee types for information on regional planning and coordination. This need reflects the nature of DOT linear infrastructure, which crosses watershed and jurisdictional boundaries.

Table 14 - Level of Need for Technical/Information Resources for Planning and Innovative Strategies in Stormwater Programs for All Permittee Types (Question 16)

Rank	Weighted Score	Topic	% High or Very High
1	3.38	Connecting stormwater investments to other community priorities and plans	48%
2	3.21	Incorporating co-benefits of stormwater controls into decision-making	42%
3	3.05	Planning across municipal departments	37%
4	3.01	Conducting watershed scale assessments	37%
5	3.01	Design of flood management projects to include water quality considerations	36%
6	2.96	Regional planning/coordination	32%
7	2.90	Public-private partnerships	31%
8	2.62	Water quality trading programs	24%
9	2.50	Integrated water supply planning that includes stormwater capture	22%
10	2.44	Other	24%

ASSET MANAGEMENT

Tables 15 and 16 are focused on asset management and associated topics. Specifically, Question 17 asks respondents if their program includes an asset management plan. Question 18 asks respondents to rate the level of need for information/technical resources on various topics associated with operations and maintenance (O&M) and asset management.

Table 15 shows that asset management planning is part of stormwater programs at levels ranging from approximately 30% to nearly 60%. The levels for most permittee types fall between 45% and 50%. It is interesting to note that EPA Region 9 MS4s employ asset management at relatively higher levels. The City of San Diego, California serves as an example of this leadership in this region.[7]

The top ranked need in the asset management/O&M topic is evaluating life-cycle costs of stormwater control measures, as shown in Table 16. This topic has a significantly higher weighted score than all other topics and is the only topic that is above 50% in the context of high or very high need. Topics ranked 2 through 5 include such topics as prioritizing stormwater assets and replacement, cost estimating for system improvement, use of automated technology to monitor and control O&M, and stormwater asset condition assessment. These topics have similar weighted scores and levels of need. Topics ranked 6 through 10 represent the lowest tier of need for technical information and/or resources. Low-tiered topics represent basic and fundamental asset management planning efforts. The fundamental nature of these topics may explain the low level of need for these topics compared to more advanced topics for those programs that have initiated asset management efforts previously.

Table 15 – Responses to Inquiry on the Use of Asset Management in Stormwater Programs by Varying Permittee Type and Grouping (Question 17)

Permittee Group/Type	Yes (%)	No (%)	Unsure (%)
All Permittees	46%	44%	10%
Phase I and Phase II	46%	44%	10%
Phase I	52%	38%	10%
Phase II	44%	46%	10%
Phase II Non-traditional	34%	57%	9%
State DOT	50%	32%	18%
All Permittees – EPA Region 3	45%	46%	9%
All Permittees – EPA Region 5	46%	47%	7%
All Permittees – EPA Region 9	57%	38%	11%

[7]https://www.waterboards.ca.gov/water_issues/programs/stormwater/storms/obj3_proj3g.shtml

Table 16 - Level of Need for Technical/Information Resources on Asset Management and Operations and Maintenance in Stormwater Programs for All Permittee Types (Question 18)

Rank	Weighted Score	Topic	% High or Very High
1	3.42	Evaluating life-cycle costs of stormwater control measures	51%
2	3.28	Prioritizing stormwater asset maintenance and replacement	45%
3	3.23	Cost estimating/cash flow analysis for capital expenditure/system improvement	45%
4	3.22	Developing a condition assessment of stormwater assets	45%
5	3.16	Using automated information technology to monitor and control operations and maintenance	45%
6	3.03	Asset management software and tools	37%
7	2.78	Mapping private stormwater control structures	34%
8	2.71	Creating an inventory/database of stormwater assets	31%
9	2.44	Mapping your storm sewer system	24%
10	2.41	Other	31%

GREEN INFRASTRUCTURE AND INNOVATIVE BMPS

When it comes to green infrastructure and innovative BMPs the need for information is consistent with responses to other questions. The top-rated need focuses on costs and funding. As Table 17 shows, the highest ranked topic is BMP life-cycle cost analysis. Other topics that ranked nearly as high as the top-ranked topic include policies to incentivize green infrastructure on private property, opportunities to encourage innovation, multi-benefit valuation of stormwater infrastructure, development of standards to encourage innovative BMPs and green infrastructure, BMP performance data, and maintenance requirements. Seven of the top ranked topics out of the total ten topics are at or near 50% of high or very high need for information or technical resources. This finding suggests that the larger topic of green infrastructure and innovative BMPs is of interest across many subtopic issues.

It is interesting to note the consistency in the weighted scores and percentages of high or very high need for Phase I and Phase II communities. However, non-traditional Phase II and DOT MS4s indicated a much lower need on such topics as policies to encourage green infrastructure on private property and development standards for green infrastructure and innovative BMPs. Topics for non-traditional Phase II and DOT permittees that are of relatively higher need are focused on BMP performance data and maintenance requirements. These differences between MS4 permittee types may be explained by DOTs and non-traditional Phase II MS4s rarely having to address private property issues.

Variations exist in rankings when viewed through the context of EPA Region as well. For instance, EPA Region 9 ranks BMP life-cycle costs analysis ninth, which differs from all other permittee types and groupings included in this analysis; the other types and regions rank this topic either first or second in terms of need for information. EPA Region 9 also ranked the need for green infrastructure work certification third, while all other permittee types and regions ranked this topic as eighth. Similarly, EPA Region 5 ranks opportunities to encourage innovation seventh, while other permittee types and regions rank this topic between 1 and 5. EPA Region 3 ranks policies and incentives for green infrastructure on private property ninth, while Phase I and II MS4s rank this as the top topic needing additional information. These varying rankings illustrate the heterogenous nature of stormwater permits and programs across the country.

Table 17 - Level of Need for Technical/Information Resources on Green Infrastructure and Innovative BMPs in Stormwater Programs for All Permittee Types (Question 19)

Rank	Weighted Score	Topic	% High or Very High
1	3.47	BMP life-cycle costs analysis	53%
2	3.40	Policies and incentives to encourage green infrastructure on private property	52%
3	3.40	Opportunities to encourage innovation	48%
4	3.39	Analyzing and valuing stormwater management on a multi-benefit basis	49%
5	3.39	Development standards and incentives that encourage innovative BMPs/ green infrastructure	51%
6	3.37	BMP performance data	49%
7	3.36	BMP maintenance requirements	49%
8	3.25	Need for certification requirements for workers that install, construct, inspect, and maintain green infrastructure	44%
9	2.82	Stormwater volume credit trading programs	34%
10	2.47	Other	31%

TMDL REQUIREMENTS

Table 18 shows which permittee types and groups deal with TMDL requirements in stormwater programs. DOT MS4s are the overwhelmingly dominant MS4 permittee type that deal with TMDL requirements — 82% "yes." The proportion of Phase II non-traditional MS4s dealing with TMDLs is half this amount — 40% "yes." EPA Region 3 has the highest amount of TMDL requirements when compared with other regions in the analysis, which is likely associated with the Chesapeake Bay TMDL. The relatively low amount of EPA Region 9 MS4s identifying TMDL requirements in stormwater programs may not reflect the incidence of TMDLs in this region but may be associated with the relatively long history MS4s in this region have with TMDLs in MS4 permits and how TMDLs have been integrated into permits.

Table 18 – Responses to Inquiry on TMDL Requirements in Stormwater Programs by Varying Permittee Type and Grouping (Question 20)

Permittee Group/Type	Yes (%)	No (%)	Unsure (%)
All Permittees	52%	39%	9%
Phase I and Phase II	52%	38%	10%
Phase I	62%	25%	13%
Phase II	49%	43%	8%
Phase II Non-traditional	40%	52%	8%
State DOT	82%	18%	0%
All Permittees – EPA Region 3	65%	27%	8%
All Permittees – EPA Region 5	57%	31%	12%
All Permittees – EPA Region 9	49%	49%	2%

TMDL COMPLIANCE

Table 19 shows the results to Question 21, which asked about various aspects of TMDL compliance in stormwater programs and the level of need for technical resources/information. The top two needs identified by all permittees as well as Phase I and Phase II MS4s are for information on the cost and effectiveness of structural and non-structural BMPs. Tracking and accounting for TMDL compliance and compliance methods for permit load allocations — ranked 3 and 4 — emerged as the second tier of need, while topics ranked 5 and 6 represent a third tier of need. Considering the significance of TMDL compliance to DOTs, it is not surprising that tracking and accounting for TMDL compliance ranked as the top need for DOTs. To contrast, respondents in EPA Region 9 ranked this topic last, which is consistent with the relatively low rate of TMDL requirements in this region compared to EPA Regions 3 and 5 as well as DOTs.

Table 19 - Level of Need for Technical/Information Resources on TMDL Compliance in Stormwater Programs for All Permittee Types (Question 21)

Rank	Weighted Score	Topic	% High or Very High
1	3.50	Cost and effectiveness of available treatment (structural) BMPs	55%
2	3.46	Cost and effectiveness of source control (non-structural) BMPs	53%
3	3.23	Tracking and accounting for TMDL compliance	45%
4	3.22	Compliance methods for permit load allocations	44%
5	3.14	Integrating TMDL requirements into stormwater planning	38%
6	3.12	Water quality modeling	41%
7	2.09	Other	18%

SUFFICIENCY OF FEDERAL STORMWATER PROGRAM

Perhaps the most compelling question in the 2020 survey asks about the sufficiency of the overall federal program to meet clean water goals in the long term. The responses on this question are shown in Table 20. None of the permittee types or groups included in the analysis answered "yes" at a rate above 50%. In fact, the responses of all respondents are split evenly between "yes", "no", and "unsure".

It is noteworthy that permittee types that typically have greater resources and more sophisticated programs, such as Phase I permittees and DOTs, rate the sufficiency of the federal stormwater program to meet clean water goals to be at or near 25%. This pattern may help to explain the difference in responses between EPA Regions 3 and 9, who rate federal sufficiency lower than EPA Region 5, as the portion of respondents that are Phase I permittees are higher in EPA Regions 3 and 9 than EPA Region 5.

The survey did not specifically ask for details behind this low level of confidence in the federal stormwater program. However, when placed in the context of other survey responses, some possible factors and linkages appear possible.

For instance, the responses related to the sufficiency of the federal stormwater program to help meet clean water goals may be associated with expanding regulations affecting MS4 programs; respondents ranked this as their fourth highest challenge and more than half of them scored this topic as a significant or very significant challenge. Phase I permittees and DOTs, which have more detailed and stringent permit requirements, may see these expanding regulations as particularly challenging compared to Phase II permittees.

Another possibility may be based upon the limited focus on regulations. While a significant portion of resources in stormwater programs are associated with meeting regulatory requirements, there are aspects of these programs that reach beyond this. The implementation of green infrastructure, as an example, drives local green jobs, reduces heat island effects, and can enhance property values and spur positive redevelopment activities.

Another component of stormwater and/or watershed programs are issues related to localized flooding, dam safety, and floodplain management. Investments in these areas are increasingly important considering the issue of non-stationarity in precipitation patterns and depths associated with climate change. While investments to address water quantity issues clearly have some water quality benefits, drivers focused on flood control are outside of the federal MS4 program, so perhaps the response reflecting a lack of sufficiency of this program reflects the view that the national stormwater program should encourage a more holistic and multi-faceted construct.

While the specifics behind the response on the national stormwater program cannot be discerned at this time, there is a need to delve into this topic to understand the specific aspects of the federal stormwater program that could be improved, enhanced, or clarified to become a more successful program. Better understanding of the shortcomings of the stormwater program is in the best interest of the entire stormwater sector. A dialogue between national groups focused on stormwater management and EPA may help to better identify actionable items to address this topic.

Table 20 – Responses to Inquiry on the Sufficiency of the Federal Stormwater to Meet Clean Water Goals in the Long Term by Varying Permittee Type and Grouping (Question 26)

Permittee Group/Type	Yes (%)	No (%)	Unsure (%)
All Permittees	36%	32%	32%
Phase I and Phase II	36%	32%	32%
Phase I	27%	40%	33%
Phase II	40%	29%	31%
Phase II Non-traditional	30%	28%	42%
State DOT	27%	36%	36%
All Permittees – EPA Region 3	25%	37%	38%
All Permittees – EPA Region 5	47%	24%	29%
All Permittees – EPA Region 9	31%	44%	25%

Analysis of MS4 Budgetary and Funding Needs Data

BUDGET AND FUNDING GAP SURVEY DATA

The 804 survey responses to the 2020 survey can be broken into three groups when it comes to budgetary and funding data. The first group is the 366 responses that identified a need for additional funding as well as specific amounts needed. This data also is needed for the funding gap analysis. This sample size meets or exceeds the measure of statistical significance at a 95% confidence level and a 5% confidence interval. Of the remaining 438 responses, 343 provided an answer on the need for additional funding, but no specific amounts. Of these 343 responses, 101 agreed on the additional need, while 242 indicated that no additional funding is needed. The third group, which included 95

responses, provided no indication on the need for additional funding. The survey showed that 58% of respondents identified a need for additional funding for their programs, confirming the importance of reliable funding sources for the future of the stormwater sector.

ANNUAL PROGRAM BUDGET AND ADDITIONAL NEEDS

Funding and financing emerged as a major challenge in both the 2018 and 2020 surveys. This includes a very high need for both information and technical resources on this topic. In 2018, two questions sought data on this topic:

- What is your estimated stormwater program budget for 2018, including approximate expenditures for programmatic, capital, operations, and maintenance activities?
- Is your estimated 2018 annual stormwater budget adequate to meet all of your current stormwater goals, including regulatory compliance? (Yes or No)

If respondents in 2018 indicated their stormwater budget was not adequate, a follow up question clarified the estimated additional amount required to meet goals:

- To be fully compliant and meet all of our current stormwater goals our agency needs approximately _____ MORE this year in addition to our current 2018 budget.

Of those who responded, 48% indicated that they did not have the resources needed to meet stormwater program goals. The 2018 survey report noted that subsequent survey efforts would seek to refine these questions.

In the 2020 survey, these questions were changed to reduce concerns survey respondents may have in expressing whether a budget gap exists in their program, and if so, by what amount. These changes were to allay worries that acknowledging a budget gap may be inferred to relate to a lack of regulatory compliance.

The first budget question in the 2020 survey was modified slightly to be more generic and not tied to a specific year.

- What is your most recent annual stormwater program budget including approximate expenditures for programmatic, capital, operations, and maintenance activities?
  (please provide dollar amount)

A new question was added to identify if additional funds beyond the annual stormwater budget exist for the stormwater program. This new question acknowledges that funding for stormwater programs often comes from many sources, some of which are outside the typical budgeted pool of funds.

- Is there additional money being spent in your jurisdiction on the stormwater program from other sources not quantified in the previous answer?
  - If yes, please provide dollar amount.

The third question, which focuses on a budget gap, was modified significantly. The key changes were the use of the phrase "budget gap" and the removal of the phrase "including regulatory compliance."

- Do you have an annual budget gap for your stormwater program? In other words, are you deferring some expenditures due to lack of funding? (Yes/No)

A fourth question was modified slightly as well. The change altered the phrase "to be fully compliant" to "to be fully funded." Changes to the third and fourth questions were intended to allay concerns of a potential perceived association between budget shortfall and regulatory compliance.

- To be fully funded to meet stormwater goals our agency needs approximately $_____ MORE per year? (please enter a dollar amount that represents the additional funding needed)

The 2020 survey findings show that Phase I MS4 communities and state DOTs have larger stormwater program budgets than Phase II municipal and non-traditional MS4s. In addition, the average amount of funding available from outside of stormwater program budgets ranged from 11% to 65%. Since the second budget question was not included in the 2018 survey, there is no way to compare this with past survey information. However, this data makes it evident that the relative amount of additional funds available outside of stormwater program budgets is significantly higher than previously thought. This reflects the complex nature of stormwater program funding and suggests that future surveys should continue to include this question to better capture the multi-sourced nature of stormwater investments. Table 21 summarizes responses on this budgetary information.

Table 21 - Summary of Information Related to Budget Status and Funding Needs of MS4 Permittees (Questions 22 and 23)

MS4 permittee type (sample size)	Average estimated 2020 program budget	Average additional funds from outside of stormwater program	Average adjusted annual funds available	Increase in funds from sources outside program budget (%)
Phase I (n = 85)	$9,902,000	$1,115,000	$11,017,000	11%
Phase II (n = 250)	$1,411,500	$915,000	$2,236,500	65%
Phase II Non-traditional (n = 21)	$687,000	$111,000	$798,000	16%
State DOT (n = 10)	$4,438,000	$2,185,000	$6,623,000	49%

In the 2018 survey, more than half of respondents stated they did not need additional funds. The 2020 survey results show that only 30% of respondents indicate they do not have an annual funding gap, which is significantly less than in 2018. Table 22 provides a breakdown of 2018 and 2020 survey data on this topic.

Overall, 58% of respondents in 2020 stated that they have an annual funding gap; 12% of respondents left this question blank. This increase in acknowledgement of a funding gap within stormwater programs confirms the suggestion in the 2018 survey report that the rate of funding gaps in these programs was likely higher than what was revealed in that survey effort. It is likely that this increase in funding gap acknowledgement is associated with the question re-phrasing, as well as increased comfort in answering budgetary/funding information in the survey.

Table 22 – Responses to Inquiry on the Presence of a Funding Gap in Stormwater Programs (Question 24)

MS4 permittee type	2018 Survey			2020 Survey		
	Yes	No	Null/Blank	Yes	No	Null/Blank
Phase I	47%	53%	N/A	59%	28%	13%
Phase II	49%	51%	N/A	59%	29%	12%
Phase II Non-traditional	41%	49%	N/A	45%	49%	6%
State DOT	57%	43%	N/A	57%	26%	17%
All Permittees	48%	52%	N/A	58%	30%	12%

Table 23 provides a summary of budget information as well as funding gap response data. Specifically, this question asks those who have identified a funding gap what the amount of that shortfall is. The table lists the amount of budgetary increase needed to meet stormwater program goals (in terms of a percentage of annual budget) for both 2020 and 2018 surveys. The budget information used for the 2020 survey data is the stormwater program budget alone. This information excludes the adjusted annual level of funding after adding in outside funding sources. The decision to use budget information was based upon the premise that budgeted data is funding that is planned annually, while additional sources may not be available year-to-year, so it may be unrealistic to view the adjusted annual funding available with the same level of surety as program budget levels identified.

As evident in Table 23, funding gaps identified by all permittee types vary greatly. This variability is not entirely surprising considering that this is an estimate, and it is likely that this is commonly determined through heuristics or some other informal process to quantify unfunded needs. Several respondents who did not provide funding gap information made statements about not knowing or having access to this information.

Table 23 - Summary of Information Related to Budget Status and Funding Needs of MS4 Permittees (Question 25)

MS4 permittee type (sample size)	2018 survey annual budget increase needed (%)	Average estimated 2020 program budget	% of respondents requiring additional funds to meet program goals	Additional annual budget needed to meet all program goals	Annual budget increase needed (%)
Phase I (n = 85)	52%	$9,902,000	59%	$8,239,000	83%
Phase II (n = 250)	136%	$1,411,500	59%	$1,262,000	89%
Phase II Non-traditional (n = 21)	234%	$687,000	46%	$368,000	54%
State DOT (n = 10)	12%	$ 4,438,000	57%	$4,580,000	103%

FUNDING GAP ANALYSIS

Based on the 2020 survey, the MS4 sector has an estimated annual funding gap of $8.5 billion, which is higher than the $7.7 billion estimate based on the 2018 survey. To arrive at this estimate, two methods were used – "simple" and "complex" – and the results from each of these were compared and used to find a figure mid-way between these two to represent the best estimate for an annual budget gap for the stormwater sector. The premise of this approach is by using two different methods, any possible unknowns not captured in one approach may be mitigated using a second approach with differing assumptions and metrics. If these two approaches produce results that are relatively close in magnitude, there is more confidence that the midpoint figure between the results produced by these two approaches is a robust estimate.

The simple method for estimating the annual funding gap uses an approach that multiplies the percentages of MS4 permittee types that identified a need for additional funding by the total number of MS4s to determine an estimate of the total number of MS4s requiring additional funds. This value was then multiplied by the estimated additional funding need identified for each MS4 permittee category and summed across all MS4 permittee categories. For example, 59% of Phase I permittees identified the need for additional funding, which is estimated to be $8.2 million annually. Using this data, along with an estimated 855 total Phase I permittees across the country (U.S. EPA, 2018) produces an estimated annual funding gap for Phase I permittees of $4.1 billion. A complete listing of information for other permittee types is presented in Table 24, which reflects a total annual funding gap estimate of $8.9 billion using this methodology.

Table 24 – Annual Funding Gap Estimate Using the Simple Method

MS4 permittee type	Total Count in the U.S.	% Needing More Funds	Number Needing More Funds	Average Annual Budget Shortfall	Total Annual Budget Shortfall (Annual Funding Gap)
Phase I	855	59%	501	$8,239,000	$4,127,876,000
Phase II	6,040	59%	3,582	$1,262,000	$4,519,629,000
Phase II Non-traditional	605	46%	275	$368,000	$101,238,000
State DOT	50	57%	28	$4,580,000	$129,385,000
Totals	7,550	N/A	4,367	N/A	$8,878,128,000

The complex analysis method focuses on population distributions for municipal MS4s as this allows for adjustments based upon municipal (city and county) population information to establish a distribution of populations that likely reflect those for communities who hold MS4 permits. Survey data on population covered by MS4 program is correlated to associated budget shortfall information. This methodology is like the simple estimate except budget shortfall data is grouped by population instead of stated MS4 permit type. It should be noted that the distribution of communities by population removed non-traditional and DOT MS4s when determining population distributions. This data is listed in Table 25.

Table 25 - Annual Funding Gap Estimate Using the Complex Method Based Upon 2020 Survey Respondent Population Data

Population/ Permittee Type	Distribution of Communities by Population[8]	Distribution of MS4s by Population Served[9]	Additional Estimated Need (Average)	Percent Identifying Need for Additional Funds	Total Need by Population Served Category
Less than 10,000	16.80%	1159	$316,362	55%	$201,240,000
10,000 to 50,000	44.5%	3068	$1,417,388	65%	$2,813,152,000
50,000 to 100,000	15.6%	1073	$1,662,823	54%	$963,642,000
100,000 to 500,000	18.0%	1244	$6,779,821	70%	$4,251,261,000
Over 500,000	5.1%	455	$25,745,853	54%	$6,360,071,000
Phase II Non-traditional	0	605	$367,770	46%	$101,238,000
State DOT	0	50	$4,580,000	54%	$124,118,000
Total	N/A	7550	N/A		$14,814,722,000

[8]*This distribution matches the distribution of survey respondents.
[9]** The number of MS4s in this distribution listed in italics reflects a total of 6895 MS4s distributed per the percentages in the column listed in the immediately adjacent column. The number of 6895 is based upon the total number of MS4s (7550) minus Phase II non-traditional and State DOT permits (605, 50, respectively).

Using this approach generated an estimated annual funding gap of $14.8 billion. The main factor behind this elevated number compared to the simple method estimate is an inadvertent oversampling of larger communities in the survey compared to the actual distribution of population represented by MS4s. This oversampling of large communities reflects the challenge in obtaining survey response rates for smaller communities at the same rate as large communities.

To adjust this potential oversampling, the response rate and identified need by population was applied to the distribution of municipal governments using National League of Cities (NLC)[10] information as listed in Table 26.

Using the response rates and funding needs from Table 25 and the distribution from Table 26, the estimated annual funding gap drops to $4.9 billion. The reason for this significantly lower estimate is due to a shift from a potential oversampling of large communities to an oversampling of small communities; the NLC data suggests a distribution of community sizes that are weighted too heavily toward small compared to the universe of MS4 communities. In other words, a significant number of the small communities (less than 10,000) in the NLC distribution should not be included in the analysis, as many of these smaller communities do not meet the threshold of urban size or density that would require them to obtain an MS4 permit.

Table 26 - Annual Funding Gap Estimate Using the Complex Method Using a Population Distribution Based Upon City Populations in the U.S. (NLC, 2007)

Population/ Permittee Type	Distribution of Communities by Population[11]	Distribution of MS4s by Population Served[12]	Additional Estimated Need (Average)	Percent Identifying Need for Additional Funds	Total Need by Population Served Category
Less than 10,000	56.71%	3910	$316,362	55%	$679,126,000
10,000 to 50,000	33.03%	2277	$1,417,388	65%	$2,088,507,000
50,000 to 100,000	6.38%	440	$1,662,823	54%	$394,998,000
100,000 to 500,000	3.33%	230	$6,779,821	70%	$784,562,000
Over 500,000	0.55%	38	$25,745,853	54%	$686,372,000
Phase II Non-traditional	0	605	$367,770	46%	$101,238,000
State DOT	0	50	$4,580,000	54%	$124,118,000
Total	N/A	7550	N/A		$4,858,921,000

The distribution of population by county in Table 27 was used to develop a county-based estimate for an annual funding gap. The distribution of population by county was based on U.S. Census data and was used because the survey data may overstate the needs of large communities, the NLC data may overstate the needs of small communities, and it is common for MS4 permits to be held at the county level.

[10]https://www.nlc.org/number-of-municipal-governments-population-distribution
[11]This distribution is based upon the number of municipal governments in the U.S. per the National League of Cities, 2007.
[12]The number of MS4s in this distribution listed in italics reflects a total of 6895 MS4s distributed per the percentages in the column listed in the immediately adjacent column. The number of 6895 is based upon the total number of MS4s (7550) minus Phase II non-traditional and State DOT permits (605, 50, respectively).

Table 27 – Annual Funding Gap Estimate Using the Complex Method Using a Population Distribution based upon County Populations in the U.S. (U.S. Census, 2013)

Population/ Permittee Type	Distribution of Communities by Population[13]	Distribution of MS4s by Population Served	Additional Estimated Need (Average)	Percent Identifying Need for Additional Funds	Total Need by Population Served Category
Less than 10,000	44.14%	3043	$316,362	55%	$528,585,000
10,000 to 50,000	38.16%	2631	$1,417,388	65%	$2,413,071,000
50,000 to 100,000	8.54%	589	$1,662,823	54%	$528,957,000
100,000 to 500,000	7.47%	515	$6,779,821	70%	$1,758,823,000
Over 500,000	1.69%	117	$25,745,853	54%	$2,109,034,000
Phase II Non-traditional	0	605	$367,770	46%	$101,238,000
State DOT	0	50	$4,580,000	54%	$124,118,000
Total	N/A	7550	N/A		$7,563,826,000

Using the distribution from Table 27 and the response rates and funding needs from Table 25, a refined annual funding gap estimate was determined to be $7.6 billion. To address the fact that some MS4 permits are held by cities and some are held by counties, a final adjustment was made to the population distribution listed in Table 26 by reducing the number of small cities considered (less than 10,000) by half, which resulted in an estimated distribution of communities in the MS4 program by population as listed in Table 28. The distribution of MS4s by population served in Table 28 is an estimated distribution of the population of all the MS4s in the country rather than a documented distribution.

Using the distribution from Table 28 and the response rates and funding needs from Table 25, an annual funding gap estimate is determined to be $8.0 billion. This number is between the two extremes produced from this analysis ($14.8 billion and $4.9 billion), and it is close to the simple method estimate of $8.9 billion. Considering these figures, it is reasonable to estimate an annual funding gap of $8.5 billion for the MS4 sector, which is the midpoint between the two most reasonable estimates generated ($8.0 billion and $8.9 billion) that were determined through different analytical methods.

The estimated funding gap should be viewed in the context of being an estimate that is statistically significant, but also based upon stormwater infrastructure costing estimations, which are notoriously variable. As the sector matures and costing data is refined, the funding gap number may change. In addition, there is an element of MS4s potentially "not knowing what they don't know" in terms of total investment needs. As asset management becomes more prevalent in the stormwater sector, there is a likelihood that the needs of stormwater programs will increase due to revealed needs previously undiscovered.

[13]This distribution reflects county populations across the U.S. per 2013 Census data.

Table 28 - Annual Funding Gap Estimate Using the Complex Method Based Upon an Estimated Distribution of MS4s by Population

Population/ Permittee Type	Distribution of Communities by Population[14]	Distribution of MS4s by Population Served	Additional Estimated Need (Average)	Percent Identifying Need for Additional Funds	Total Need by Population Served Category
Less than 10,000	28.35%	1955	$316,362	55%	$339,550,000
10,000 to 50,000	52.40%	3613	$1,417,388	65%	$3,313,312,000
50,000 to 100,000	10.72%	739	$1,662,823	54%	$663,481,000
100,000 to 500,000	7.12%	491	$6,779,821	70%	$1,677,290,000
Over 500,000	1.41%	97	$25,745,853	54%	$1,756,857,000
Phase II Non-traditional	0	605	$367,770	46%	$101,238,000
State DOT	0	50	$4,580,000	54%	$124,118,000
Total	N/A	7550	N/A		$7,975,846,000

Conclusion

The stormwater sector continues to evolve with more vigor than other infrastructure sectors. After years of consideration, and with support from WEF and other stormwater sector organizations, the American Society of Civil Engineers (ASCE) agreed to include stormwater as a separate infrastructure sector in its *2021 Infrastructure Report Card*. This addition recognizes the rising significance of the stormwater sector as part of all infrastructure. In 2019, EPA convened a group of environmental funding and financing specialists (some within WEF membership) to investigate the challenges of funding and financing in the stormwater sector, and in 2020, released an internal report – *Evaluating Stormwater Infrastructure Funding and Financing.*[15] The EPA Stormwater Infrastructure Finance Task Force's central conclusion was that an increase of funding from the federal government is needed for the stormwater sector.

STORMWATER SECTOR MATURES AND NEEDS ADDITIONAL FUNDING

The ASCE *2021 Infrastructure Report Card* and EPA funding and financing report are examples of progress for the stormwater sector and focus on areas of particular importance in the stormwater sector: funding and sector maturation. The results of the 2020 WEF MS4 Needs Assessment Survey captured elements of both areas.

The topic of funding and financing ranks at or near the top of challenges stormwater programs face; these programs also indicated a high need of technical information and resources on this topic. These findings are consistent with the 2018 MS4 survey and are likely to remain consistent in the future as demands grow and available funds remain limited.

[14]This distribution is based upon a modification of the information listed in Table 26. Specifically, the number of cities with less than 10K in population from Table 27 was reduced by half with the remaining half of communities divided into the remaining population bin in proportion to the distribution of communities reflected by counties (Table 27). Specifically, the distribution of communities between 10-50K, 50-100K, 100-500K and 500K-1M+ or more was used to provide the distribution of the remaining half of small cities assumed to not be in the MS4 program. In this way, elements of both cities and counties are integrated into the overall nature of community size distributions -this reflects that MS4 permits are held by cities in some states/regions and others are held by counties.

[15]https://www.epa.gov/waterfinancecenter/efab-report-evaluating-stormwater-infrastructure-funding-and-financing

Aging infrastructure is a growing topic of interest for the stormwater sector. It was identified as a challenge in 2018 and became a top challenge and need for information and technical resources in 2020. This growth in focus on aging infrastructure reflects that an increasing amount of stormwater infrastructure is reaching the end of its design life, which is a clear sign of sector maturity.

EVOLVING REGULATIONS AND OTHER CHALLENGES

While the stormwater sector is maturing, some aspects of the sector are relatively nascent. This is evident in the continuously evolving regulatory programs, which are identified in the 2020 survey as a significant challenge for many stormwater programs.

Water quality and watershed-based planning are noted significant drivers in stormwater programs. This signals that challenges in addressing the impacts of urban runoff continue in the context of the quality of receiving waters. More holistic, watershed-based approaches to address stormwater-oriented problems are seen as more advantageous. This also reflects the growing recognition of the watershed-based connection between urban stormwater runoff and water supplies, habitat, agriculture, and other sectors.

It is noteworthy that localized flooding is a lower driver in 2020 than reflected in the 2018 survey. Similarly, climate change continues to be a relatively limited motivator in stormwater programs, which suggests that more fundamental drivers are crowding out other, less directly impactful (at this time) drivers.

ASSET MANAGEMENT AND CO-BENEFITS

The stormwater sector also exhibits a growing hunger for information on asset management. The 2020 survey results illustrate that approximately half of MS4s have implemented some type of asset management plan; some permittee types and regions are slightly further ahead or behind in this regard. The survey results also reveal that more basic aspects of asset management, such as infrastructure identification and mapping, are generally less needed than more advanced and complex aspects, such as life-cycle analysis, prioritization and cash-flow analysis for asset replacement, and condition assessments of stormwater assets.

The survey also shows that permittees have relatively high need for information and resources on less technical topics, such as connecting stormwater investments to community priorities and using co-benefit valuation in decision making within stormwater programs.

DOT MS4 PROGRAM EVOLVING NEEDS

The analysis of the 2020 survey results presented in this report includes a breakout by MS4 permittee type as well as a spotlight on certain geographic areas, defined by EPA Region. Differences in challenges, needs, and drivers emerge when delving into regional or permittee type analysis. One consistent theme that arises is the uniqueness of DOT MS4 programs, which have fewer challenges and needs related to funding and financing and relatively stronger interest in TMDL compliance. During the national stormwater rulemaking effort led by EPA between 2009 and 2014, a proposed change to the stormwater program to better accommodate the transportation sector was considered. This change would have created a new permittee type category – the Transportation MS4 or TS4 permittee type. The results of this survey, as well as in the 2018 survey, support the potential need for this type of permit.

REGIONAL OBSERVATIONS AND POLICY IMPLICATIONS

A clear thematic pattern is present in the 2020 survey results that highlights the significant effect that the Chesapeake Bay TMDL is having on EPA Region 3 stormwater programs. Another pattern is that EPA Region 9 communities are less concerned with aging infrastructure and seem to be more advanced than other regions in the context of asset management. The level of interest in green infrastructure is relatively higher in EPA Region 9 than in other regions, which likely reflects the policies adopted by states and localities in this region that place a relatively higher value on green infrastructure investments than gray stormwater infrastructure. More than 80% of all MS4s have co-permittees associated with their program, with this rate being near 95% for EPA Region 3 communities

compared with just over 70% in EPA Region 9. Differences also emerge in the use of general permits, which over half of MS4s utilize with an expected greater amount of Phase II communities (60%) compared with Phase I communities (39%) using this option. Similarly, some regions, for instance EPA Region 9, utilize general permits (60%) more than both EPA Regions 3 and 5 (46% and 47%, respectively). While it may be assumed that this higher use of general permits might be due to the distribution of permittee types in each region, it should be noted that EPA Region 9 survey respondents were more heavily weighted toward Phase I communities compared to either EPA Region 3 or 5 as well as all permittees taken as a whole.

These regional differences play a significant role in stormwater sector policy and consideration should be made to focus future study into the details of these differences. This focus may help to identify lessons learned that can be shared for a larger benefit across the sector. A level of granularity not reflected in this analysis is the variability of stormwater needs and challenges at the state level. However, this does not suggest that this variability does not exist. To the contrary, states define their own stormwater programs (with the exception of the four states and the District of Columbia who lack regulatory primacy) to match the unique needs and dynamics within their state. This state-led architecture in the stormwater sector drives variability between state programs even for those states in the same EPA Region.

FEDERAL STORMWATER PROGRAM NEEDS AND CHALLENGES

The responses provided to the question on the sufficiency of the federal stormwater program to meet the clean water goals is perhaps the single most revealing take-away from this survey. Only one-third of MS4s indicate that the federal stormwater program will be sufficient to meet clean water goals. The other two-thirds equally divide their views between the program being insufficient and being unsure on how to respond.

The federal MS4 program is roughly 30 years old, and while the development of local MS4 programs has been occurring over these 30 years, most regulated communities and entities now have gone through multiple permit cycles. The experience up to this point on the implementation of the federal stormwater program has clearly led to mixed results, as noted in survey responses. This may reflect the lack of sufficiency to effectively address Clean Water Act goals or it may capture a broader view that the community-oriented goals of sustainability, resilience, and economic strength that are also part of many stormwater programs should be better aligned to provide a more holistic and comprehensive programmatic approach to stormwater. There is a need to better understand the dynamics behind the sentiment expressed by the approximately 64% of permittees in this survey who consider the program as either insufficient or, at best, are unsure of the sufficiency of the program.

MORE DATA NEEDED TO CONTINUE TO REFINE THE FUNDING GAP

Obtaining statistically significant data sets for two National MS4 Needs Assessment Surveys just two years apart creates confidence that continued surveys will have equal or greater success. This is an even more significant consideration when noting that the number of responses increased by nearly 30%. More work is needed to continue to refine the survey, as is typical for newly established sector survey efforts.

The MS4 Needs Assessment Survey produces funding gap estimates at a level of accuracy provided by no other similar survey effort. While the estimated annual funding gap has changed from $7.7 billion[16] in 2018 to $8.5 billion in 2020, so have the questions and analysis methodologies to seek more and more accurate estimates.

It should be recognized that the topic of the coronavirus pandemic was not included in this survey. Some may see this as an omission, but the questions were finalized well before the pandemic, and the survey was released prior to its broader effect.

The pandemic has and will continue to affect the stormwater sector. To understand the scale and nature of these effects, efforts should be made in future surveys to capture this information to help us prepare, as a sector, for future similar events.

READER-LED DATA ANALYSIS

The findings presented in this report reflect a limited number of analysis snapshots. Survey results focusing on all permittees provides a broad view of survey responses; focusing on specific permittee types or geographic regions can provide insights on trends and highlights in these focused data sets. It is recognized that there are several additional ways to view the results of this survey. For instance, results can be found for specific permittee types – or groups of permittee types – within each EPA Region – or within groupings of EPA Regions. It is impractical to attempt to develop analysis outputs for every possible data permutation in this report, but using technology, readers can explore the data using various data filters to produce various results.

Readers are invited to use the online SWI MS4 Needs Assessment Data Dashboard to perform custom analyses by going to https://wefstormwaterinstitute.org/programs/ms4survey/.

[16]The 2018 value of $7.5 billion has been adjusted to account for inflation between 2018 and 2020 based upon the U.S Bureau of Labor Statistics (https://www.dol.gov/general/topic/statistics/inflation)

References

National League of Cities, 2007. Number of Municipal Governments & Population Distribution. Accessed February, 2019. https://www.nlc.org/number-of-municipal-governments-population-distribution

U.S. Census Data, 2013. American Fact Finder. Annual Estimates of the Resident Population by Sex, Race Alone or in Combination, and Hispanic Origin for the United States, States, and Counties: April 1, 2010 to July 1, 2013. Accessed February, 2019.

WEF, 2015. Rainfall to Results: The Future of Stormwater. Water Environment Federation Stormwater Institute. February, 2019. http://wefstormwaterinstitute.org/rainfall-to-results/

U.S. EPA, 2021. Stormwater Management and Green Infrastructure Research. U.S. EPA. January, 2021. https://www.epa.gov/water-research/stormwater-management-and-green-infrastructure-research

Stormwater Institute Subscribers

MUNICIPAL/UTILITY

Boston Water and Sewer Commission, MA
Capital Region Water, Harrisburg, PA
Capitol Region Watershed District, Saint Paul, MN
City of Baltimore Department of Public Works, MD
DC Water and Sewer Authority
Fairfax County, VA
Kansas City Water Services Department, MO
Metropolitan Sewer District Louisville, KY
Metropolitan Sewer District of Greater Cincinnati, OH
Metropolitan Water Reclamation District of Greater Chicago, IL
Milwaukee Metropolitan Sewerage District, WI
Montgomery County, MD
New Orleans Delegation, LA
Pittsburgh Water and Sewer Authority, PA
San Francisco Public Utilities Commission, CA
Sanitation District No. 1 of Northern Kentucky

TECHNOLOGY/SERVICE PROVIDERS

AbTech Industries, Inc.
AECOM
Arcadis
Atkins, a Member of SNC-Lavalin
BaySaver Technologies
Berntsen International Inc.
Black & Veatch Corporation
CDM Smith
Contech Engineered Solutions, LLC
Convergent Water Technologies
EA Engineering, Science, and Technology, Inc., PBC
Greyline Instruments
Haskell
Hazen and Sawyer
Herrera Environmental Consultants
Jacobs Engineering Group
Larry Walker Associates
LimnoTech
Oldcastle Precast – Stormwater
OptiRTC, Inc.
Stantec Consulting
StormTrap
Tetra Tech, Inc.
Woodard & Curran

NON-GOVERNMENTAL

Sacramento State, Office of Water Programs
University of Louisville Center for Infrastructure Research
University of New Hampshire Stormwater Center
Villanova Urban Stormwater Partnership

Under the direction of the WEF Stormwater Institute, February 2021
Copyright © 2021 Water Environment Federation. All rights reserved.

wef® Stormwater Institute

wef®

601 Wythe Street, Alexandria, Virginia 22314 | www.wef.org | www.wef.org/stormwater