Willamette Basin Five-Year Review Report

City, County, Special District Total Maximum Daily Load Implementation 2013 to 2018

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Executive Summary

The Willamette Basin Total Maximum Daily Load Five-Year Review is the second comprehensive assessment of Total Maximum Daily Load implementation activities that urban and rural cities, counties, and special districts in the basin implemented between 2013 and 2018. A 2018 survey tool was used by 47 of the 89 rural and urban cities, counties, and special districts implementing TMDL water quality improvement plans in the Willamette Basin. They took the survey between April and December 2018. DEQ published the first **Willamette Basin TMDL Five-Year Review** in February 2014.The first report was a comprehensive five-year assessment of TMDL implementation activities that urban and rural cities, counties, and special districts implemented between 2008 and 2013. A 2013 survey was also used to collect the data.

This report includes a general discussion of implementation activities and recommendations that will be applied to future TMDL water quality improvement measures. DEQ concludes that a large percentage of designated management agencies are implementing pollution reduction strategies and reporting on their progress. Overall, the management agencies reported an increase in selected implementation strategies between the 2013 and 2018 survey tools that were used to collect and pool the data. DEQ identified five broad tasks for continued improvement over the next five years, 2018 to 2023, for TMDL implementation. The primary focus will be on enhancing internal and external communication, providing technical assistance for rural and urban entities, and improved survey monitoring and evaluation.

This report includes an implementation tracking matrix for the specific measurable actions for the tasks that will be implemented and monitored between 2018 and 2023.

The following is a summary of the achievements:

Stormwater management

- Designated management agencies that are municipal separate storm sewer system Phase I permitees have the applicable stormwater control measures in place.
- Management agencies that are MS4 Phase II permittees have four of the five stormwater control measures in place, and 50 percent are fully implementing post-construction stormwater control program.
- Small management agencies, with populations less than 10,000 people, in more dense urban areas are also implementing a number of stormwater control measures that are required for larger communities.
- Sixty-five percent of management agencies with a population less than 10,000 reported they have construction stormwater control programs in place. All other DMA groups reported they have a construction stormwater control program, resulting in 85 percent of all responding have a program in place.
- Sixty percent of respondents indicated they had procedures for responding to illicit discharges and enforcing compliance. All designated management agencies working under the MS4 permit have an illicit discharge detection and elimination program.

Riparian restoration

- About 57 percent of the management agencies stated that they are implementing or collaborating on riparian restoration projects. It is important to note that the survey does not capture all of the on-the-ground restoration by watershed councils, non-governmental agencies, and state and federal agencies that has been underway since the issuance of the TMDL.
- The total number of restoration projects reported was 103**.** The estimated linear measurement of the riparian areas where projects occurred was greater than 91,450 feet, or more than 17 miles.
- A total of 15 projects related to cold water refuges were reported by MS4 Phase I management agencies and management agencies with populations greater than or equal to 10,000 people. The cold water refuge temperature standard applies along the mainstem of the Willamette from river mile 50 to the confluence with the Columbia River.

Comparison between 2013 and 2018 surveys

- The percent of active riparian restoration increased by 24 percent in 2018, while the percent of no active restoration decreased by 24 percent in 2018.
- Eighty-two percent of the management agencies in 2013 reported they had TMDL implementation funding limitations compared to 66 percent of the management agencies in 2018.
- Overall, in 2018, 74 percent of the stormwater and riparian control strategies had a reported increase, nine percent remained stable, and 17 percent indicated a decline in control strategy implementation compared to the 2013 survey data.

Intended use of this report

DEQ intends for data and information contained in this report to be used to evaluate the overall progress of urban and rural cities, counties, and special districts in implementing practices that will reduce nonpoint source pollutant loads to surface water in the Willamette River Basin. A 2018 DEQ five-year review survey tool was used by the entities between April and December 2018. This report does not evaluate or establish compliance with permits or TMDL orders. DEQ acknowledges several limitations of the survey used to collect this information:

1. Overlapping and similar-sounding programs and strategies, and generalized questions in the survey may have led to underrepresentation and overrepresentation in some implementation categories.
2. The survey may not have accounted for the extent of strategies being partially completed and/or adopted, or other intergovernmental agreements for water quality programs.
3. The survey only captured 53 percent of the Willamette Basin DMAs who reported between April and December 2018, and therefore the information does not cover all of the Willamette Basin progress.
4. DEQ staff did not verify each DMA response to the survey. Therefore, results summarized in this report are based solely on DMA-provided information.

Acronyms used in this report

BMP	Best Management Practice
CWR	Cold Water Refugia
DEQ	[Oregon] Department of Environmental Quality
DMA	Designated Management Agency
EPA	[U.S.] Environmental Protection Agency
IDDE	Illicit Discharge Detection and Elimination
MS4	Multiple Separate Storm Sewer System
NPDES	National Pollutant Discharge and Elimination System
OAR	Oregon Administrative Rule
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
WQMP	Water Quality Management Plan

1 TMDL background

Water pollution has been identified in many streams in Oregon, including streams in the Willamette River Basin. Under the Federal Clean Water Act, a delegated authority must develop water pollution control plans to restore and maintain the chemical, physical and biological integrity of the state's waters. In Oregon, DEQ is the delegated authority responsible for developing these plans. Water pollution control plans are known as Total Maximum Daily Loads, and development of TMDLs is an important step toward restoring the state's waters to support designated beneficial uses (**Appendix A**). Water quality standards are established to protect beneficial uses of the state's waters, and the Willamette Basin TMDLs address several sources of pollutants (parameters) that negatively impact these uses.

1.1 TMDL development authority

Oregon Administrative Rule Chapter 340 Division 42 sets forth the process for developing and implementing TMDLs. These regulations are found on the Oregon Secretary of State website: **OAR 340-042** (**Appendix B**). Oregon's history for developing and implementing TMDLs spans more than 25 years, and Oregon's TMDL implementation program has continued to evolve over that time frame. In 2002, Oregon adopted rules concerning the development and implementation of TMDLs (OAR 340-042-0080). These rules outline the major requirements for both TMDL content and implementation. While changes in the TMDL program have occurred over time, the basic elements of TMDLs have remained unchanged. At their core, TMDLs identify pollution sources and define load (pollution from non-point sources) and wasteload (pollution from permitted point sources) allocations, or limits, for those sources.

TMDLs identify entities with legal authority over a sector or source of water quality pollutants that are responsible for implementing the TMDL. These entities include cities, counties, special districts, and responsible persons. Collectively, they are often referred to as Designated Management Agencies (DMAs). A TMDL is issued as an Order. When a TMDL identifies DMAs, DEQ must notify them within 20 days of the issuance of the TMDL. DEQ is itself a DMA based on its authority to implement several water quality programs, including the National Pollutant Discharge Elimination System program that controls the discharge of pollution from point sources. City and county governments are commonly identified as DMAs for both their ability to adopt ordinances, and for land ownership responsibilities. Other state and federal agencies are often identified as DMAs based on their land ownership or management responsibilities, or for their administration of permit programs that affect water quality.

1.2 Willamette Basin TMDLs

Oregon's Willamette River is the thirteenth largest river in the contiguous 48 states in terms of stream flow, and encompasses 11,478 square miles in western Oregon. The Willamette Valley is currently home to 70% of Oregon's population. The mainstem Willamette River begins where the Coast Fork and Middle Fork Willamette River meet near Eugene. It flows north to the Columbia River, adding stream flows of 12 subbasins that together make up the Willamette

Basin (**Figure 1**) TMDLs. TMDLs developed included pollutant load reduction targets for nonpoint sources (**Appendix C**)**.** The Willamette Basin TMDLs identify nonpoint source pollution as the largest contributing factor to water quality impairments. The complete documentation of Willamette Basin TMDLs can be found on DEQ's webpage: **Willamette Basin TMDLs.**

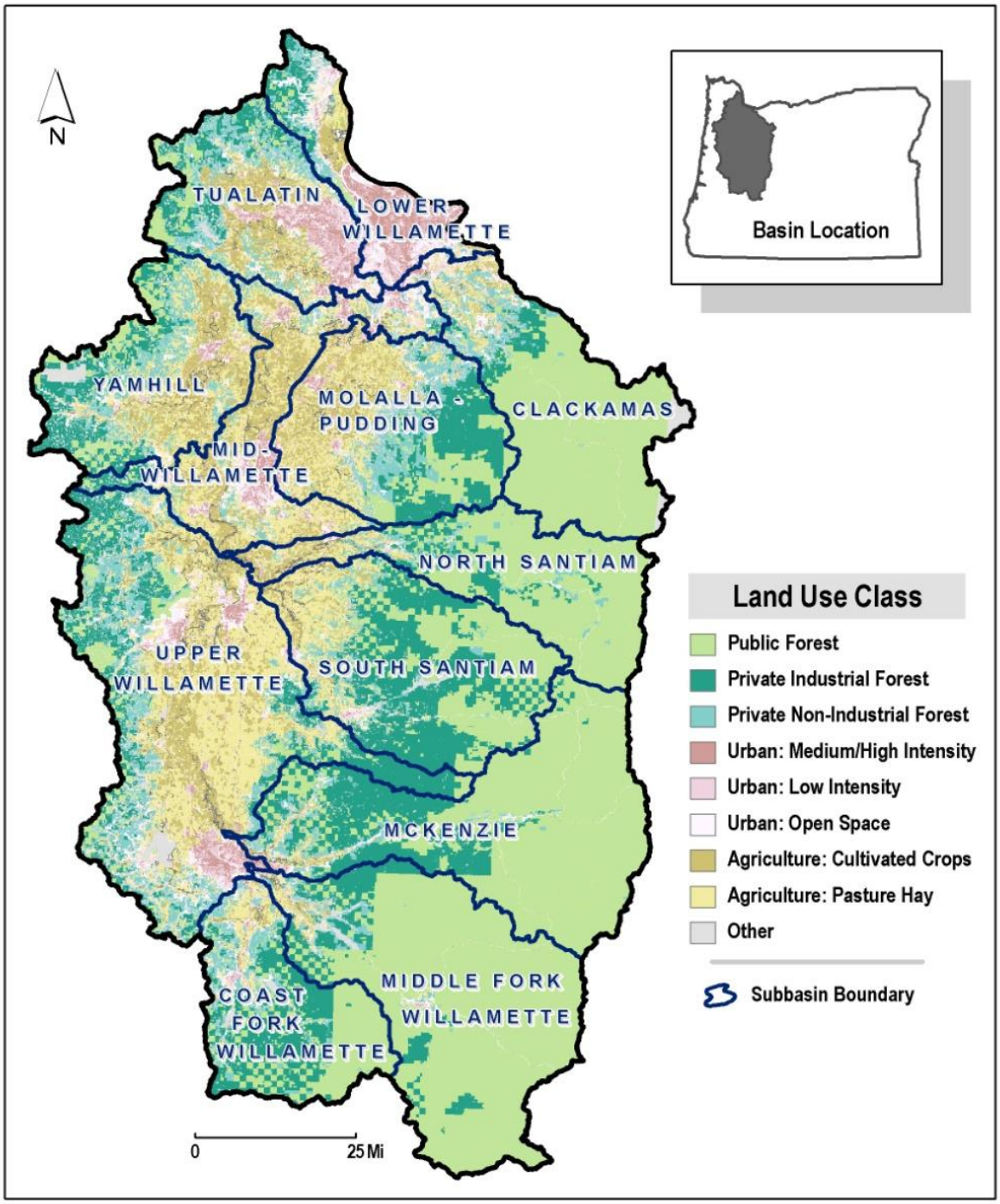

Figure 1. The 12 Subbasin boundaries of the Willamette River Basin.

1.3 Reporting requirements for TMDL implementation

A TMDL is issued as a department order and provides sufficient authority for DEQ to require DMAs to develop plans and report on TMDL implementation. The TMDL Order requires DMAs in the Willamette Basin to submit TMDL implementation plans to DEQ for review and approval, and requires DMAs to submit annual progress reports. After four years of consecutive implementation and reporting, a fifth year assessment must also be submitted. This report addresses implementation efforts from 2013 to 2018 of DMAs that utilized a DEQ survey tool between April and December 2018.

Implementation plans include a description of each TMDL pollutant source and the actions that will be taken to reduce pollution from that source, as appropriate. The required components of a TMDL implementation plan are described in OAR 340-042-0080(4) and **DEQ guidance**. The implementation plan component list follows:

- The management strategies the DMA will use to achieve load allocations and reduce pollutant loading;
- A timeline for implementing management strategies and a schedule for completing milestones;
- Performance monitoring with a plan for periodic review and revision of the implementation plan;
- Evidence of compliance with land use requirements; and
- Any other analyses or information specified in the Water Quality Management Plan (that accompanies a TMDL, usually as the final chapter). Willamette Basin examples include, but are not limited to, public involvement, fiscal analysis, and cold water refugia. The **2006 Water Quality Management Plan** is a good example for reference.

There are 104 Willamette Valley DMAs listed in **Appendix D**. The urban and rural city, county, and special district Willamette Valley DMAs are 89 of that total. State and federal agencies, water conveyance districts, and special utility districts represent the remaining 15 of the total. **Appendix D** summarizes all of the Willamette Basin DMAs and identifies the DMAs that submitted data for this report, as well as the Willamette DMAs who did not report data between April and December 2018.

1.4 Reporting status for TMDL implementation

In February 2014, DEQ published the **Willamette Basin TMDL Five Year Review** (**Appendix B**). This first **Willamette Basin TMDL Five Year Review** (**Appendix B**) report (2008-2013) captured 44 of the urban rural city, county, and special district Willamette Valley DMAs who submitted reports using a 2013 survey tool between January and July 2013. The 2014 report is a comprehensive five-year assessment of TMDL implementation activities that 44 urban and rural DMAs implemented between 2008 and 2013.

This report is the second comprehensive five-year assessment of TMDL implementation activities that DMAs implemented between 2013 and 2018. Between April and December 2018, 47 of the urban and rural Willamette Valley DMAs, or 53 percent, utilized a 2018 survey tool to report data for this report. The plan and reporting timeline for DMAs who are included in this report is shown in **Figure 2**. In general, the plan and report cycle is adopted at the time of

TMDL issuance, and the cycle will repeat every five years until water quality standards under the TMDLs are met. This timeline and reporting process is designed to maintain the implementation of water quality improvement strategies over time and provide “reasonable assurance of nonpoint source implementation” for the Willamette Basin TMDLs (OAR 340-042-0040).

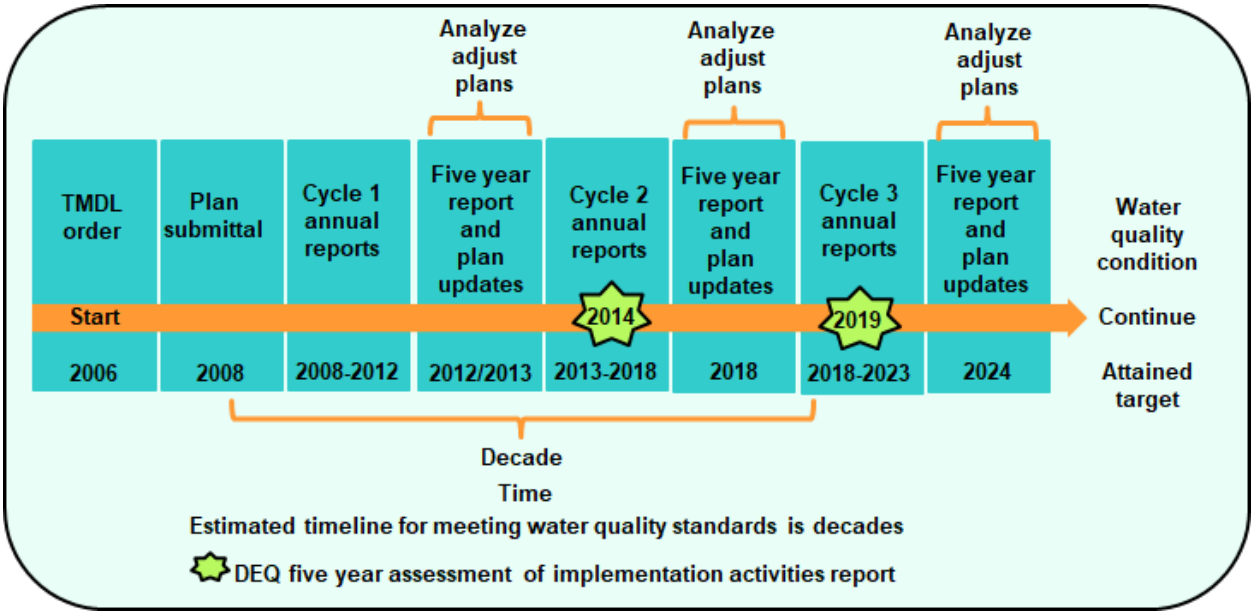

Figure 2. Illustrates the reporting timeline for the DMAs who reported for this report. This timeline and reporting process is designed to sustain the implementation of water quality improvement strategies over time, and provide for reasonable assurance.

2 TMDL implementation assessment and status

2.1 Stormwater and riparian program planning

DMAs in urban and rural areas implement TMDLs primarily through stormwater management and riparian restoration and protection program planning. Municipalities that have a municipal separate storm sewer system, and meet specific population and urbanized area criteria are required to obtain National Discharge Pollutant Elimination Systems permits from DEQ. These permits are called MS4 permits and they require a municipality to develop a storm water management plan that addresses a number of control measures and applicable strategies as specified in the permit. The stormwater control measures are generally accepted as capturing the effective strategies (**Appendix A**) for addressing most of the Willamette Basin TMDL load allocations shown in **Appendix C.**

Sources that need to obtain a MS4 permit are classified as either Phase I or Phase II. Phase I MS4s are those with populations greater than 100,000. Regulated Phase II MS4s serve populations less than 100,000 that are located within U.S. Census Bureau-defined urbanized

areas. Federal regulations also provide EPA and the states the discretion to require other MS4s outside of urbanized areas to apply for a permit. An MS4 permit may also require the municipality to report on progress, establish pollution load reduction benchmarks for relevant TMDL pollutants, and collect water quality data to evaluate progress toward meeting those benchmarks.

DMAs not covered by MS4 permits, must also utilize control measures to address TMDLs through stormwater management and riparian protection and restoration. These control measures are documented in their TMDL nonpoint source implementation plans, and implementation progress is reported to DEQ on an annual basis. Cities with populations greater than or equal to 10,000 are required to develop a stormwater management plan as specified in Willamette Basin TMDL Water Quality Management Plans. The control measures were based on the 2007 MS4 Phase II permit that expired in 2012 and is superseded by the **March 2019 MS4 Phase II Permit**. Smaller DMAs (populations less than 10,000) must also implement stormwater management plans, and are expected to also consider implementing the storm water control measures specified in the WQMP.

DEQ expects all DMAs to demonstrate that they will address temperature and other nonpoint sources of TMDL pollutants not addressed by a stormwater management plan. For any stormwater management plan that covers all TMDL parameters including temperature, the stormwater management plan would suffice as an implementation plan (**Appendix C**). To address streamside urban and suburban development that compromises many riparian functions and processes, urban DMAs typically enact ordinances or implement voluntary programs intended to protect riparian areas.

The 2018 survey included a checklist of stormwater and riparian program planning control measures and numerous specific best management practices/strategies associated with the measures. The stormwater control measures were based on the more stringent **March 2019 MS4 Phase II Permit** and enhanced with BMPs/strategies reported in the 2013 survey that also fell under the MS4 control measures. The wetland, water quality, and riparian strategies were based on the 2013 survey data reported, and enhanced to include more specific measureable data. The graphs in this section represent the tallied responses from the 47 DMAs who reported (**Appendix D**) data between April and December 2018 for the following selected set of control measures:

- Wetland, water quality, and riparian strategies
- Pollution prevention in municipal operations
- Illicit discharge detection and elimination
- Construction erosion control
- Post-Construction
- Public education, outreach, and involvement

The graphs that follow display the percent or number of DMAs implementing a particular strategy or best management practice. DEQ grouped the DMAs into four categories to simplify the information for graphical display. MS4 Phase I, MS4 Phase II, population greater than or equal to 10,000, and population less than 10,000. The MS4 categories represent the DMAs that have either a Phase I or Phase II MS4 permit through DEQ's NPDES program. The number of DMAs within each of the categories are displayed in **Figure 3**. A group identified as "All" is also included in most of the figures in section 2 and 3. It represents the overall average response rate or total count of DMAs that answered a question.

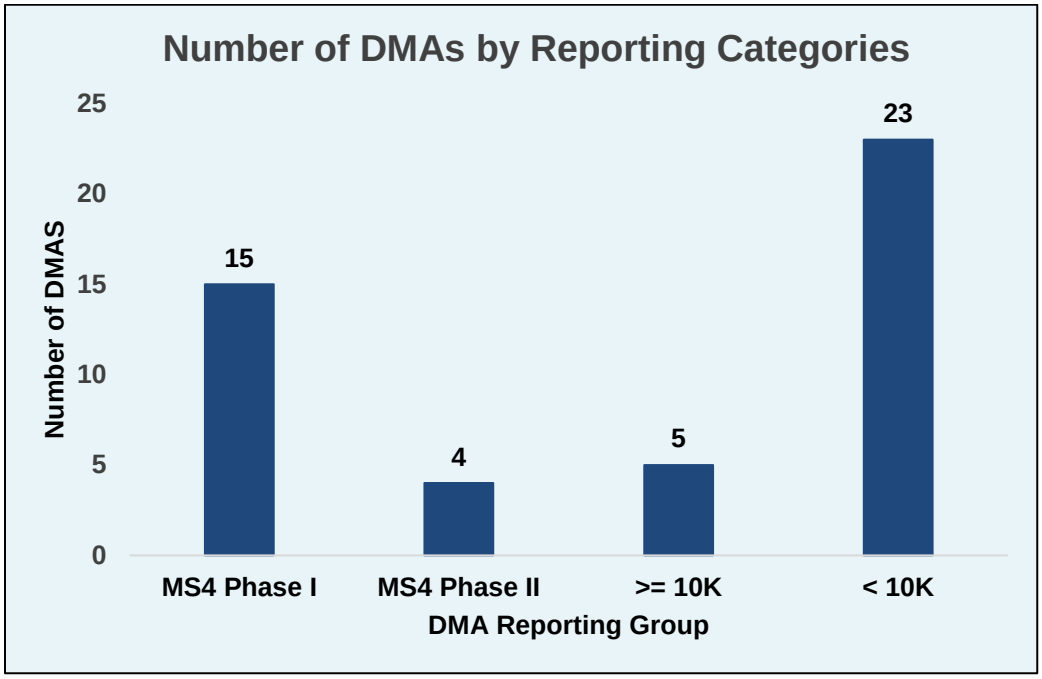

Figure 3. A total of 47 DMAs reported data included in this report. DEQ grouped the DMAs into four categories to simplify the information for graphical display.

2.1.1 Stormwater control measures

DMA responses about five stormwater control measures that are designed to address bacteria, mercury, and other sediment driven TMDL pollutants (**Appendix A** and **Appendix C**) are shown in **Figure 4**. As previously discussed, the six control measures in the newly issued and more stringent **March 2019 MS4 Phase II Permit** were used as the primary foundation for developing control measures and associated best management practices (BMPs). These stormwater BMPs and strategies were grouped into 5 control measures in this report. Selection and implementation of the stormwater control measures specified in the WQMP are expected to result in significant reductions of bacteria, mercury or other TMDL pollutants found in urban stormwater or attached to sediment to receiving waterbodies. Urban and rural stormwater BMPs are identified in the Willamette TMDL as being effective at removing sediment levels in stormwater runoff, and are likely effective at removing TMDL parameters that reside in sediment. Urban and rural reduction targets for total suspended solids (TSS) are established to meet several of the following Willamette basin TMDLs: Legacy pesticides, PCBs, Dioxins, Iron and Turbidity. Willamette TMDLs identify riparian protection and restoration, as well as, erosion and sediment storm water control BMPs for mercury and lead TMDL reductions.

Results show that 100 percent of the MS4 Phase I permitted DMAs have all five controls in place. Results also show that 100 percent of the MS4 Phase II permitted DMAs have four of the five programs in place, and 50 percent are fully implementing Post-Construction stormwater requirements.

Four non-MS4 permitted DMAs in the Middle and Upper Willamette Basin **(Figure 3)** had populations greater than or equal to 10,000, so they were required to implement all of the stormwater control measures specified in the 2006 Willamette Basin TMDL Water Quality

Management Plan. An additional DMA in the Clackamas Subbasin reached the 10,000 population threshold in 2018, so they were also grouped with the greater than or equal to 10,000 population category for this report. **Figure 4** illustrates that this population category is still implementing at a rate comparable to their MS4 Phase II peers under the newer permit. Greater than 80 percent of these DMAs reported that they are implementing the stormwater control measures specified in the WQMP **(Figure 4)**. Data reported in the first 2013 survey also indicated that this reporting group is implementing the measures at comparable rates to MS4 Phase II permit holders. Small DMAs (populations under 10,000) in more dense urban areas are also implementing stormwater control measures as required in the WQMP and the MS4 Phase II newer permit.

The control measures shown in **Figure 4** include the subset of specific strategies or best management practices associated with each control measure. The top 10 DMA reported strategies are shown in **Figure 5**. An extensive review of the strategies that are addressed by the control measures is provided in subsequent figures.

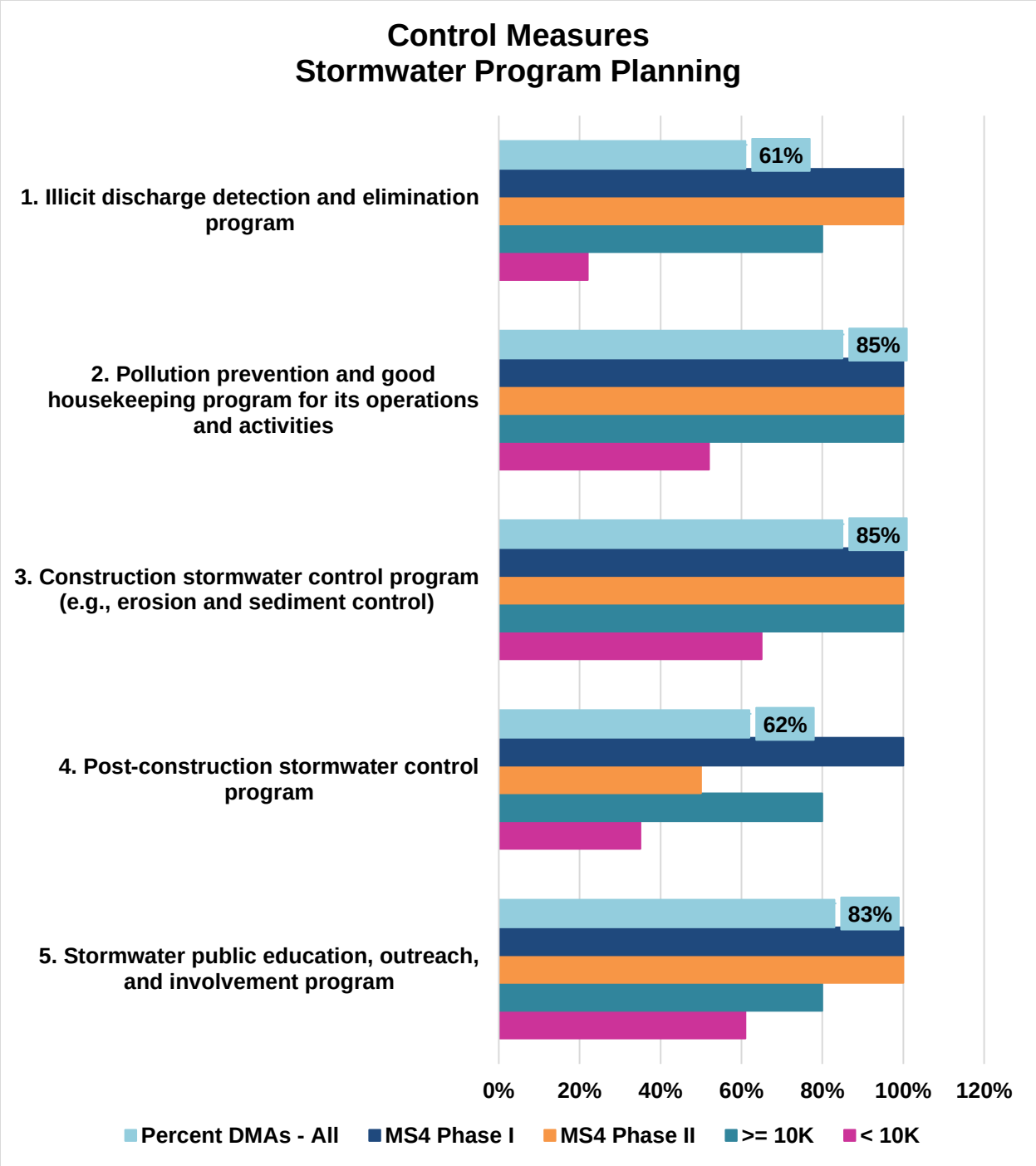

Figure 4. The percent of DMAs, as shown by DMA category, that implement control measures comparable to an MS4 Phase II permit.

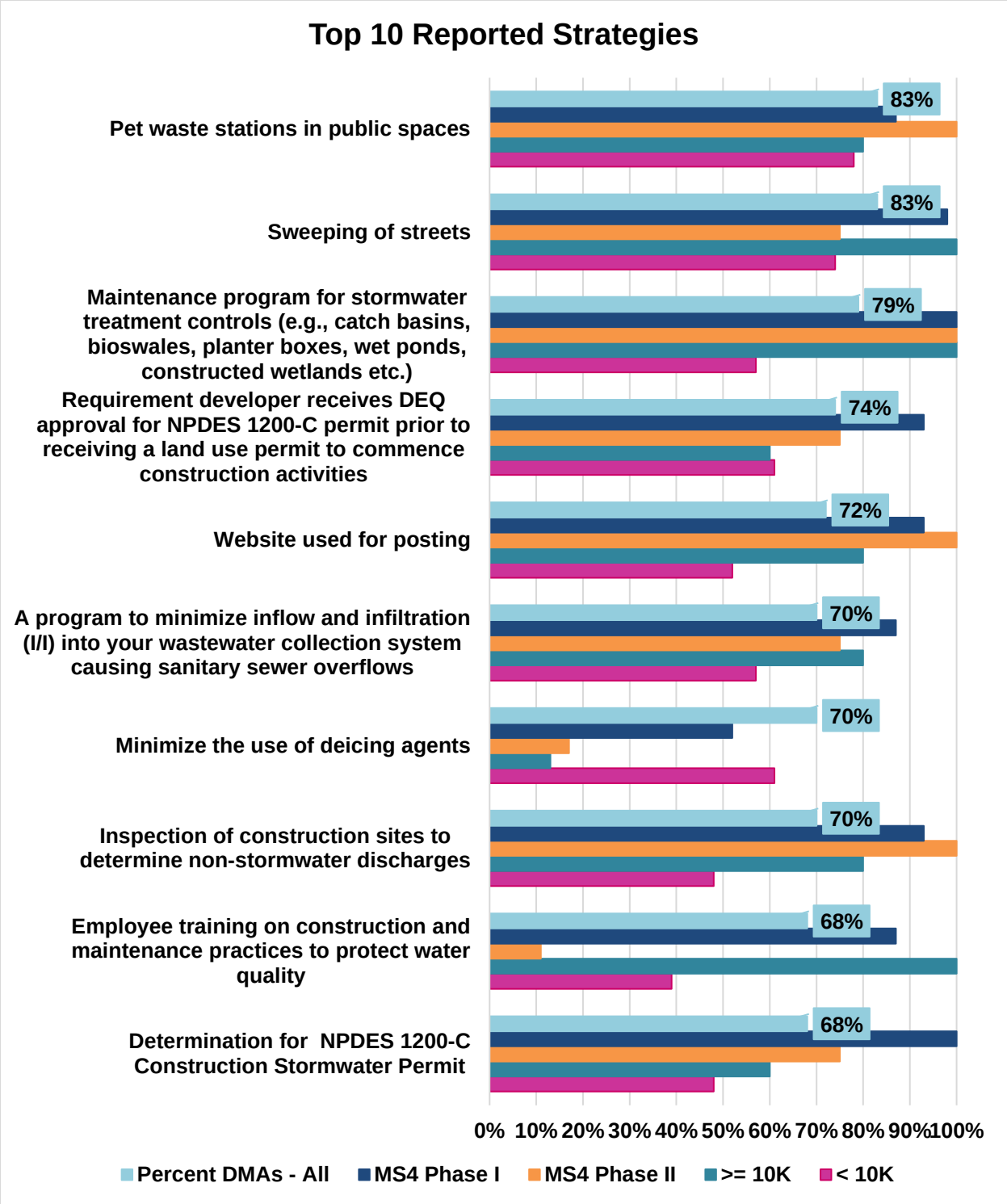

Figure 5. The top ten DMA reported strategies, as shown by DMA category, being implemented. These strategies fall within the categories of control measures for stormwater program planning in Figure 4.

2.1.2 Wetland, water quality, and riparian

Riparian protection and restoration is an important strategy for protecting and improving water quality (**Appendix A**). The wetland, water quality, and riparian strategies that DMAs implemented varied in approach, but the most common strategies included riparian and wetland ordinances, codes, and rules to manage riparian vegetation**.** The MS4 Phase I DMAs and DMAs with population greater than or equal to 10,000 are the predominant implementers in this category (**Figure 6a**)**.**

Approximately 57 percent of the DMAs stated that they are implementing riparian restoration projects (**Figure 6b**). Many DMAs reported riparian restoration under a Willamette Basin TMDL Subbasin grouping when they took the 2018 survey. **Figure 6c** accounts for this grouping to illustrate where riparian restoration is occurring in the Willamette Basin. A higher percentage of projects are occurring in the lower portion of the Willamette with a progressive decrease in the number of projects as you move toward the middle and upper portions of the Willamette Basin. A limitation of DEQ's survey is that it only represents actions by 53 percent of the urban and rural cities, counties, and special districts who reported between April and December 2018. The DMAs who report under a different timeframe reside higher in the watershed. Additionally, the survey does not capture all of the on-the-ground restoration by watershed councils, non-governmental agencies, and state and federal agencies that has been underway since the issuance of the TMDLs. Oregon Water Enhancement Board tracks and maintains a database of restoration projects. These projects can be viewed using OWEB's **Oregon Watershed Restoration Tool**. Tracking recommendations to improve the integration and documentation of conservation efforts occurring on the ground are listed in **Appendix E**.

The total number of restoration projects reported was 103 (**Figure 6d**)**.** The estimated linear measurement of the riparian areas where projects occurred was greater than 91,450 feet (**Figure 6d**)**.** Proportionally, from highest to lowest, restoration extent by population category is: MS4 Phase I; Greater than or equal to 10,000; Less than 10,000; and MS4 Phase II. One of the limitations of DEQ's survey is that linear feet are represented as a range and resulted in under reporting. The max in the range for selection is greater than 7,000 linear feet. Total projects was also capped at greater than 10 projects. Additionally, land acquisition for linear feet of riparian and wetland protection adopted over the last four years by DMAs is not a specific survey question. Under the "other information to provide" for riparian restoration, one DMA reported linear feet of greater than 24,000 and one DMA reported acquisition of greater than 76,000 linear feet of riparian corridor. Two DMAs reported a total of 52 riparian restoration projects. This information will be valuable for updating the survey for future five-year survey assessments.

2.1.2.1 Cold Water Refugia

DEQ recently completed a CWR Study for the Lower Willamette that identifies CWR locations provided by tributaries and channel features along the migration corridor and assesses their level of use by adult and juvenile salmonids. Implementation plans shall evaluate impacts to the existing CWR identified in the study, identify additional CWR if applicable, and provide options for protecting or enhancing such areas. Wherever localized cold water refugia have been altered through channel modification or by other means, consideration should be given to exploring options for restoring or enhancing these CWR where feasible.

Seventeen DMAs are along the Willamette River where CWR applies. Four of those DMAs fall under a different reporting schedule and did not provide data for this report. Six of the DMAs, out of thirteen, who took the survey reported that they implemented one or more projects in support of CWR**.** A total of 15 projects were reported by MS4 Phase I DMAs and DMAs with population greater than or equal to 10,000. A weakness of the survey may be that the question was too general and limited in project type. The plans for the current cycle of implementation should be reviewed to identify all the project types to address CWR under the Willamette Basin Temperature TMDL. This information will be valuable for updating the survey for future five-year survey assessments.

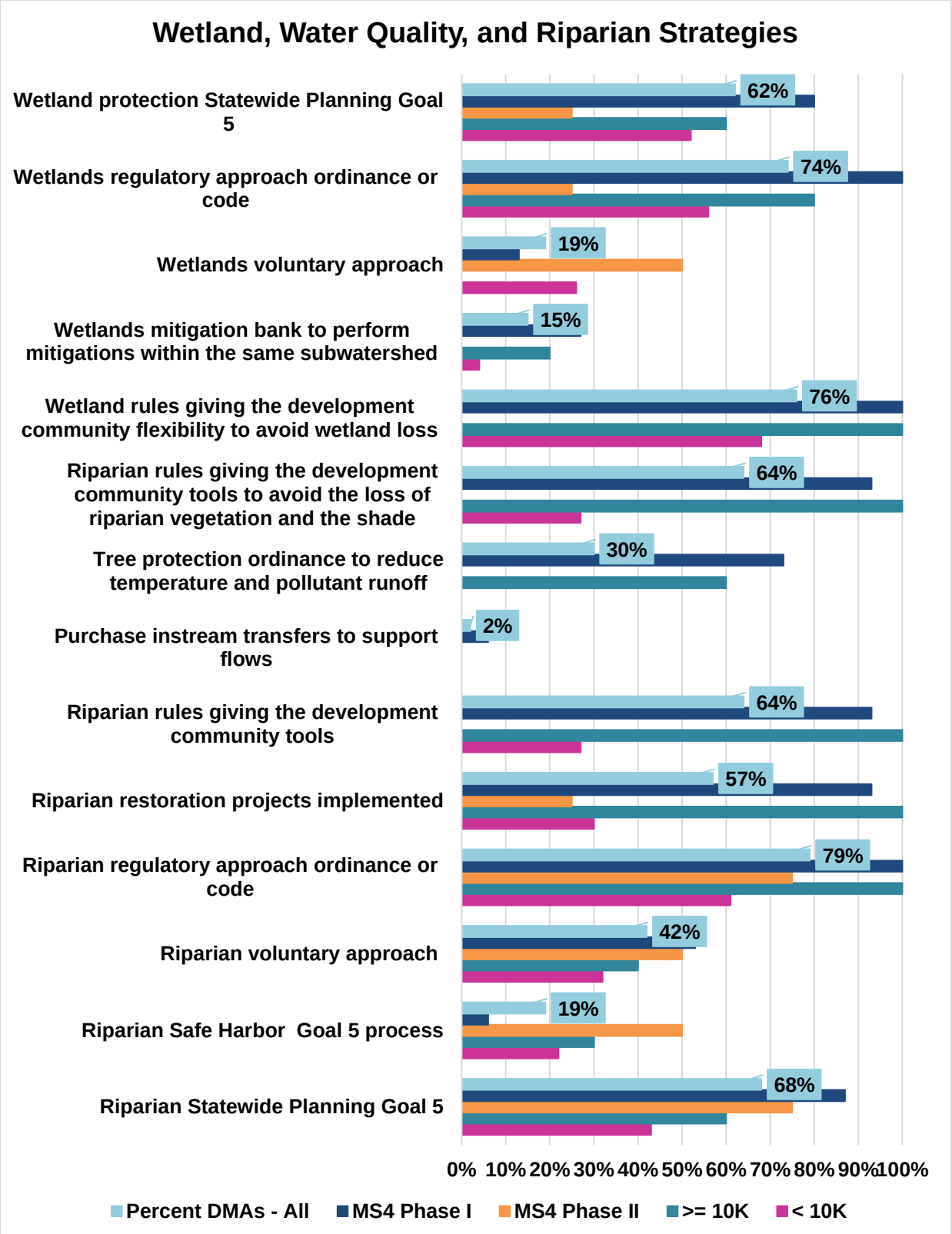

Figure 6a. The percent of DMAs, as shown by DMA category, that implement wetland, water quality, and riparian strategies for protecting and improving water quality.

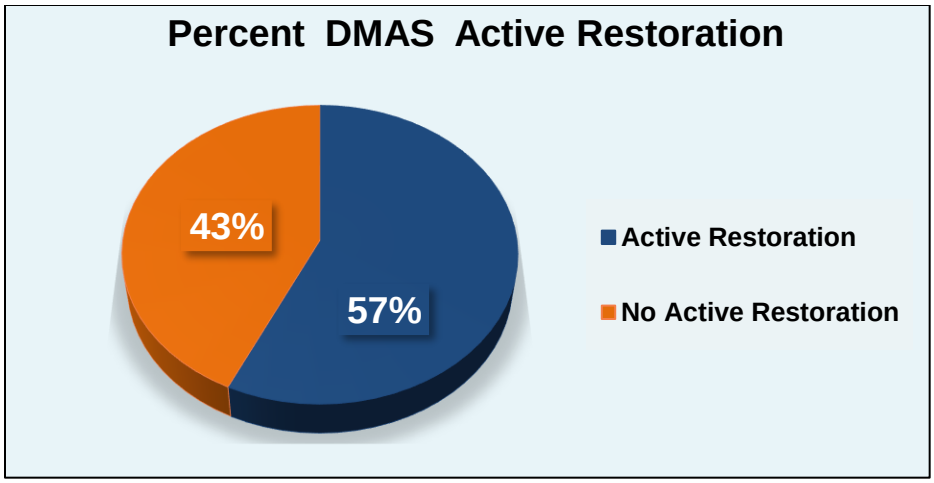

Figure 6b. The percent of DMAs that implemented riparian restoration. 57 percent of the DMAs have active restoration projects occurring and 43 percent are not implementing restoration.

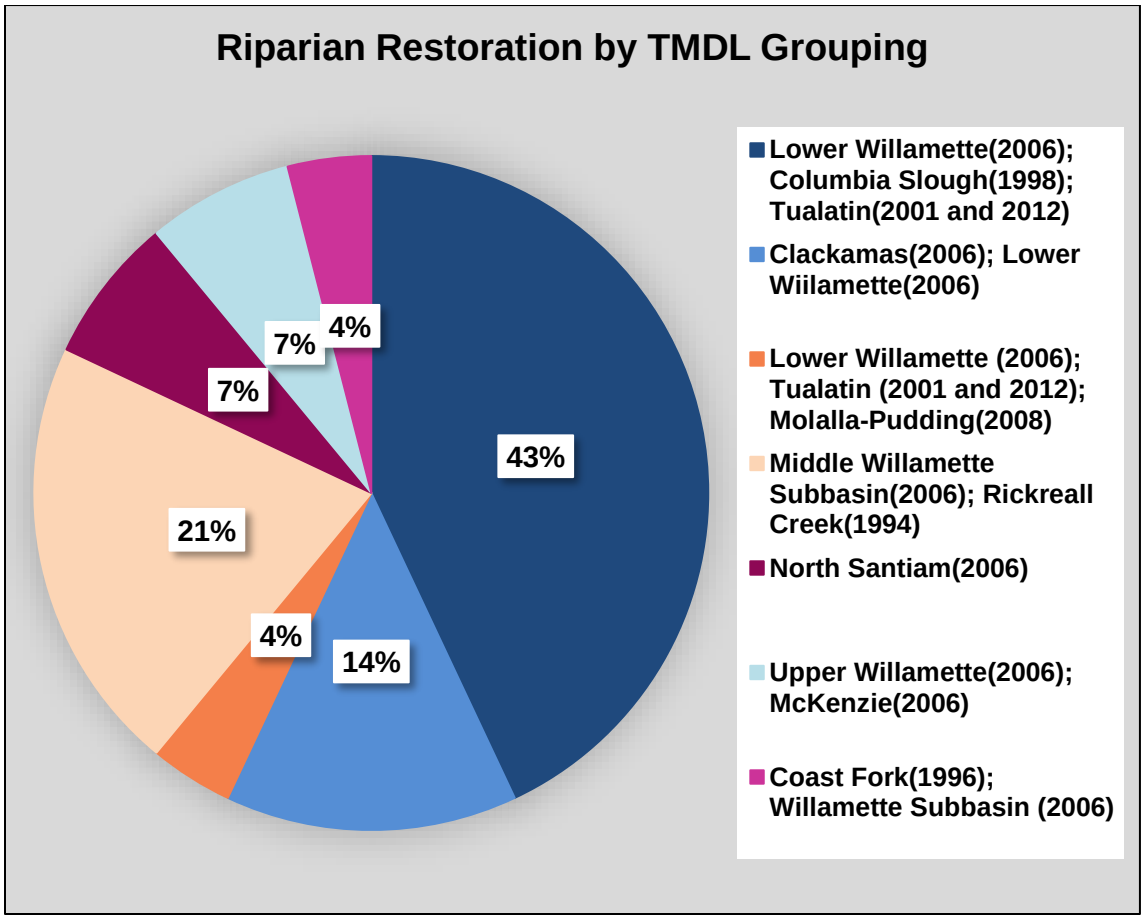

Figure 6c. The percent of riparian restoration reported by DMAs. Many DMAs reported by Willamette TMDL subbasin when they took the 2018 survey.

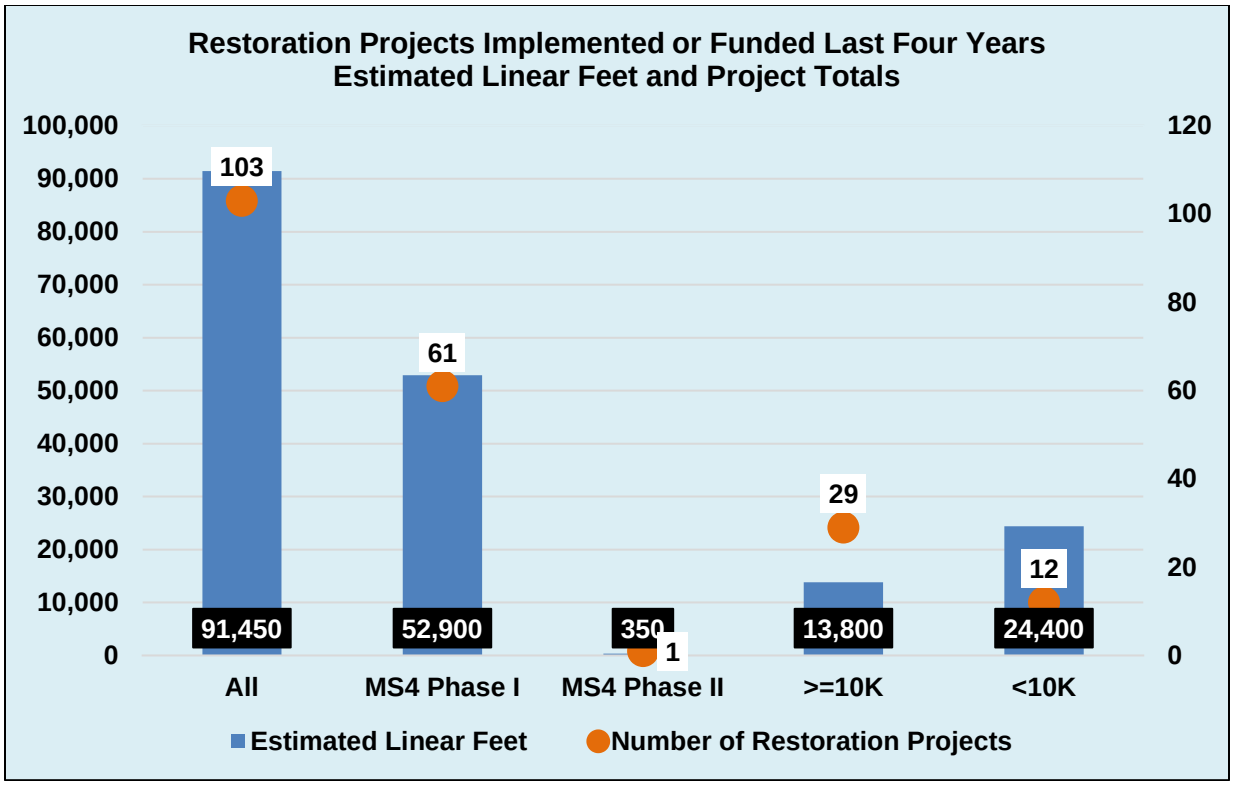

Figure 6d. The estimated linear feet and total number of projects reported as implemented or funded within the last four years, by DMA category.

2.1.3 Pollution prevention in municipal operations

DMAs reported a high level of implementation of some of the basic municipal operations that help to address pollution in urban and rural environments. Regular street sweeping, a program to minimize inflow and infiltration into waste water systems, pet waste stations in public parks, and a stormwater maintenance program for collection and treatment are important best management practices that most cities and counties are utilizing (**Figure 7**). The MS4 permit requires some of these best management strategies under the control measures, but there are other BMPs added to the 2018 survey from the 2013 survey that are not required by the MS4 permit but remain viable practices for improving the quality of stormwater. Overall, 85 percent of the DMAs have a pollution prevention and good housekeeping program for their municipal operations and activities (**Figure 4**). MS4s and DMAs with a population greater than or equal to 10,000 all noted that they have a formal program in place. It is particularly important to note that 52 percent of the smaller DMAs (population less than 10,000) are also embracing this measure even though they do not have a MS4 permit. The reported data is important for working with this category of DMAs one-on-one, as well as coordinating with the DEQ MS4 technical staff.

2.1.4 Illicit discharge detection and elimination

The list of actions for this report section had relatively lower percent implementation than other control measures (**Figure 8a**). Some of the illicit discharge detection and elimination (IDDE) best management practices are required under the MS4 Phase II IDDE control measure. There are additional BMPs that are not included in the permit that were reported by DMAs, and these are also viable practices for improving the quality of stormwater. For some of the strategies,

lower results may be attributed to the fact that some DMAs had the strategies in-place and did not need to develop and implement them as new strategies.

All MS4 Phase I and Phase II DMAs have a formal IDDE program in place and have the authority to prohibit illicit discharge (**Figure 8b**). It is particularly important to note that the other DMA groups in **Figure 8b** are embracing this measure without a permit. Several non-MS4 communities stand out in terms of the resources they have invested in addressing IDDE, and despite having a rate lower than 100 percent for a formal IDDE program, a high percentage of non-MS4 DMAs have authority to prohibit illicit discharge.

2.1.5 Construction stormwater erosion control

Construction erosion control strategies represent another suite of best management practices that DMAs have generally adopted across all permit and other reporting categories (**Figure 9**). While some erosion control strategies are required for MS4 permit holders, survey results indicate that many small communities that do not have a MS4 permit have developed erosion control related programs. **Figure 4** illustrates 100 percent of MS4 Phase I and Phase II DMAs, and DMAs with a population greater than or equal to 10,000, reported they have a construction stormwater control program, while 65 percent of the DMAs with a population less than 10,000 reported the same. It is particularly important to note that DMAs with population greater than or equal to 10,000 and population less than 10,000 are embracing this measure without a permit. Overall, 85 percent of the DMAs have a program in place and 51 percent have a program to address construction not referred to the DEQ 1200C construction permit.

2.1.6 Post-Construction stormwater

DEQ recognized that the checklist in the 2013 survey did not include specific elements of hydromodification modeling, mitigation, and treatment for the DMAs to select. For the 2018 survey, DEQ included 17 strategies comparable to a post-construction stormwater control measure under an MS4 permit. Several of the strategies are required under the MS4 Phase I permit, which is evident from the high rate of implementation of these strategies reported by this DMA category **(Figure 10)**. It is particularly important to note that although at a lower rate, the DMAs with population greater than and equal to 10,000 or less than 10,000 are embracing this measure without a MS4 permit. For some of the BMPs, these DMAs have comparable programs to the MS4 Phase II DMAs.

Post-Construction stormwater management in densely populated areas undergoing development and redevelopment is necessary because runoff from these areas has been shown to affect receiving waterbodies. Having a post-construction program is the second lowest reported strategy for DMAs overall (62 percent) when compared to the five programmatic categories in **Figure 4.** DEQ emphasis on increasing post-construction by way of DMA technical assistance is important for meeting the TMDL load allocations. Continued interagency collaboration amongst the DEQ storm water programs will help clarify the common elements for protecting water quality and streamline DMA adoption of this control measure. DMAs with high population growth rates over the last five years should be evaluating the adoption of this control measure.

2.1.6.1 Urban stormwater BMP performance

The urban and rural DMAs have routinely requested DEQ provide information on BMP selection and performance effectiveness for post-construction and other stormwater control strategies. DEQ has not collected DMA data to derive sediment or nutrient removal rates for BMPs being

implemented. **Appendix F** includes tables that summarize pollutant removal percentages for urban and rural post-construction development and redevelopment, as well as pollution prevention in municipal operations street cleaning, that were derived from a literature search. A small set of BMPs that support nutrient and bacteria TMDL reductions are also included. This information was compiled to meet the request and assist DMAs with the selection and implementation of effective stormwater strategies for implementation plan updates.

2.1.7 Public education, outreach, and involvement

This group of strategies represents the common elements of the Public education, outreach, and involvement control measures in a MS4 Permit (**Figure 11**). Outreach and education programs are scalable. For example, a small community can employ the same techniques and use the same tools as a larger community, but apply them to a smaller area. The TMDLs in the Willamette Basin identify this control measure as essential to any program designed to improve water quality. DEQ expects that every DMA will have an outreach and education program, including ways to promote public involvement (e.g., public access and review of stormwater plans; city council meetings). All DMAs are implementing outreach, education, and public involvement. Several DMAs provided additional information to capture how extensive their education and outreach program is. They also provided DEQ with a list of strategies not in the survey used for this report. This information will be utilized for updating survey tools.

DEQ encourages DMAs to educate its citizens about the importance of watershed management and health and assess how effective their efforts are in changing behavior and actions. Fifteen DMAs (32 percent) reported they are collecting quantitative results and opinions on how effective efforts are. Measures used to determine success include such things as educational pre and post surveys; the number of public requests for stormwater drain medallion installation; continuation of outdoor school funding based on voting; volunteer rates of participation over time; and public use of pet-pickup stations in areas with high pet walking. The information will be valuable for DEQ's promotion of successful efforts and lessons learned during DMA plan reviews and technical assistance workshops. The information is available upon request.

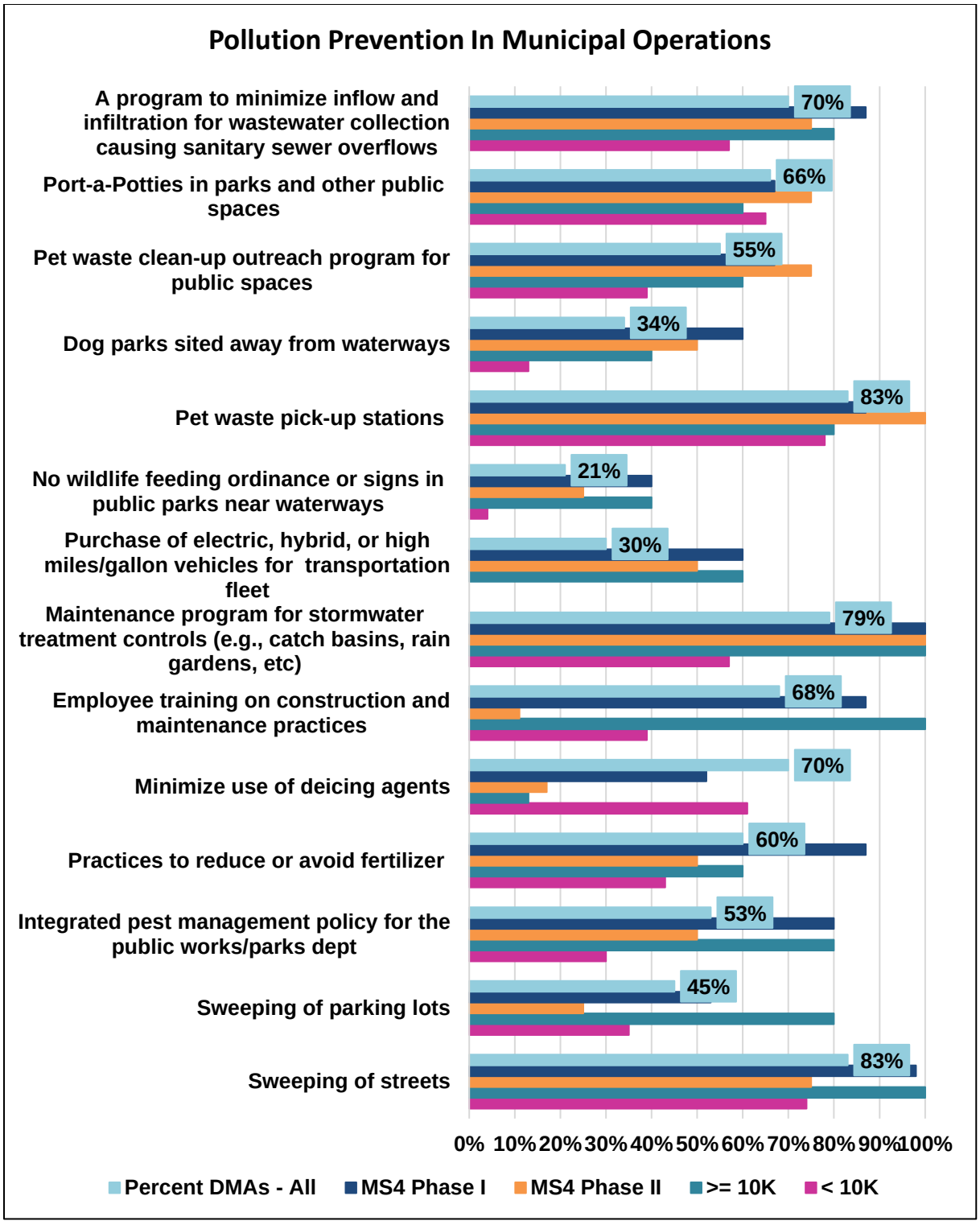

Figure 7. The percent of DMAs, as shown by DMA category, that implement pollution prevention in municipal operations strategies for protecting and improving water quality.

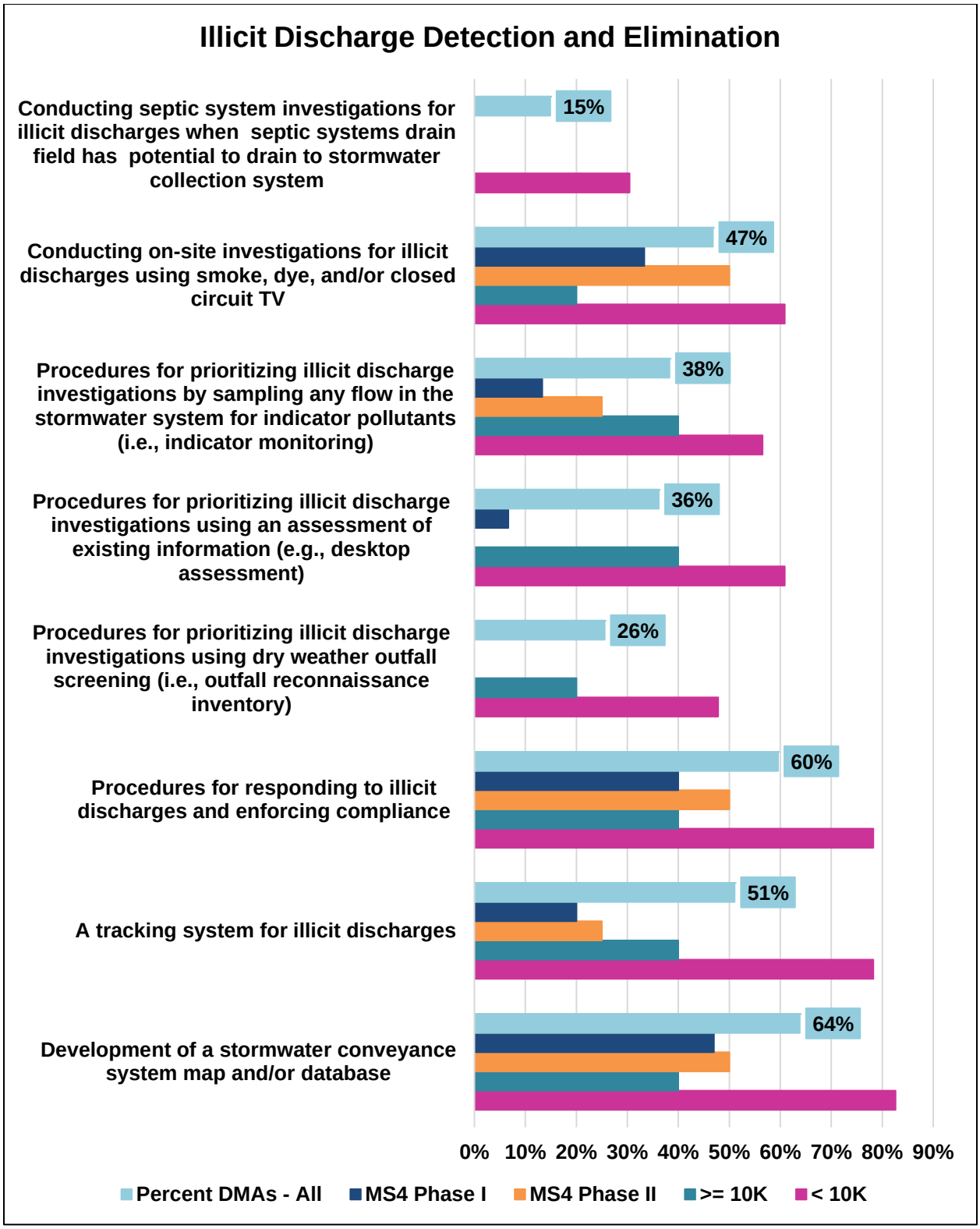

Figure 8a. The percent of DMAs, as shown by DMA category, that implement IDDE strategies for protecting and improving water quality.

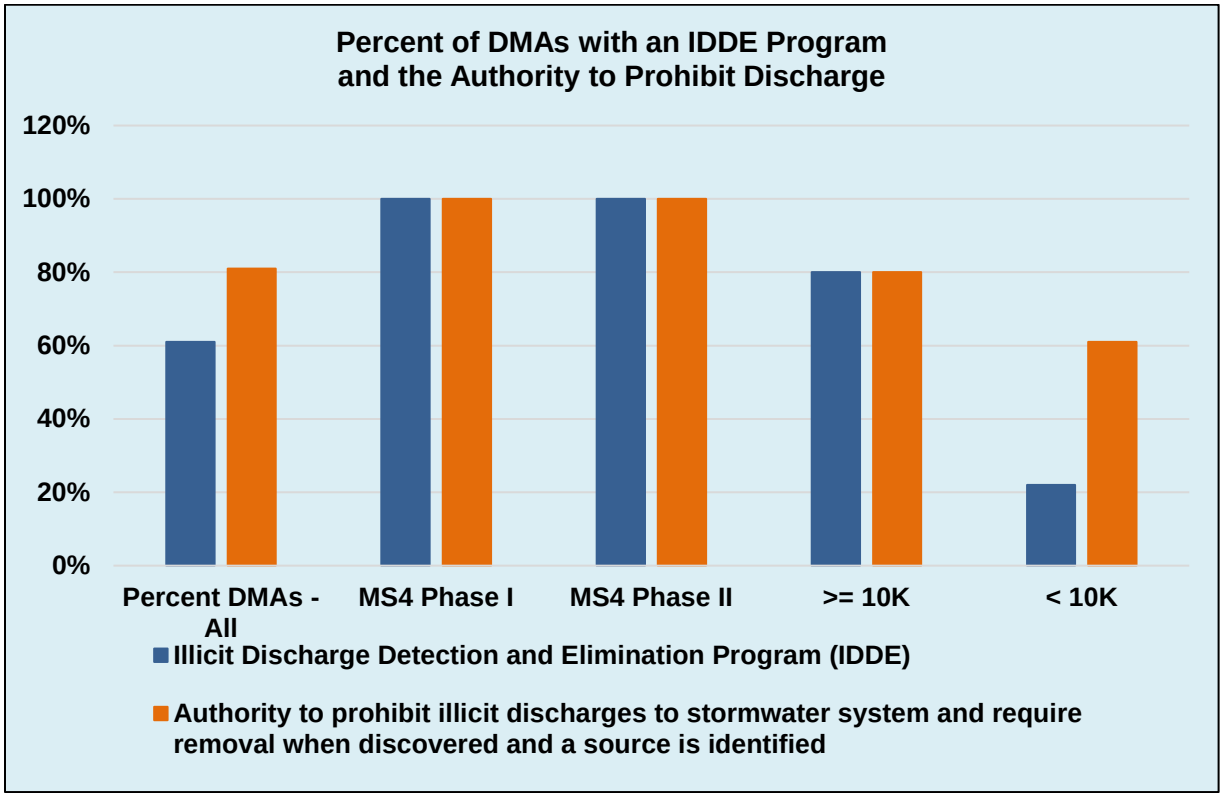

Figure 8b. The percent of DMAs, by DMA category, that have the authority to prohibit illicit discharge relative to the percent of DMAs that have an IDDE program. Despite having a rate lower than 100 percent for a formal IDDE program, a high percentage of non-MS4 DMAs have authority to prohibit illicit discharge.

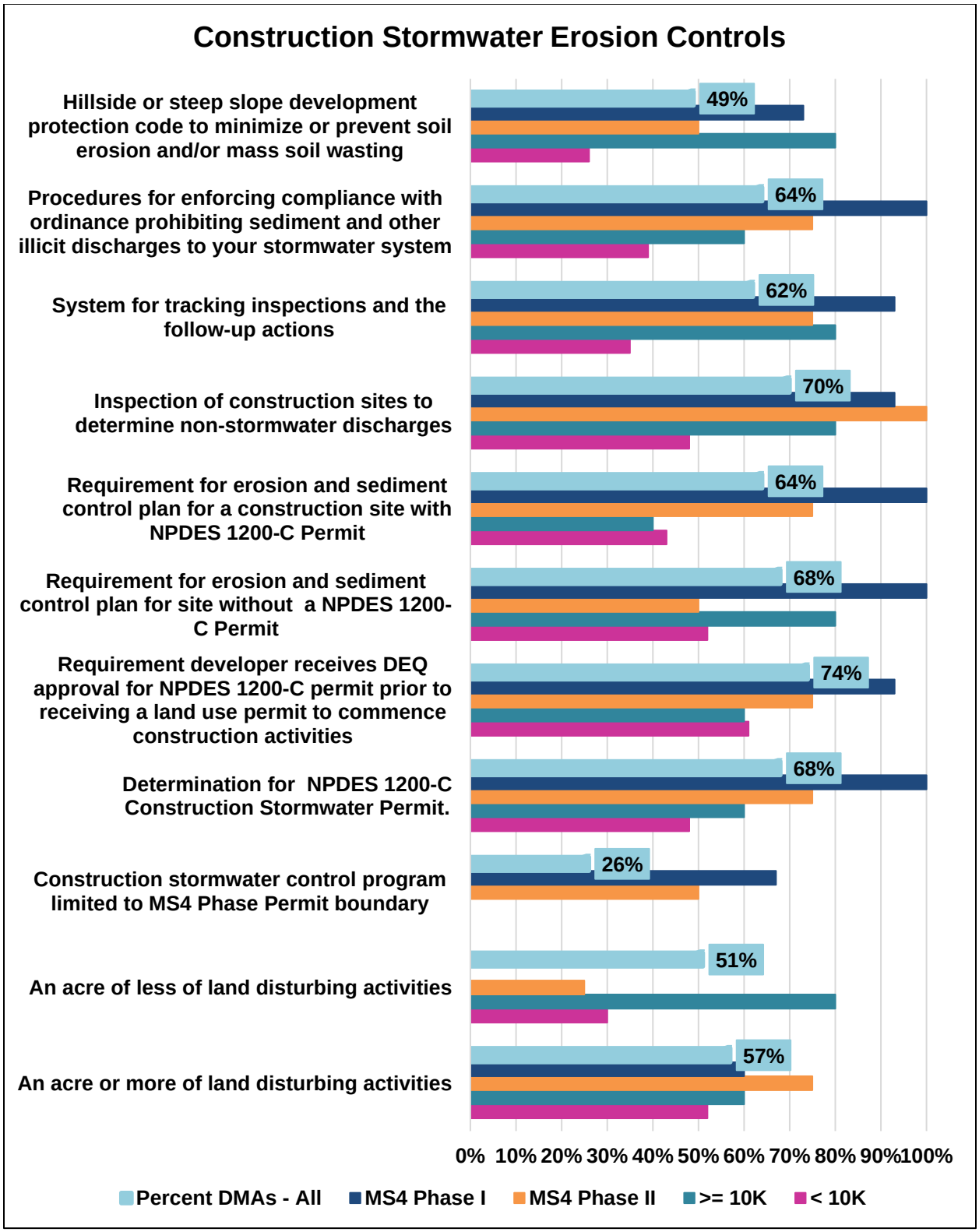

Figure 9. The percent of DMAs, by DMA category, that implement construction stormwater erosion controls for protecting and improving water quality.

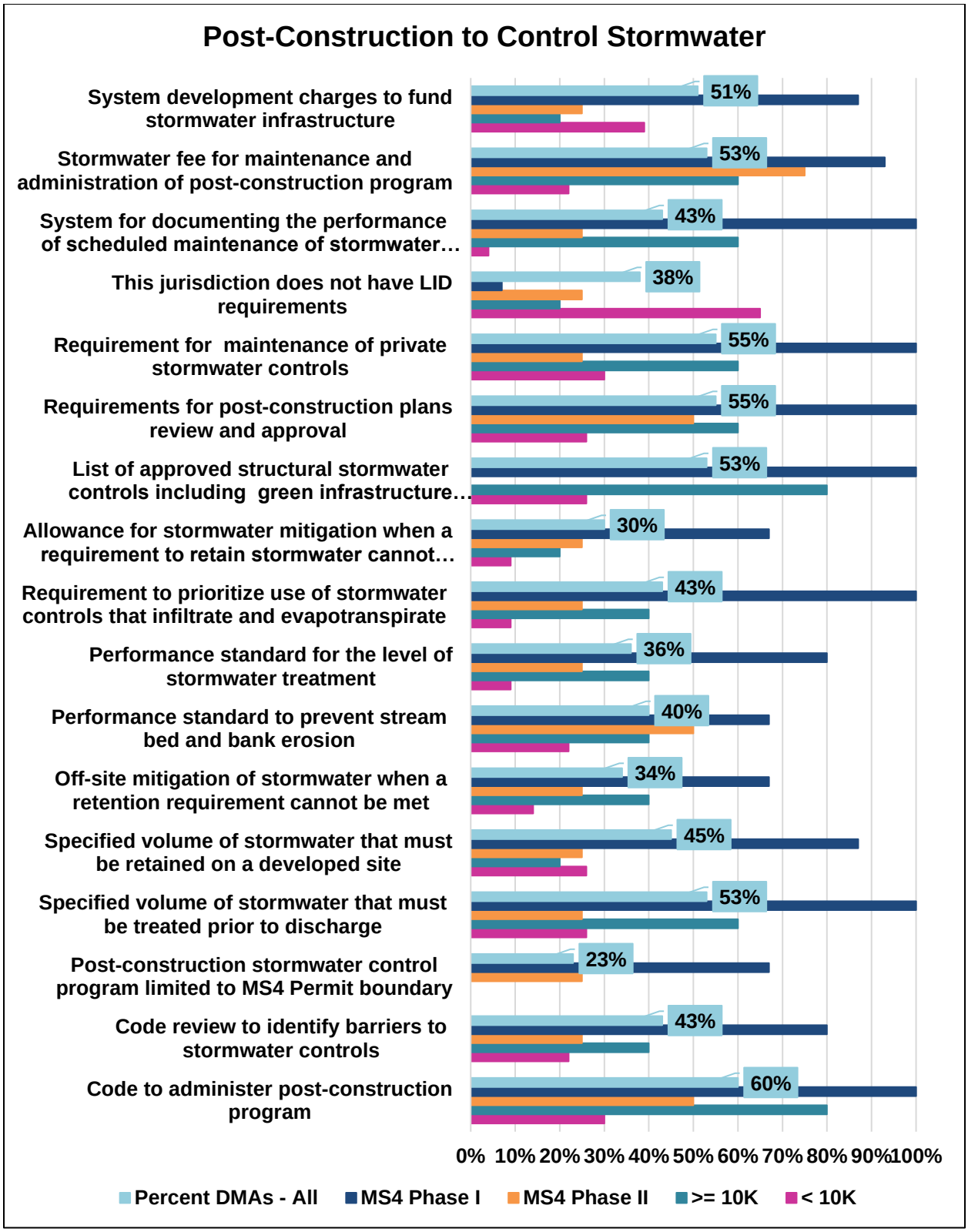

Figure 10. The percent of DMAs, by DMA category, that implement the Post-Construction stormwater strategies for protecting and improving water quality.

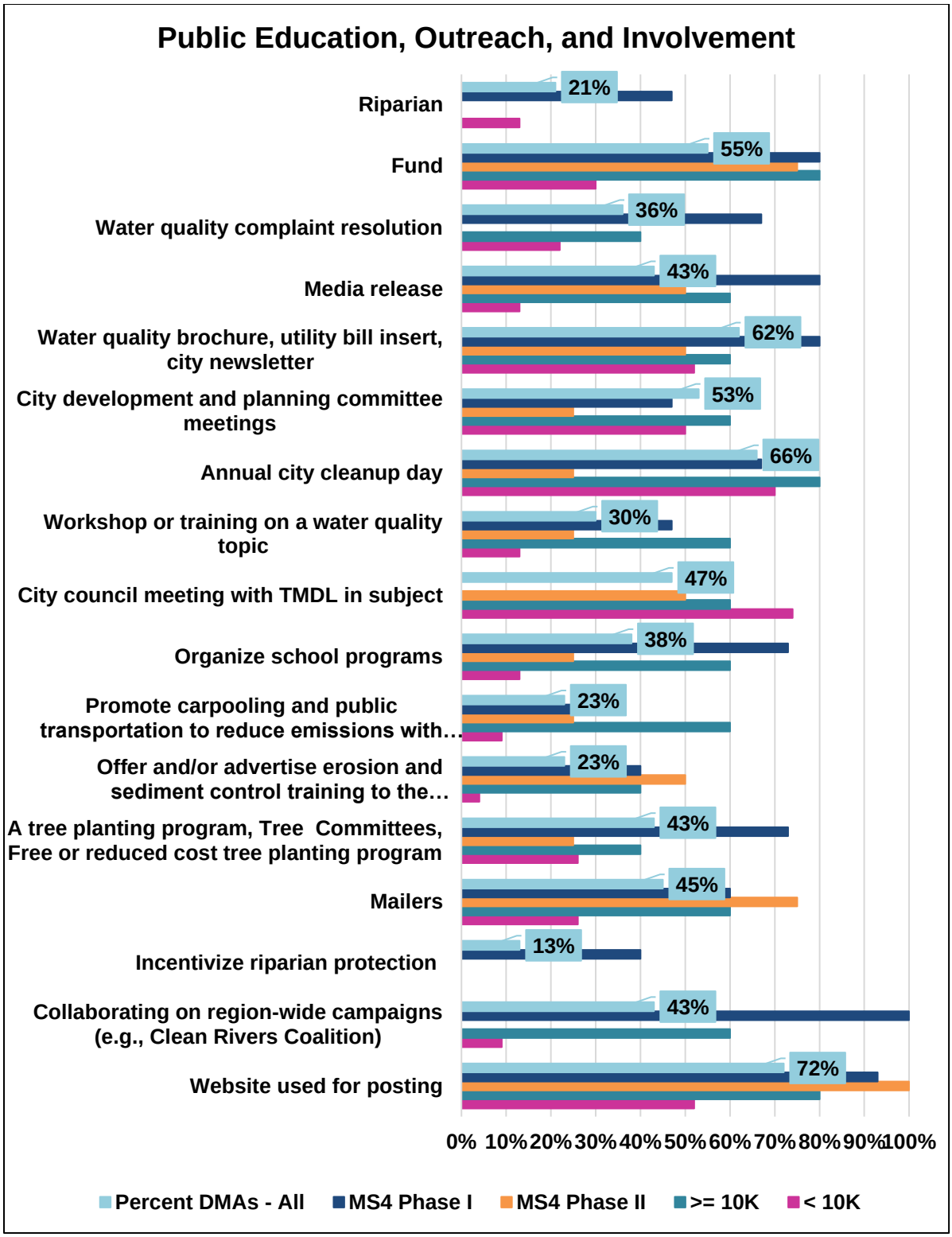

Figure 11. The percent of DMAs, by DMA category, that implement the outreach, education and public involvement strategies for protecting and improving water quality.

3 Maintaining strategies over time

3.1 Reporting certification

Engaging management, residents, city councils and boards is important for building and sustaining successful surface water protection programs. DEQ requested that the survey be certified by a principal executive officer or ranking elected official to measure engagement with public officials. **Figure 12** illustrates that 85 percent of the DMAs had a Principal Executive Officer or ranking elected Official certify the survey completion. With continued technical assistance, DEQ expects that certification will improve over time. DEQ's expectation is for 100 percent of the surveys to be certified.

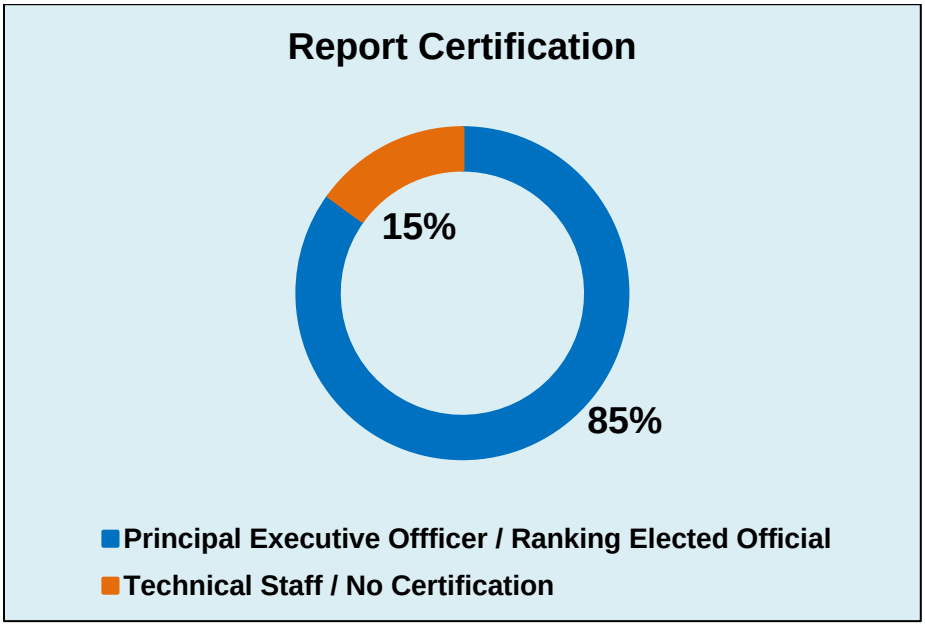

Figure 12. The percent of DMAs that had a principal executive officer or ranking elected official certify the survey completion is 85 percent. Engaging higher level officials is important for developing and sustaining the TMDL water quality improvement program over time.

3.2 Drinking water

Only six DMAs responded to the drinking water section of the checklist identifying drinking water protection strategies in the 2013 survey. Because of the low response rate, there was no figure for this category developed. DEQ attributed the low response rate to several factors: (1) the strategies checklist did not include sufficient or clearly worded questions about drinking water strategies; (2) many implementation plans did not include drinking water as a TMDL strategy; and (3) the DMA staff reporting may not be the department responsible for delivering drinking water.

The 2018 survey for this report's data accounted for some of these limiting factors in order to elevate the importance of protecting drinking water and identify it as a valid strategy in a nonpoint source TMDL implementation plan. Although the total number of DMAs participating in this category is lower than most questions overall, based on **Figure 13**, the number of DMAs reporting on drinking water strategies increased compared to the 2013 survey. Up to three to 15 DMAs, per question, reported drinking water information. Results suggest the survey functioned as a means for DMAs to connect drinking water protection strategies to their TMDL implementation planning efforts. Drinking water funds and grants often support restoration projects that have a mutual benefit for public water systems. The **Drinking Water Providers Partnership** (**Appendix B**) is one example of the opportunity for our watershed partners (SWCDs, Watershed Councils, local governments, etc.) to work with our federal partners and public water systems to implement mutually beneficial projects.

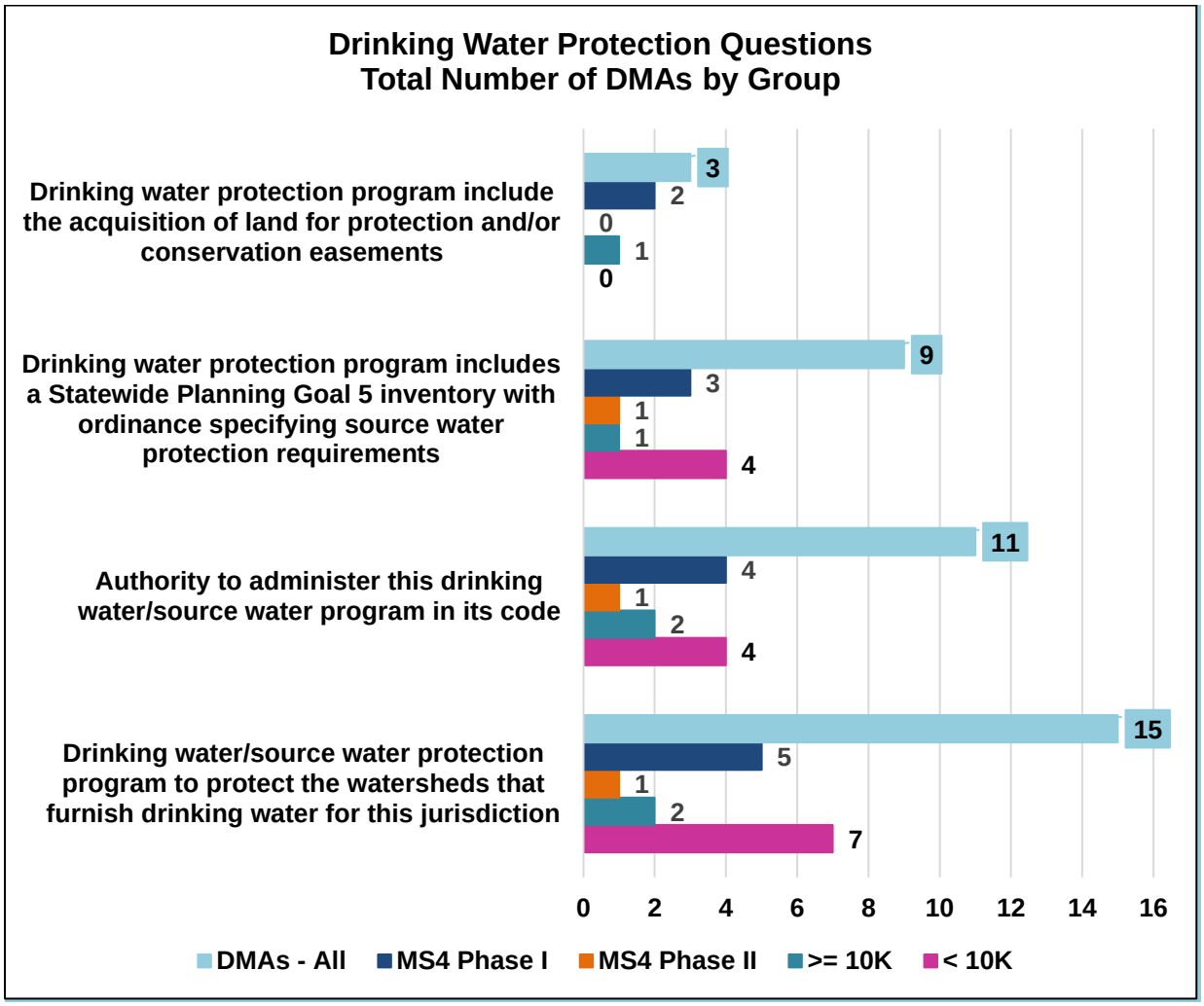

Figure 13. The total number of DMAs, by reporting category, which reported data for drinking water strategy implementation.

3.3 DEQ improvements

Only 24 percent of the reporting DMAs answered one or more questions about how DEQ should improve upon or expand its efforts (**Figure 14**). Based on the review of the data reported for the 10 questions, the validity of the reported data is questionable. For some of the survey questions it is unclear if the low response rate is because DMAs chose not to participate in this section of the survey. DEQ also speculates the improper wording of the questions resulted in a no response. After evaluating some of the responses for the 10 questions in **Figure 14**, DEQ identified five broad categories as areas to better focus efforts to help meet the needs of DMAs in successfully implementing their nonpoint source program. **Section 3.6** and **Appendix E** contains information about implementing and tracking the categories that were selected.

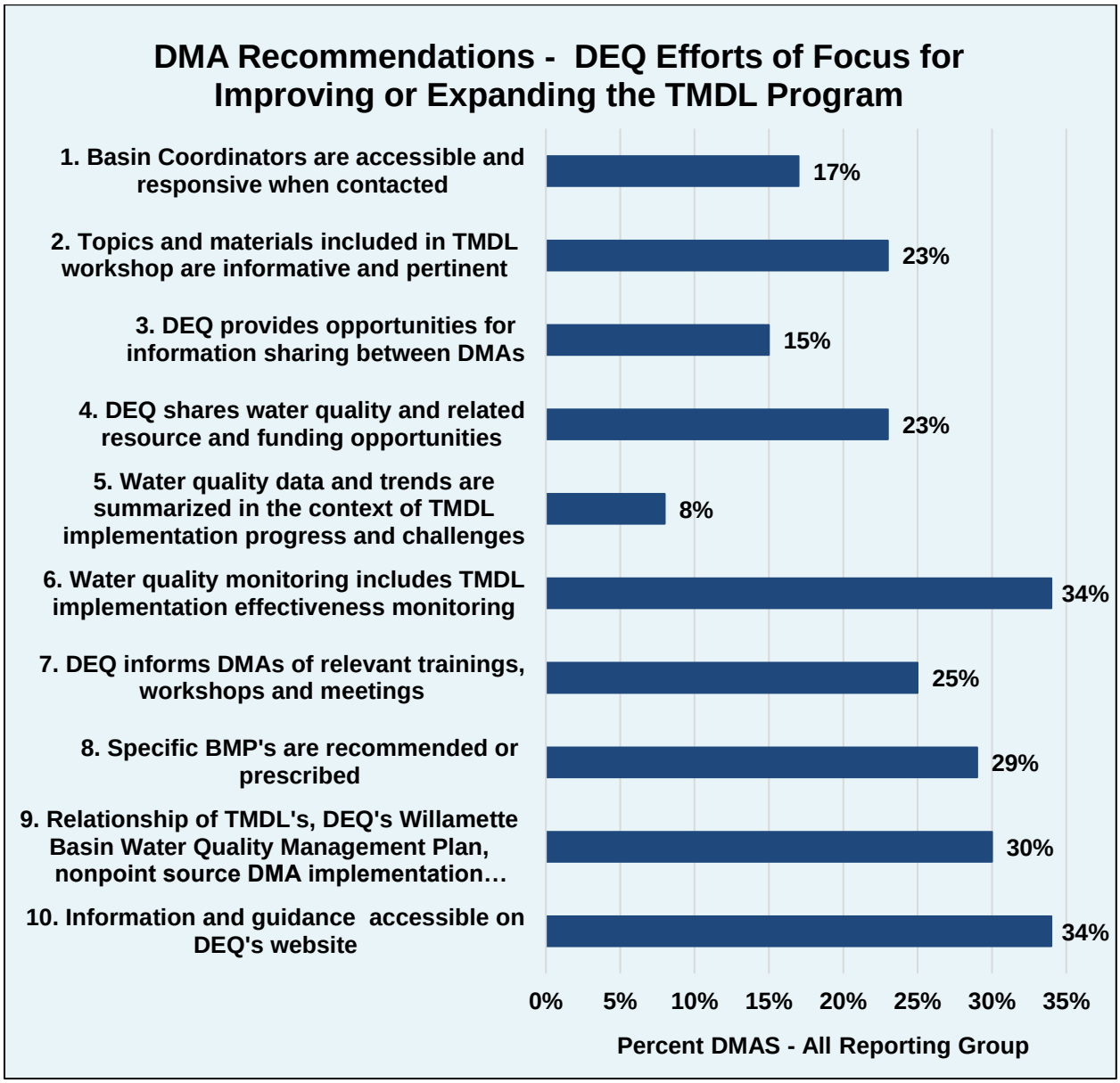

Figure 14. Twenty-four percent of DMAs answered survey questions pertaining to how DEQ can improve or expand TMDL implementation efforts.

3.4 Data comparison – 2013 and 2018 surveys

The 2018 survey tool utilized a checklist of stormwater and riparian program planning control measures and the corresponding BMPs under each control measure. The purpose was to establish a list of strategies and actions that would be acceptable for all TMDL implementation plans, as well as collect information to ensure that the basic programs and elements of a plan are in place for the four urban and rural DMA population reporting groups. The **March 2019 MS4 Phase II Permit** control measures were used as a guide. Despite differences between the 2013 and 2018 survey tools, DEQ was able to compare 2013 and 2018 survey data reported for questions to evaluate TMDL implementation over the last five years. For example, the total number of DMAs who reported in 2013 and 2018 are comparable in terms of number and reporting group. **Figure 15** identifies the number of DMAs by reporting group for 2013 and 2018. Additionally, although not all of the strategy questions between the two survey tools matched, five common questions could be directly compared (**Figure 16**), and there was a direct match for data reported for 30 questions in each survey. DEQ was able to duplicate several of the graphs in the first 2014 **Willamette Basin TMDL Five Year Review** report developed with the 2013 survey data for comparison with the 2018 survey data. **Figure 18** through **Figure 21** illustrate the reported comparisons between the 2013 and 2018 survey data.

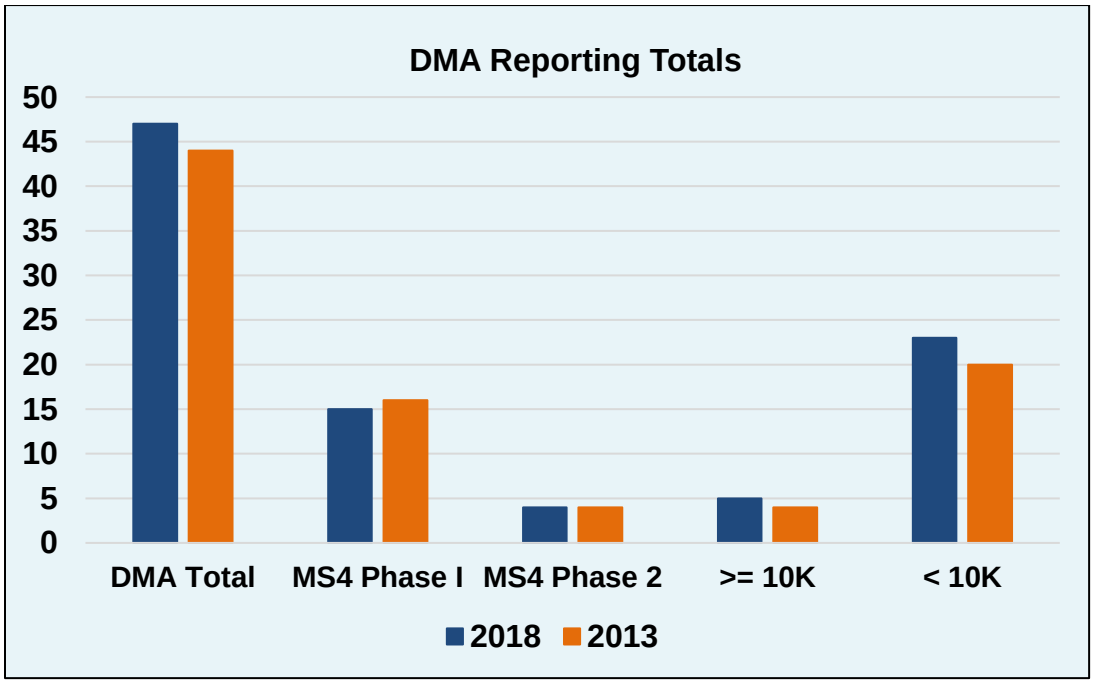

Figure 15. The total number of DMAs, by reporting group and survey year.

3.4.1 Riparian protection and restoration

The first 2014 **Willamette Basin TMDL Five Year Review** report identified urban and rural DMAs are responsible for about 198 riparian miles in the Willamette Basin. The Willamette Basin Temperature TMDLs identified that the Willamette Valley floor has poor riparian shade compared to the uplands. Riparian area shade was assessed in four categories of shade needed to attain 100 percent effective shade for needed temperature reductions:

Additional Shade needed
0 – 25 percent
26 – 50 percent
51 – 75 percent
More than 75 percent

The 2014 **Willamette Basin TMDL Five Year Review** report also identifies that cities currently have a wide range of percent shade for lands under their jurisdiction and for most urban and rural land, shade is much lower than the effective shade targets set forth in the TMDL. Conservation and restoration of functioning riparian areas on the valley floor is the strategy identified in the Willamette Basin TMDLs that would have the highest value for improving stream temperatures.

In the 2014 report DEQ recommends that comparing total riparian miles with linear feet protected, restored, and lost may be more suitable indicators for assessing riparian efforts. DEQ did not collect this information with the 2013 survey. The 2018 survey tool asked DMAs to report if they are implementing riparian restoration projects and to report the estimated linear feet restored. **Figure 16** illustrates the percent of active restoration increased and no active restoration decreased when compared to the same categories in the 2013 survey. **Figure 6d** in the previous section illustrates an estimated 91,450 linear feet, or approximately 17 miles of active restoration implemented. Although 17 out of 198 miles is a relatively low value, the information remains valuable for documenting that DMA efforts are underway, and need to continue, in support of water quality improvements for temperature, mercury, bacteria, and other TMDL pollutants.

Another important finding for this category is that both surveys identified riparian restoration as having a low implementation rate when compared to the control measures for stormwater in **Figure 4**. Over the past five years, DEQ hosted three technical assistance riparian workshops, and will continue to emphasize this measure in future workshops by sharing successful DMA strategies gleaned from the recent survey tool. Riparian restoration is an expensive strategy to implement, and this may be one of the key limiting factors. Project priorities, as well as jurisdictional authority of riparian corridors, may also be limiting factors. Furthermore, data for this report only captures 53 percent of the urban and rural DMAs in the Willamette Valley implementing active restoration, and it does not capture ongoing efforts by nongovernmental entities and forestry and agricultural agencies. Additionally, the 2018 survey tool capped the project number and linear feet values which resulted in underreporting by several DMAs.

Riparian restoration project numbers, types, and linear feet data should continue being collected in the future through DEQ surveys to help document improved water quality outcomes achieved through conservation actions. The Willamette Basin TMDLs describe the baseline conditions DMAs should use for riparian shade conditions. The survey data reported for riparian restoration can be used with the baseline information to assess progress towards achieving the system potential shade targets that are established in the TMDL. Specific linear feet protected and lost,

in conjunction with active restoration throughout the Willamette Valley, would also improve assessment of actions in support of the TMDLs.

3.4.2 Funding

DMAs identified funding as the key limiting factor in the 2013 survey. DMAs also identified solutions for funding limitations. In the 2018 survey, DEQ asked DMAs to report funding limitations and if solutions to funding in 2013 were implemented. Based on **Figure 16**, in 2013 82 percent of the DMAs reported they have funding limitations and in 2018 66 percent of the DMAs reported they have funding limitations. For this report, 57 percent, or 27 DMAs, also provided narrative information pertaining to funding solutions or limitations. **Figure 17** illustrates the successful solutions to funding that DMAs implemented between 2013 and 2018. Although more than 50 percent of the DMAs responded to the question regarding implementation of solutions, five of the DMAs used this question as an opportunity to provide recommendations for funding limitations, information on lack of progress in implementing a solution, and matrix timeline adjustments to meet funding needs. **Table 2** is an aggregated list of DMA concerns that need to be considered as limiting the success of TMDL implementation.

Based on information reported in 2018, 66 percent of the DMAs continue to have funding limitations as they transition to the third cycle of TMDL implementation (**Figure 2**)**.** DEQ acknowledges funding limitations as a concern. The reported successful funding strategies will be informative for DMAs currently evaluating solutions for funding TMDL implementation. DEQ will continue to work with DMAs and inform them about the successes reported for overcoming funding limitations, as well as continue to forward grant and loan opportunities they can potentially consider applying for.

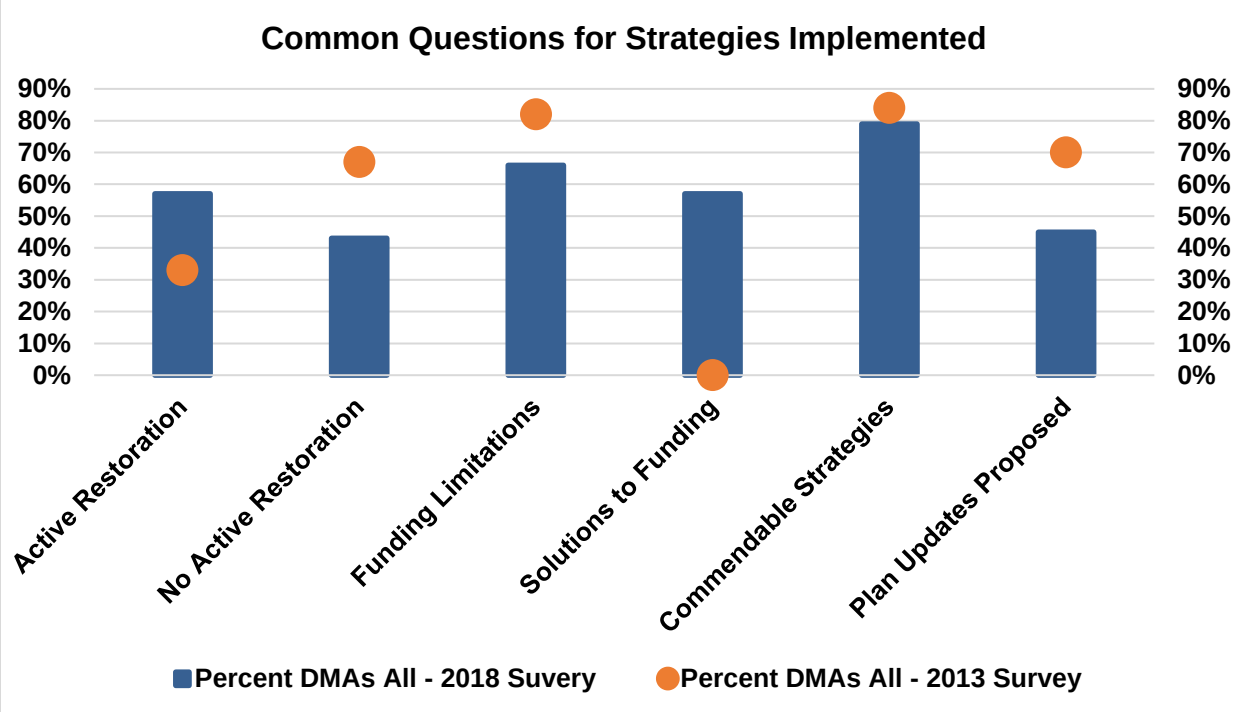

Figure 16. Comparison of the overall DMA response rate to five common questions included in both the 2013 and 2018 surveys, and one unique question in the 2018 survey. "Solutions to funding" is shown as zero percent for 2013 since it was not included as a question in 2013.

Table 2. The funding concerns DMAs reported for TMDL implementation.

Funding Concerns Reported by DMAs
1. **Difficulty acquiring funding to inspect sewer lines. Adjusting the total amount of inspections completed will be more feasible to implement.**
2. **Extending number of years for specific studies to be done. Need for riparian/habitat analysis.**
3. **New stormwater utility service charge. Initial funding levels anticipated to cover growth. However, current estimates of funding needed to meet proposed regulatory and infrastructure requirements exceeds the funding levels approved through fiscal year 2020-2021.**
4. **The water bodies are being protected as water bodies of the state. State of Oregon should start providing some resources to help us in these efforts, rather than only requiring reports and permits.**
5. **The city has not embraced the importance of environmental values. The focus is entirely on development rather than preservation. This core perception needs to change and that will require willingness to support and promote by the elected officials.**

3.4.3 Successful and commendable strategies

A high percentage of DMAs in 2013 (84 percent) and 2018 (79 percent) chose to share their successful and commendable strategies (**Figure 16**). The list of commendable strategies reported in the 2013 survey were: (1) shared with DMAs during report reviews; (2) added to the recent 2018 survey tool as effective BMPs; or (3) used in technical assistance workshops. Additional successful and commendable strategies reported for the 2018 survey are also valuable for the third cycle of implementation and will be used in the same fashion. Due to the extent of the information reported by the DMAs, the information pulled by DEQ was not included but is available upon request.

3.4.4 Proposed TMDL implementation plan updates

Figure 16 indicates that the percent of DMAs who reported 2018 proposed plan updates for the transition into the third cycle of TMDL implementation (2018-2023) declined (45 percent) compared to DMAs who reported proposed plan updates in 2013 (70 percent) for the second cycle of TMDL implementation (2008-2013).The reason behind the decline is unclear.

DEQ's **water quality assessment database** and maps indicate that Willamette Basin streams remain water quality limited for TMDL parameters. Plan improvements or sufficiency of current strategies are important DEQ measures for confirming adequate strategies are maintained over time. The overall objective is to meet water quality standards throughout the Willamette Basin. The 2018 survey serves as a tool for DEQ and DMAs to assess whether BMPs under the control measures in the survey are contained in the updated TMDL implementation plans. DEQ will use this information during report reviews as an opportunity to identify gaps in plans and provide feedback to DMAs.

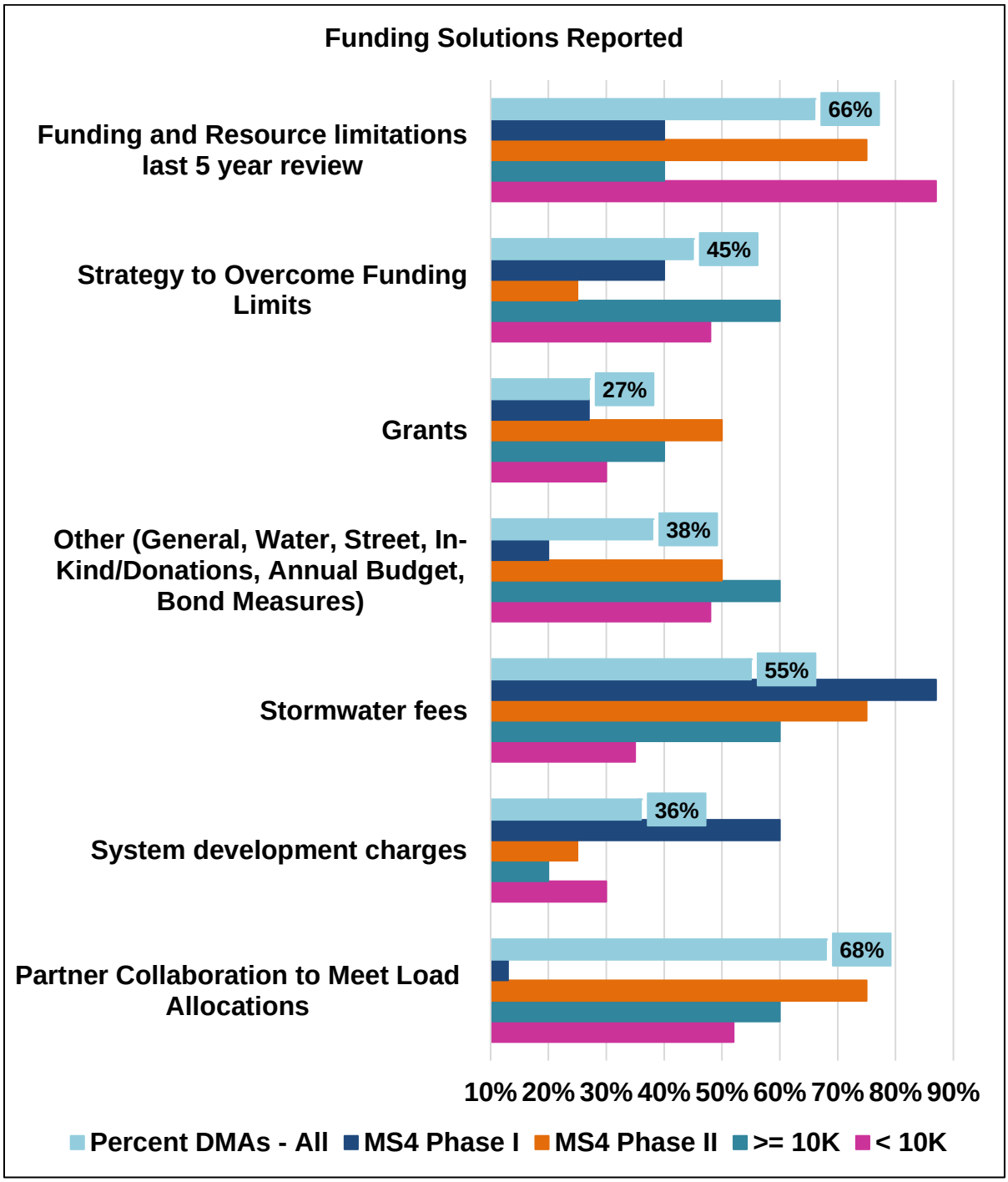

Figure 17. The percent of DMAs, by reporting category, that reported implementation of funding solutions in 2018 (Figure 2) for the funding limitations that were identified in the 2013.

3.4.5 Common questions

Figure 18 through **Figure 21** document the overall percent for DMA responses to the 30 common questions that were graphed in the first 2014 **Willamette Basin TMDL Five Year Review** using the 2013 survey data. DEQ compared the 2013 and 2018 survey data to assess what change took place in implementation for strategies implemented over the last four years. This comparison is important for documenting both successes and concerns in TMDL implementation. An overall increase in strategy implementation may indicate reporting and implementation improved, and there is reasonable assurance that implementation in the Willamette Basin is progressing. An overall decrease in strategy implementation is likely an indicator that focused plan and report review at the DMA or survey question level may be needed to determine the source of the decline.

Overall, 74 percent of the strategies had a reported increase, nine percent remained stable, and 17 percent indicated a decline in strategy implementation for this report. The percent in **Figure 18** indicates a measurable increase of four out of six strategies implemented. **Figure 19** indicates a measurable increase of eight out of nine strategies implemented. **Figure 20** indicates a measurable increase of five out of eight strategies implemented. Particularly noteworthy, the percent of DMAs who reported providing updates to Council increased from two to 48 percent. As indicated previously, engaging residents, city councils and boards is important for building and sustaining successful surface water protection programs.

The implementation of strategies that remained stable include: Regular street sweeping and erosion control ordinance for less than 1 acre. These strategies are important for reducing mercury as well as other parameters reduced by sediment control.

The implementation of strategies that declined include: Employee training on maintenance and construction, purchase of instream flows for improving water quality, requiring erosion control plans during the plan review process, promote/collaborate/incentivize riparian restoration, and improved stream flows. Improved stream flows have the potential to attenuate high temperatures and bacteria loading.

Riparian restoration to establish shade to reduce thermal loading is the primary strategy identified in the Willamette Basin temperature TMDLs. DEQ technical assistance during TMDL implementation plan and annual report reviews, as well as workshops and future surveys, should emphasize the adoption of the above effective strategies and identify key barriers to successful implementation for improving temperature.

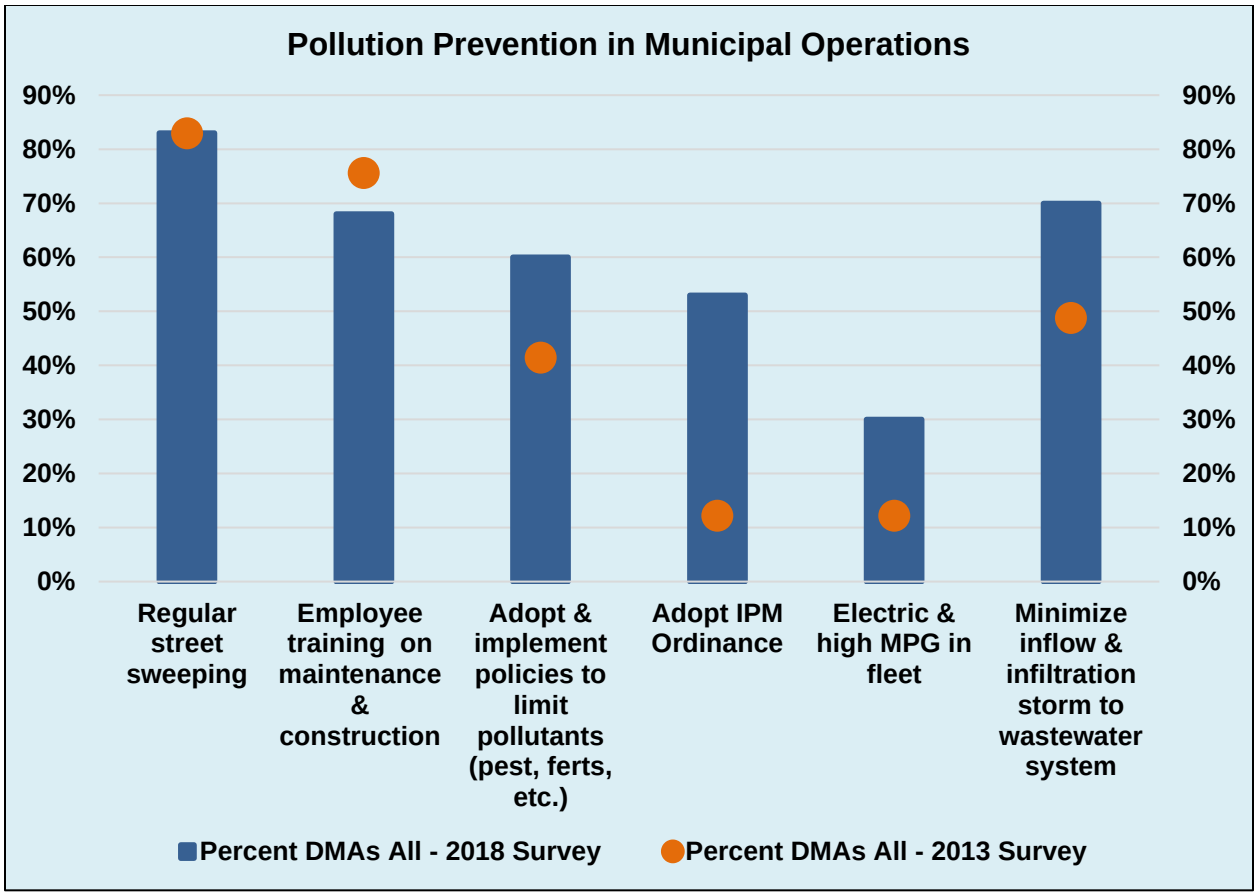

Figure 18. Comparison of the overall DMA response rate to six strategy/BMP questions that were included in both the 2013 and 2018 surveys. The strategies are specific to the control measure Pollution prevention in municipal operations, see Section 2.1.3.

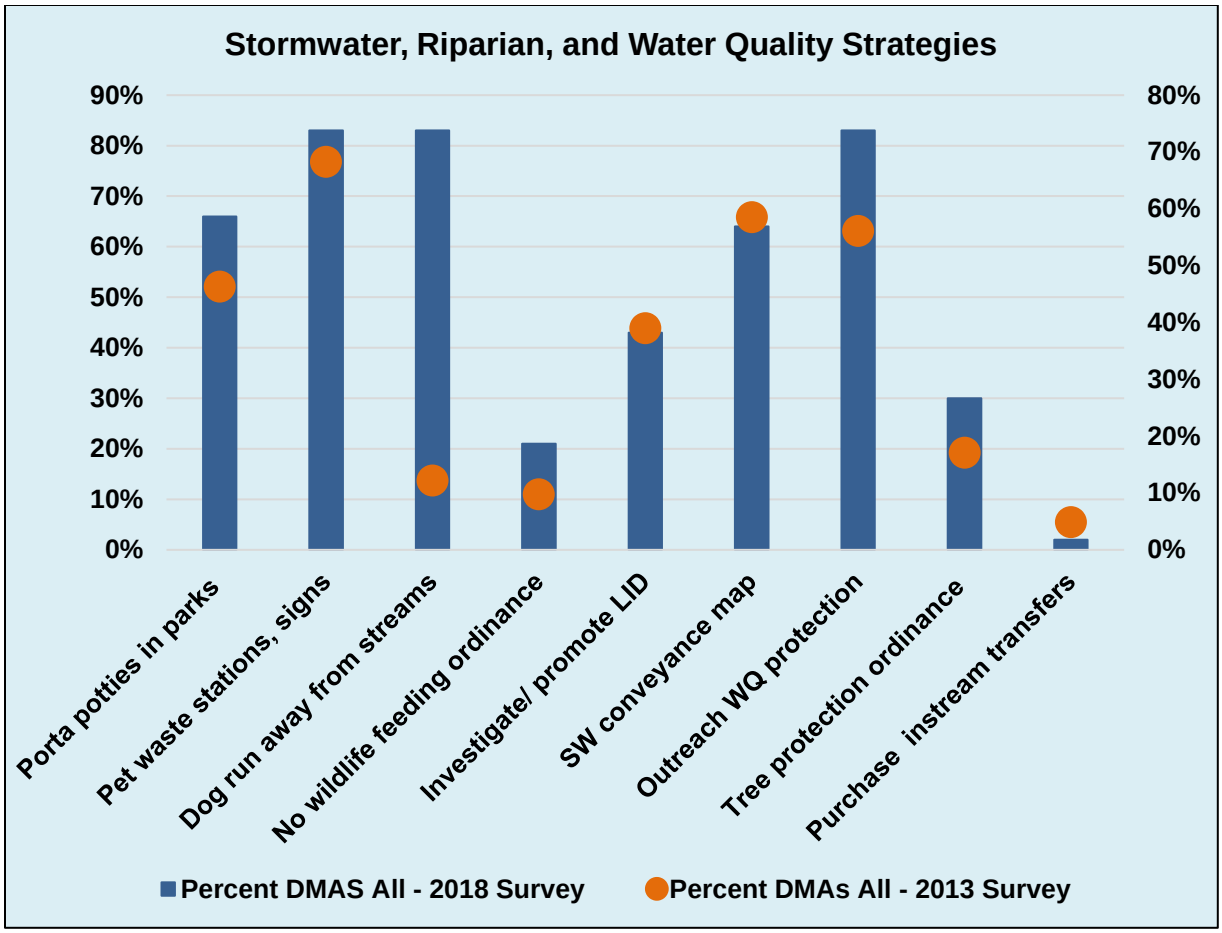

Figure 19. Comparison of the overall DMA response rate to nine strategy/BMP questions that were included in both the 2013 and 2018 surveys. The specific strategies fall under several Section 2 control measures.

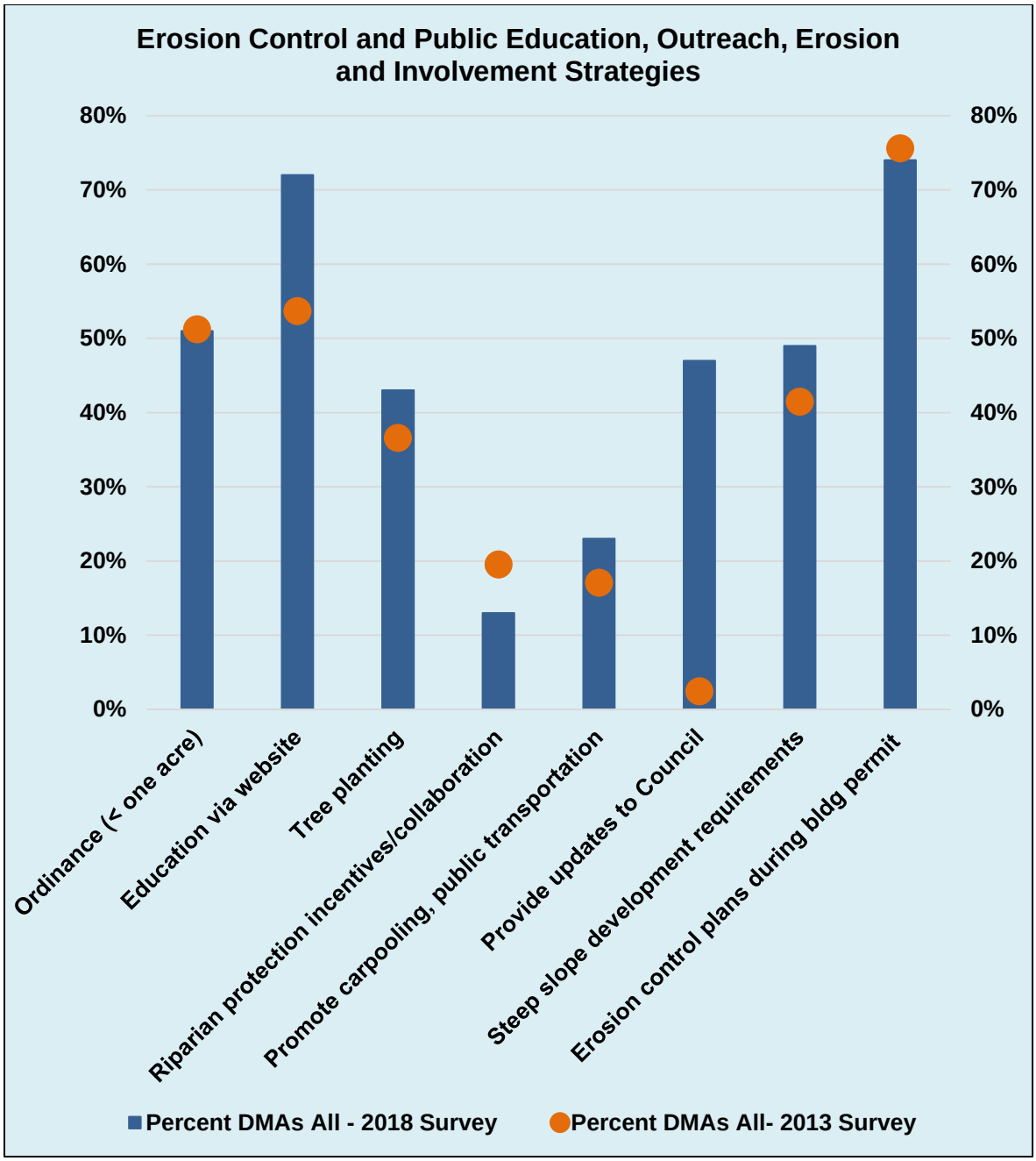

Figure 20. Comparison of the overall DMA response rate to eight strategy/BMP questions that were included in both the 2013 and 2018 surveys. From left to right, the first three strategies fall under Section 2.1.5 Construction stormwater erosion control. The remaining five are under Section 2.1.7 Public education, outreach, and involvement.

3.4.6 Top strategies to be added or continued

In 2013, DMAs identified several “Up and Coming” strategies that they were going to add to their implementation plans or continue implementing in the next five years; these are graphed in the first **Willamette Basin TMDL Five Year Review** report. **Figure 21** compares the percent of DMAs who reported implementation of the up and coming strategies in 2018 to the percent that proposed or were implementing these strategies in 2013. The 2018 results (**Figure 21)** are lower than the 2013 results for all strategies. Several factors, such as the funding limitations (see section **3.4.2)** likely contribute to DMAs not implementing all of strategies they proposed in 2013. Several of the strategies proposed represent forward thinking and innovation. All of the strategies proposed are resource intensive and require phases of implementation and extensive public education, outreach, and involvement with residents, councils, boards, and commissions.

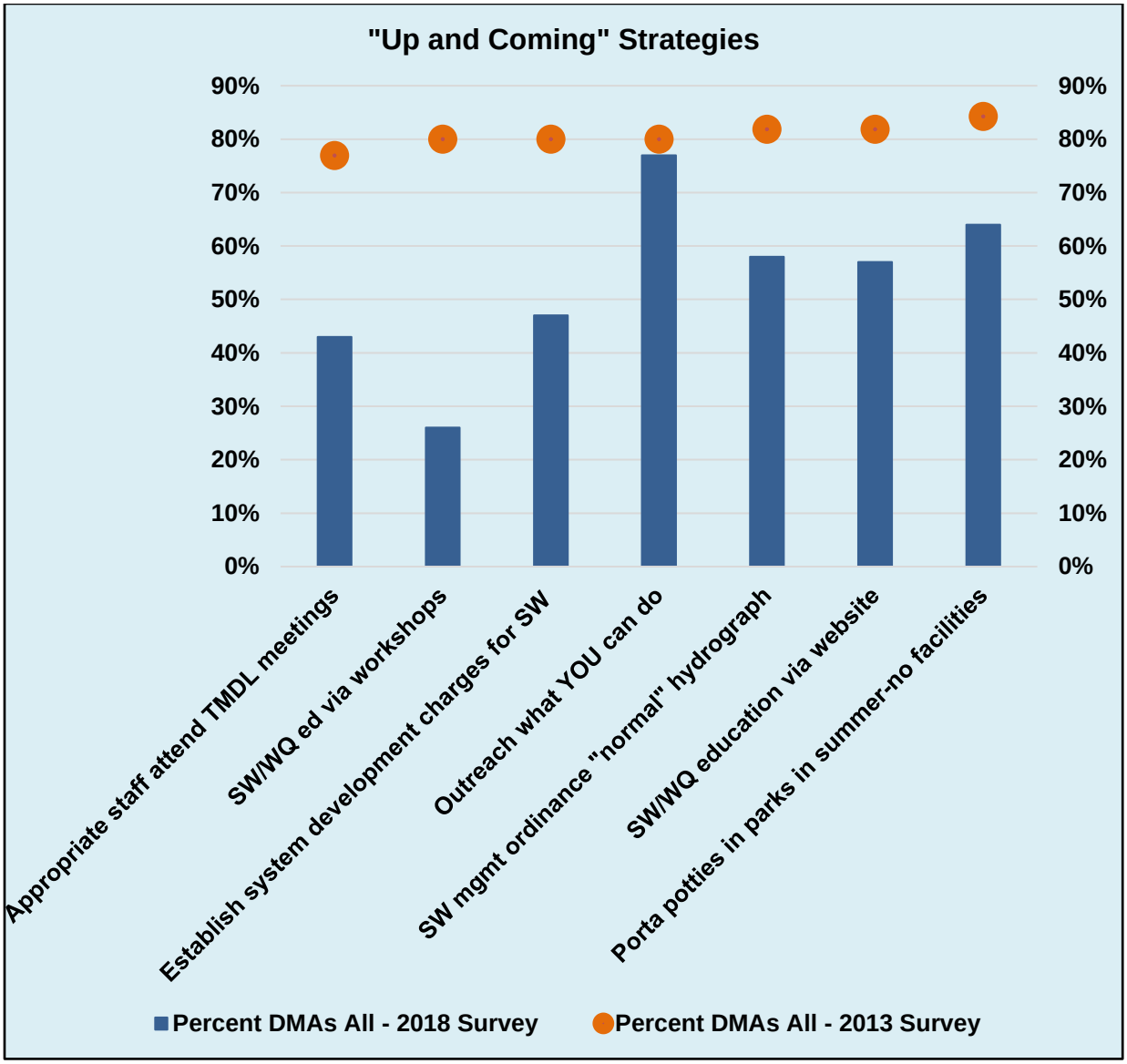

Figure 21. The overall DMA response rate for strategies that DMAs reported they will begin or continue in the next five years. The 2018 survey results in Figure 21 are lower than the 2013 survey results for all strategies. Several factors likely contribute to the lower rate of implementation.

3.5 Monitoring and evaluation

Monitoring and evaluation for nonpoint source TMDL implementation has three broad components and is outlined in the management plans for the **Willamette Basin TMDLs.**

1. Selection and implementation of effective strategies in TMDL implementation plans.
2. Strategy effectiveness monitoring.
3. Assessment of water quality or surrogate measure improvement.

The data reported and pooled by the survey tools is a major component of documenting the "reasonable assurance of implementation" for the Willamette Basin **(Figure 2)** TMDLs. The implementation data reported may be used at the Willamette Basin, Subbasin, and DMA scale to determine the selection and implementation of effective strategies, as well as improvement for riparian restoration.

DEQ can also use the survey data in conjunction with other DEQ reporting, water quality, and riparian monitoring tools to further assess if strategy selection and implementation is having the desired effects or if changes in strategies and/or TMDLs will be required. DEQ will continue to evaluate how to enhance current TMDL implementation monitoring and evaluation for assessing if progress is being made towards meeting water quality standards and targets. Section **3.6** and **Appendix E** identify tasks for improving TMDL implementation monitoring and evaluation data over the next five years. The sections below are derived from **Appendix E** and illustrate three ways DEQ is proposing to improve monitoring and evaluation.

3.5.1 MS4 Phase I monitoring and benchmark analysis

The main objective of a TMDL is to achieve TMDL allocations over time to meet water quality standards. MS4 Phase I permittees are the only DMAs required to conduct watershed and stormwater monitoring. MS4 Phase I permittees are also required to show continual progress by meeting "benchmarks" of performance within each permit term. A TMDL pollutant reduction benchmark must be developed for each applicable TMDL parameter where existing BMP implementation is not achieving the wasteload allocation. The goal of setting progressively lower incremental benchmarks is that BMPs implemented over time will eventually achieve TMDL wasteload allocations. Water quality monitoring and conducting pollutant load reduction and wasteload attainment analyses are the primary methods for permit holders to meet WQMP requirements and evaluate program success. This data can be reviewed and compiled at the Willamette Basin and individual DMA scale.

Based on the reported data from the recent survey for this report, 100 percent of the MS4 Phase I's are monitoring surface water and storm water and over 85 percent performed a TMDL pollutant load reduction analysis as part of permit renewal requirements**.** Additionally, 100 percent of the Phase Is are collaborating with other entities on water quality monitoring and greater than 90 percent are using the data to assess progress towards meeting TMDL wasteload allocations.

3.5.2 Status and trends

DEQ recognizes that it will take time before BMPs identified in the WQMP are fully implemented and effective in reducing and controlling pollution to meet water quality standards **(Figure 2)** in the Willamette Basin.

DEQ is tracking water quality status and trends concurrently with DMA implementation strategies and reporting. Water quality monitoring data for the reports is pooled from DEQ's **Ambient Water Quality Monitoring System** (AQMS) and the **water quality assessment database**. The 2019 **Water Quality and Status and Trends** reports are informative for reviewing monitoring stations that are representative of land use and land cover for urban and rural DMAs. **Appendix E** 2018 to 2023 (cycle three) tracking matrix identifies basin coordinator participation in the development of status and trends reports that are representative of all land uses, such as, urban, rural, agricultural, and forestry.

A condensed summary of trend results for the Willamette Basin is provided in **Appendix G**. Available data were sufficient to assess trends at 2199 stations within the Willamette basin. These stations were located across 510 assessment units consisting of "Lakes", "Streams" and "Watershed Units". Data for dissolved oxygen, Escherichia coli, pH, total phosphorus, temperature and total suspended solids were available for analysis and included in the summary report. As indicated in the graphs, DEQ had insufficient data to determine trends at multiple stations in the Willamette Basin. DMA submission of data will help to supplement and inform these trend analyses in the future. DEQ encourages DMAs to review the **Water quality and status and trends analysis** and do the following: become familiar with water quality status and trends in their basins; identify existing monitoring locations and areas where they can augment monitoring; include water quality status and trends in their public outreach and involvement efforts.

The **Water quality and status and trends analysis** report will be a useful tool to help Basin Coordinators' discussions with DMAs and other watershed partners. Integrating a riparian mapping piece is a potential useful tool that will be considered, as well as shade analyses for outreach and education.

3.5.3 DMA reporting

The Willamette TMDLs provide nonpoint source timelines for implementing strategies. This includes implementation plan submittal, annual reporting, nonpoint source plan revisions, and completion of measurable milestones. DEQ primarily utilizes the Agency Compliance Enforcement Database to track most of the Willamette DMA report submittals and DEQ report reviews and completion. Utilizing one tracking system for all DMAs would improve DEQ consistency and accountability of the nonpoint TMDL implementation program. **Appendix E** 2018-2023 cycle three tracking matrix identifies one tracking system for TMDL nonpoint source implementation reporting as a task to work on.

3.6 Recommendations and tracking for TMDL implementation

3.6.1 2013 five-year review survey

In the first **Willamette Basin TMDL Five Year Review** report, DEQ identified recommendations for DMAs as well as internal recommendations pertaining to DEQ's operations, processes and priorities based on the 2013 survey information pooled. Based on this information, DEQ developed a 2013 to 2018 implementation tracking matrix for a select set of DMA and DEQ recommendations for improving TMDL Implementation. The implementation of the matrix recommendations was tracked up to June 2018. To see the outcomes of specific recommendations, see **Appendix H**.

3.6.2 2018 five-year review survey

Based on the review and analysis of specific information DMAs provided in the 2018 survey for this report, DEQ identified five broad tasks for continued improvement in TMDL implementation:

1. **Improve DEQ internal communication for stormwater programs**
2. **Provide DMA technical assistance**
3. **Partner to achieve TMDL implementation reporting and tracking**
4. **Water quality, BMP, and riparian monitoring and evaluation for urban/rural DMAs**
5. **Update survey for next five-year review in 2023**

DEQ developed an implementation tracking matrix in **Appendix E** for the specific measurable actions that will be implemented and monitored to document improvements under the broad tasks identified above. Several tasks in **Appendix H**, which tracked actions as a result of the 2013 survey, still pertain to these broad categories and have been carried into **Appendix E**.

3.7 Conclusions

DEQ concludes that a large percentage of designated management agencies are implementing pollution reduction strategies and reporting on their progress. Overall, management agencies reported an increase in implementation of selected strategies between the 2013 and 2018 surveys. The quantitative data reported by management agencies provides a representative sample of management agency activities that are underway to reduce pollutant loads, specifically temperature, bacteria and mercury. Particularly noteworthy, small management agencies with populations under 10,000 people in more dense urban areas are also implementing a number of stormwater control measures that are required for larger communities in the TMDL water quality management plan. Through these efforts, these small and growing communities are in a good position to shape stormwater management and future development patterns in order to meet community, as well as water quality goals.

Municipal Separate Storm Sewer System Phase II communities are implementing selected strategies at a lower rate compared to other management agency groups. The issuance of the **March 2019 MS4 Phase II Permit**, as well as the hiring of additional system MS4 staff, and revising future survey tools to be more representative for Phase II communities, will have a positive impact on the implementation and tracking of stormwater management measures. DEQ

encourages all management agencies to implement post-construction and illicit discharge detection and elimination control measures. These two control measures are important for balancing water quality protection with the continuing growth in population and suburban development.

In addition, there is documented growth in riparian restoration activities with some management agencies developing sophisticated methods for tracking and prioritizing where riparian restoration is most effective. DEQ encourages all management agencies to better track status of meeting percent effective shade targets applicable to their jurisdictions as part of annual reporting. Establishing partnerships is key to sustained progress. Funding for restoration is expensive, and grant opportunities are very competitive. Preservation of existing riparian areas and riparian protection ordinances should be considered by urban and rural jurisdictions with limited funding opportunities.

DEQ reviewed all the data and determined that DEQ internal and management agency external communication, as well as process improvement and resources, are critical for sustaining TMDL and water quality management plan implementation over the next five years and beyond. **Appendix E** outlines the specific water quality management plan implementation actions that will be implemented and monitored by DEQ over the next five years to sustain the nonpoint source program. Additionally, DEQ and management agency focus has primarily been on implementation monitoring; whether best management practices were implemented as specified in water quality management plans. DEQ acknowledges that implementation monitoring itself cannot directly link management activities to water quality or riparian response. DEQ has identified monitoring and evaluation tasks in **Appendix E** that are designed to evaluate change on the landscape and improvements in water quality.

Appendix A: List of impaired beneficial uses in the Willamette Basin

Implementation of these strategies to reduce pollution will help to protect beneficial uses that are impacted when water quality standards are not met for a waterbody.

Beneficial Use	Parameter	Source(s)	Strategies to Reduce Pollution
Water Contact Recreation; Drinking Water	Bacteria *E. Coli*	Bacteria are carried to waterways in stormwater, overland flow, and pipes systems.	Reduce inputs of bacteria through riparian protection & restoration, erosion control, stormwater control and treatment, low impact development, septic maintenance, various domestic and agricultural practices.
Resident Fish and Aquatic Life, Salmonid Fish Spawning and Rearing	Dissolved Oxygen	In-stream sediment from runoff and stream bank erosion and high nutrient loads.	Reduce sediment delivered to streams through riparian protection & restoration, erosion control and stormwater control and treatment, low impact development, nutrient load reduction
Fish and other aquatic animals, invertebrates, plants/other; water supply/aesthetics, water contact recreation	Turbidity		
Resident Fish and Aquatic Life, Salmon Fish Spawning and Rearing	Temperature	Removal of trees and other shade-producing woody vegetation from stream banks.	Increase effective shade through restoration and protections for natural stream hydrology, cool water refuges, increase natural stream flow.
Waters of the state must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities	Nutrients: Phosphorus, pH, Chlorophyll a	In-stream sediment from runoff and stream bank erosion and high nutrient loads.	Reduce inputs of nutrients through riparian protection & restoration, erosion control, stormwater control and treatment, low impact development, septic maintenance, various domestic and agricultural practices.
Resident Fish and Aquatic Life, Fishing and Fish Consumption	Toxic Substance: Mercury	In-stream sediment from runoff and stream bank erosion; air deposition.	Reduce sediment delivered to streams by various means including riparian protection and restoration, erosion control and stormwater control and treatment, low impact development.
Resident Fish and Aquatic Life, Drinking Water	Toxic Substance: Legacy Pesticides (DDT, Dieldrin)		

Appendix B: Web links

Ambient Water Quality Monitoring System
https://www.oregon.gov/deq/wq/pages/wqdata.aspx

Chesapeake Bay Part 1: Removal of Urban Toxic Contaminants
https://www.chesapeakebay.net/channel_files/22745/110115_review_draft_urban_toxics_contaminants_report.pdf

DEQ guidance
https://www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-Implementation.aspx

Drinking Water Partnership
https://www.workingwatersgeos.org/drinking-water-providers-partnership

EPA Nutrient Policy Data BMP Treatment Clearinghouse
https://www.epa.gov/nutrient-policy-data/best-management-practices-bmp-and-treatment-technologies-clearinghouse

February 2014 Willamette Basin TMDL Five Year Review
https://www.oregon.gov/deq/FilterDocs/willtmdl2014.pdf

International Stormwater Best Management Practices Database
http://www.bmpdatabase.org/index.htm

Minnesota Information on Pollutant Removal by BMPs
https://stormwater.pca.state.mn.us/index.php/Information_on_pollutant_removal_by_BMPs

National Pollutant Removal Performance Database for Stormwater Treatment Practices
http://www.stormwatercenter.net/Library/STP-Pollutant-Removal-Database.pdf

New Jersey BMP Practices Manual Chapter 4 Pollutant Removal
https://www.nj.gov/dep/stormwater/bmp_manual/NJ%20SWBMP%20covcon%20CD.pdf

OAR Chapter 340 Division 42
https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=1459

Oregon Watershed Restoration Tool
https://tools.oregonexplorer.info/OE_HtmlViewer/Index.html?viewer=owrt

Post-Construction Stormwater Manual
https://www.oregon.gov/deq/FilterDocs/tmdls-07wq004tmdlimplplan.pdf

Status and Trends
https://www.oregon.gov/deq/wq/programs/Pages/wqstatustrends.aspx

The Water Quality Status and Trends analysis
https://www.oregon.gov/deq/wq/programs/Pages/wqstatustrends.aspx

Water quality assessment database
https://www.oregon.gov/deq/wq/Pages/WQ-Assessment.aspxindicates

Western Region LID
https://www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-LID.aspx

Willamette Basin TMDLs
https://www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-Willamette-Basin.aspx

Appendix C: Willamette Basin TMDL nonpoint source load allocations

TMDL	Parameter Reductions
Willamette 2006; Molalla-Pudding; Tualatin	**Mercury:** 27% Willamette Basin-wide for all subbasins **Temperature:** Attainment and preservation of effective shade levels on smaller tributaries associated with system potential vegetation will eliminate most anthropogenic nonpoint source heat loads. Surrogate measure is percent effective shade targets and a heat load equivalent of 0.05 ºC of the Human Use Allowance. Other important measures— include preserving and restoring cool water refuges where salmonids rear and migrate to when the river warms up in the summer; restore instream flow quantity.
Willamette 2006 - Clackamas	**Bacteria:** 78% fall-winter-spring-summer Clackamas River and Tributaries; 83% Bargfeld Creek fall-winter-spring-summer; 89% Delano Creek fall-winter-spring-summer
Willamette 2006 - Coast Fork	**Bacteria:** Coast Fork 303(d) listing removal, continuation of strategy implementation for other TMDLs 80% Willamette basin-wide average
Willamette 2006 -Lower	**Bacteria:** Johnson Creek Ur/Ag 78%; Fairview Creek Urban 66%**;** Springbrook Creek Urban 80%**;** Willamette River 78% reduction calculated for the Johnson Creek Watershed to all other tributaries in the Lower Willamette Subbasin **Toxics - DDT and Dieldrin:** Johnson Creek urban municipal storm sewer: 77% reduction. All land use categories and sources total suspended solids: 15 mg/l for 94% reduction.
Willamette 2006 - McKenzie; Middle Fork; North Santiam; South Santiam	**Bacteria:** 80% to 94%
Middle Willamette	**Bacteria:** 88% summer 75% fall-winter-spring and Middle Willamette Specific Tributaries**;** 81% Mill Creek Turner Road**;** 79% Pringle Creek at Pringle Park/Church Street**;** 89% Clark Creek at Mouth Bush Park
Molalla-Pudding 2008	**Bacteria:** 75% to 87% summer; 70% to 92% fall-winter-spring
Pudding 2008	**Iron:** 19% to 96% based on stream flow **Legacy Pesticides:** Pudding River and Tributaries 30%DDT Pudding River and Tributaries 90% Dieldrin Pudding River In stream total suspended solids targets (15 mg/L) **Nitrates:** Zollner Creek and Tributaries10 mg/l criterion met based on stream flow
Willamette 2006 -Middle Willamette; Rickreall Creek 1994	**Dissolved Oxygen 1994:** Reduce oxygen-demanding pollutants into Rickreall Creek (e.g., nutrients, bacterial pollution). Riparian protection and restoration measures developed to address stream temperature concerns in the basin will benefit dissolved oxygen levels. Implementation of best management practices designed to reduce nonpoint sources of pollution support dissolved oxygen improvements.

TMDL	Parameter Reductions
Tualatin 2001 and 2012	**Bacteria:** Mean event or grab 406 E. coli organisms per 100 mL **Chlorophyll a, pH, Phosphorus – Total phosphorus** range by stream 0.04-0.67 mg/L **Dissolved Oxygen –** Monthly mean; see TMDL
Willamette 2006 - Upper	**Bacteria:** 65% reduction average; 77% Upper Long Tom; 84%Upper Amazon; 33% A-3 Drain **Dissolved Oxygen:** **Coyote Creek** 40% reduction in sediment oxygen demand, Biological Oxygen Demand and nutrients **Amazon Creek and Diversion Canal** 20% reduction in sediment oxygen demand, Biological Oxygen Demand and nutrients Coyote Creek below Spencer Creek **Turbidity:** Coyote Creek 19-55% and Amazon Creek 42-56% TSS reduction
Yamhill	**1998, 2012 phosphorus, pH, and chloryphyll a:** Chloryphyll a reservoir, river, estuary, non-thermally stratified lake: 0.015 mg/l Phosphorus < .07 mg/l
Columbia Slough 1998	**Bacteria:** NPS control strategies in lieu of load allocations **DDT/dieldrin**: NPS control strategies in lieu of load allocations. Surrogate of 50 mg/L TSS for MS4s **PCBs:** NPS control strategies in lieu of load allocations. Surrogate of 50 mg/L TSS for MS4s **Dioxin:** Surrogate of 50 mg/L TSS for MS4s **Dissolved Oxygen/BOD:** Based on WLAs for BOD. NPS control strategies in lieu of load allocations. **Lead:** NPS control strategies in lieu of load allocations

Appendix D: Willamette Basin Designated Management Agencies

DEQ Region	TMDL	DMA Name	2010 Population	2018 Population	DMA Group	2013 Survey	2018 Survey	Comment	DMA Category	Land Use
NWR/ WR	Willamette 9 Subbasins; Molalla-Pudding	BLM	NA	NA	NA	no	no	DMA not covered in 2014 or 2019	Federal	Forestry
WR	Willamette Upper	Adair Village	840	860	<10K	no	no	Different Reporting Cycle	City	Urban
WR	Willamette Upper	Albany	43,600	53,145	>=10K 6 measures	yes	yes	MS4 Phase II future	City	Urban
WR	Yamhill	Amity	1,480	1,655	< 10K	no	no	No reporting required	City	Urban
NWR/ WR	Willamette 9 Subbasins	Army Corps of Engineers	NA	NA	NA	no	no	DMA not covered in 2014 or 2019 Reports	Federal	Other
WR	Willamette Middle	Aumsville	3,700	3,975	<10K	yes	yes		City	Urban

DEQ Region	TMDL	DMA Name	2010 Population	2018 Population	DMA Group	2013 Survey	2018 Survey	Comment	DMA Category	Land Use
WR	Molalla-Pudding	Aurora	660	985	<10K	no	no	Molalla-Pudding different reporting cycle	City	Urban
NWR	Molalla-Pudding	Barlow	135	135	<10K	no	no	Molalla-Pudding different reporting cycle	City	Urban
WR	Willamette Upper, Middle	Benton County	80,500	93,590	MS4 Phase II	yes	yes		County	Urban Rural
WR	WillametteUpper	Brownsville	1,500	1,705	<10K	no	no	Different Reporting Cycle	City	Urban
NWR	Molalla-Pudding	Canby	15,829	16,800	NA	no	no	Molalla-Pudding different reporting cycle	City	Urban
WR	Yamhill	Carlton	1,550	2,270	< 10K	no	no	No reporting required	City	Urban
NWR	Willamette Clackamas; Molalla-Pudding	Clackamas County Clackamas; Clackamas County Molalla	375,992	419,425	MS4 Phase I	yes	yes	Includes WES= CCSD#1 (+Happy Valley) and SWMACC (+Rivergrove)	County	Urban Rural
NWR	Tualatin	Clean Water Services	NA	NA	MS4 Phase I	yes	yes	MS4 Phase I thru CWS	Special District	Other

DEQ Region	TMDL	DMA Name	2010 Population	2018 Population	DMA Group	2013 Survey	2018 Survey	Comment	DMA Category	Land Use
NWR	Willamette Upper	Coburg + GWMA	1,050	1,195	<10K	yes	yes		City	Urban
WR	Willamette Upper	Corvallis	52,950	59,280	MS4 Phase II	no	no	Different Reporting Cycle	City	Urban
WR	Coast Fork	Cottage Grove	8,910	10,005	<10K	yes	no	Different Reporting Cycle	City	Urban
WR	Coast Fork	Creswell	3,990	5,455	<10K	yes	yes		City	Urban
WR	Willamette Middle	Dallas	13,270	15,830	>=10K 6 measures	yes	yes		City	Urban
NWR	Willamette Clackamas	Damascus	10,539	2016 unincoprated	>=10K 6 measures	yes	no	Transition w/incorporation	City	Urban
WR	Yamhill	Dayton	2,230	2,720	< 10K	no	no	No reporting required	City	Urban
WR	North Santiam	Detroit	250	210	<10K	yes	yes		City	Urban

DEQ Region	TMDL	DMA Name	2010 Population	2018 Population	DMA Group	2013 Survey	2018 Survey	Comment	DMA Category	Land Use
WR	Molalla-Pudding	Donald	640	985	<10K	no	no	Molalla-Pudding different reporting cycle	City	Urban
NWR	Willamette Middle	Dundee	2,860	3,230	<10K	no	yes		City	Urban
NWR	Willamette Clackamas	Estacada	2,695	3,400	<10K	yes	yes		City	Urban
WR	Willamette Upper	Eugene	143,910	169,695	MS4 Phase I	no	yes		City	Urban
WR	Willamette Upper, McKenzie	EWEB	NA	NA	NA	no	no	Different Reporting Cycle	Special District	Other
NWR	Willamette Lower	Fairview	8,920	8,990	MS4 Phase I	yes	yes		City	Urban
WR	Willamette Upper	Falls City	960	955	<10K	yes	yes		City	Urban
WR	North Santiam	Gates	490	485	<10K	yes	yes		City	Urban

DEQ Region	TMDL	DMA Name	2010 Population	2018 Population	DMA Group	2013 Survey	2018 Survey	Comment	DMA Category	Land Use
WR	Molalla-Pudding	Gervais	2,110	2,585	<10K	no	no	Molalla-Pudding different reporting cycle	City	Urban
NWR	Willamette Clackamas; Lower	Gladstone	11497	11,880	MS4 Phase I	yes	yes		City	Urban
NWR	WillametteLower	Gresham	105,594	110,505	MS4 Phase I	yes	yes		City	Urban
WR	Willamette - Upper	Halsey	740	935	<10K	no	no	Different Reporting Cycle	City	Urban
WR	WillametteUpper	Harrisburg + GWMA	2,930	3,660	<10K	no	no	Different Reporting Cycle	City	Urban
WR	Molalla-Pudding	Hubbard	2,700	3,305	<10K	no	no	Molalla-Pudding different reporting cycle	City	Urban
WR	North Santiam	Idanha	230	140	<10K	yes	yes		City	Urban
WR	Willamette Middle	Independence	6,850	9,370	<10K	yes	yes		City	Urban

DEQ Region	TMDL	DMA Name	2010 Population	2018 Population	DMA Group	2013 Survey	2018 Survey	Comment	DMA Category	Land Use
WR	Willamette Middle	Jefferson	2,480	3,245	<10K	yes	no	Used own template Feb 2018	City	Urban
WR	Willamette Upper	Junction City + GWMA	4,870	6,125	<10K	no	no	Different Reporting Cycle	City	Urban
WR	Willamette Middle	Keizer	34,010	38,505	MS4 Phase II	yes	yes		City	Urban
WR	Molalla-Pudding	Labish Water Control District	NA	NA	NA	no	no	DMA not covered in 2014 or 2019	Water Conveyance	Agriculture
WR	Yamhill	Lafayette	3,010	4,105	< 10K	no	no	No reporting required	City	Urban
NWR	Tualatin	Lake Oswego	36619	38,215	MS4 Phase I	yes	yes		City	Urban
WR	Willamette Coast Fork, McKenzie, Middle Fork, Upper	Lane County	329,400	375,120	MS4 Phase II	no	no	Different Reporting Cycle	County	Urban Rural
WR	South Santiam	Lebanon	13,140	16,920	>=10K 6 measures	no	no	Different Reporting Cycle	City	Urban

DEQ Region	TMDL	DMA Name	2010 Population	2018 Population	DMA Group	2013 Survey	2018 Survey	Comment	DMA Category	Land Use
WR	Willamette Upper, South Santiam	Linn County	104,900	125,575	NA	no	no	Different Reporting Cycle	County	Urban Rural
WR	Middle Fork	Lowell	890	1,195	<10K	yes	yes		City	Urban
WR	North Santiam	Lyons	1,060	1,195	<10K	yes	yes		City	Urban
WR	Willamette Middle, North Santiam; Molalla-Pudding	Marion County	315,335	344,035	MS4 Phase II	no	no	Molalla-Pudding different reporting cycle	County	Urban Rural
NWR	WillametteLower	Maywood	752	750	<10K	no	no		City	Urban
WR	Yamhill	McMinnville	28,890	33,810	>=10K 6 measures	no	no	No reporting required	City	Urban
NWR	Willamette Lower	Metro	NA	NA	NA	yes	yes	Not an MS4 permittee	Special District	Other

DEQ Region	TMDL	DMA Name	2010 Population	2018 Population	DMA Group	2013 Survey	2018 Survey	Comment	DMA Category	Land Use
WR	Wiilamette North Santiam	Mill City	1,530	1,865	<10K	no	yes		City	Urban
WR	Willamette Upper	Millersburg	720	2,315	<10K	no	no	Different Reporting Cycle	City	Urban
NWR	Willamette - Lower	Milwaukie	20291	20,525	MS4 Phase I	yes	yes		City	Urban
NWR	Molalla-Pudding	Molalla	8,108	9,625	<10K	no	yes		City	Urban
WR	Willamette Middle	Monmouth	8,793	9,890	<10K	yes	yes		City	Urban
WR	Willamette Upper	Monroe + GWMA	610	625	<10K	no	no	Different Reporting Cycle	City	Urban
WR	Molalla-Pudding	Mt. Angel	3,700	3,415	<10K	no	no	Molalla-Pudding different reporting cycle	City	Urban
NWR	Willamette Lower	Multnomah Co	735,334	813,300	MS4 Phase I	yes	yes		County	Urban Rural

DEQ Region	TMDL	DMA Name	2010 Population	2018 Population	DMA Group	2013 Survey	2018 Survey	Comment	DMA Category	Land Use
WR	Willamette Middle	Newberg	19,530	23,795	>=10K 6 measures	yes	no	Used own template Mar 2018	City	Urban
NWR	Willamette Lower	Oak Lodge Water Service District	NA	NA	MS4 Phase I	yes	yes	MS4 Phase I thru Clackamas County	Special District	Urban
WR	Willamette Middle Fork	Oakridge	3,680	3,280	<10K	yes	no	Different Reporting Cycle	City	Urban
NWR/ WR	Molalla-Pudding	OR Dept. Geology & Mineral Industries	NA	NA	NA	no	no	DMA not covered in 2014 or 2019	State	Other
NWR	Willamette Clackamas; Lower; Middle	Oregon City	31,859	34,860	MS4 Phase I	yes	yes		City	Urban
NWR/ WR	Willamette 9 Subbasins; Molalla-Pudding; Tualatin	Oregon Dept. of Ag	NA	NA	NA	no	no	DMA not covered in 2014 or 2019	State	Agriculture

DEQ Region	TMDL	DMA Name	2010 Population	2018 Population	DMA Group	2013 Survey	2018 Survey	Comment	DMA Category	Land Use
NWR/ WR	Willamette Clackamas, Coast Fork, Lower, McKenzie, Middle Fork, Middle, North Santiam, South Santiam, Upper; Molalla-Pudding	Oregon Dept. of Forestry	NA	NA	NA	no	no	DMA not covered in 2014 or 2019	State	Forestry
NWR/ WR	Willamette 9 Subbasins; Molalla-Pudding; Tualatin	Oregon Dept. of Transportation	NA	NA	MS4 Phase I	no	no	DMA not covered in 2014 or 2019	State	Other
NWR/ WR	Willamette 9 Subbasins; Molalla-Pudding; Tualatin	Oregon Dept. State Lands	NA	NA	NA	no	no	DMA not covered in 2014 or 2019	State	Other
NWR/ WR	Molalla Pudding	Oregon Marine Board	NA	NA	NA	no	no	DMA not covered in 2014 or 2019	State	Other
NWR/ WR	Willamette 9 Subbasins; Molalla-Pudding; Tualatin	Oregon State Parks	NA	NA	NA	no	no	DMA not covered in 2014 or 2019	State	Other

DEQ Region	TMDL	DMA Name	2010 Population	2018 Population	DMA Group	2013 Survey	2018 Survey	Comment	DMA Category	Land Use
NWR	Willamette Clackamas	PGE	NA	NA	NA	no	no	DMA not covered in 2014 or 2019	Special District	Other
WR	Willamette Upper	Philomath	4,310	4,715	MS4 Phase II	no	no	Different Reporting Cycle	City	Urban
WR	Willamette Middle; Yamhill	Polk County	75,403	82,100	MS4 Phase II	yes	no	Used own template Mar 2018	County	Urban Rural
NWR	Willamette Lower	Port of Portland	NA	NA	MS4 Phase I	yes	yes		Special District	Other
NWR	Willamette Lower	Portland	583,776	648,740	MS4 Phase I	yes	yes		City	Urban
WR	Willamette Middle; Molalla-Pudding	Salem	142,940	165,265	MS4 Phase I	no	no	Molalla-Pudding different reporting cycle	City	Urban
NWR	Willamette Clackamas	Sandy	9,570	10,990	<10K	yes	yes		City	Urban
WR	South Santiam	Scio	710	920	<10K	no	yes	DMA not covered in this report	City	Urban

DEQ Region	TMDL	DMA Name	2010 Population	2018 Population	DMA Group	2013 Survey	2018 Survey	Comment	DMA Category	Land Use
WR	Molalla-Pudding	Scotts Mills	300	375	<10K	no	no	Molalla-Pudding different reporting cycle	City	Urban
WR	Yamhill	Sheridan	5,620	6,190	< 10K	no	no	No reporting required	City	Urban
WR	Molalla-Pudding	Silverton	7,980	10,325	<10K	no	no	Molalla-Pudding different reporting cycle	City	Urban
WR	South Santiam	Sodaville	290	345	<10K	no	yes		City	Urban
WR	Willamette McKenzie, Upper	Springfield	54,720	60,865	MS4 Phase II	no	no	Different Reporting Cycle	City	Urban
WR	Willamette Middle	St Paul	400	435	<10K	yes	yes		City	Urban
WR	Willamette Middle, North Santiam	Stayton	7,300	7,810	<10K	no	yes		City	Urban
WR	Willamette Middle	Sublimity	2,160	2,890	<10K	yes	yes		City	Urban

DEQ Region	TMDL	DMA Name	2010 Population	2018 Population	DMA Group	2013 Survey	2018 Survey	Comment	DMA Category	Land Use
NWR	Tualatin	Surface Water Management Agency of Clackamas County – Water Environment Services	NA	NA	NA	no	no	Different reporting Cycle	County	Urban Rural
WR	Willamette South Santiam	Sweet Home	8,330	9,225	<10K	yes	no		City	Urban
WR	Willamette Upper	Tangent	920	1,250	<10K	no	yes		City	Urban
NWR	Tualatin	Tualatin Irrigation District	NA	NA	NA	no	no	Different reporting Cycle	Water Conveyance	Urban Rural
WR	Willamette Middle	Turner	1,480	2,085	MS4 Phase II	no	yes		City	Urban
NWR/ WR	Molalla-Pudding; Tualatin	US Fish & Wildlife Service	NA	NA	NA	no	no	DMA not covered in 2014 or 2019	Federal	Forestry
NWR/ WR	Willamette 9 Subbasins; Molalla-Pudding	US Forest Service	NA	NA	NA	no	no	DMA not covered in 2014 or 2019	Federal	Forestry

DEQ Region	TMDL	DMA Name	2010 Population	2018 Population	DMA Group	2013 Survey	2018 Survey	Comment	DMA Category	Land Use
WR	Willamette Upper	Veneta	3,480	4,790	<10K	yes	yes		City	Urban
NWR	Tualatin	Washington County	529,710	606,280	MS4 Phase I	yes	yes	MS4 Phase I thru CWS	County	Urban Rural
WR	South Santiam	Waterloo	240	235	<10K	no	yes		City	Urban
WR	Willamette Middle	West Labish Water Control District	NA	NA	NA	no	no	DMA not covered in 2014 or 2019	Irrigation District	Agriculture
NWR	Willamette Lower	West Linn	25109	25,830	MS4 Phase I	yes	yes		City	Urban
WR	Willamette Middle Fork	Westfir	330	260	<10K	no	no	Different Reporting Cycle	City	Urban
WR	Yamhill	Willamina	1,840	2,160	< 10K	no	no	No reporting required	City	Urban
NWR	Willamette Middle	Wilsonville	19,509	25,250	MS4 Phase I	yes	yes		City	Urban

DEQ Region	TMDL	DMA Name	2010 Population	2018 Population	DMA Group	2013 Survey	2018 Survey	Comment	DMA Category	Land Use
NWR	Willamette Lower	Wood Village	3,878	3,920	MS4 Phase II	yes	yes		City	Urban
WR	Molalla-Pudding	Woodburn	21,560	24,760	>=10K 6 measures	no	no	Molalla-Pudding different reporting cycle	City	Urban
WR	Yamhill	Yamhill	820	1,090	< 10K	no	no	No reporting required	City	Urban
WR	Yamhill	Yamhill County	___	107,415	>=10K 6 measures	no	no	No reporting required	County	Urban Rural

Appendix E: Willamette Basin 2018-2023 TMDL implementation review recommendations matrix for tracking cycle three of TMDL implementation

To be filled out by DEQ over next five years.

Task	Year 2020	Year 2021	Year 2022	Year 2023	Status of [insert month] 2024
1. Improve internal communication for stormwater programs					
1.1 Conduct one cross program training with one of the DEQ stormwater or other programs per year (401, MS4 I & II, UIC, Div 33, 1200C/Z, CWSRF, Drinking Water)					
1.2. Promote the use of the Stormwater integration group training modules for new employee on-boarding					
1.3. Share 2019 report results with DMAs and other DEQ basin coordinators					
2. Provide DMA technical assistance					
2.1. Conduct 1 workshop focused on population ≥ to 10,000					

Task	Year 2020	Year 2021	Year 2022	Year 2023	Status of [insert month] 2024
2.2. Provide one-on-one assistance, as needed, for new DMA TMDL contacts as a result of employee transition					
2.3. Collaborate with DEQ CWSRF or MS4 Phase I staff to host workshop focused on nonpoint source funding and BMP effectiveness					
2.4. Share outreach and education quantitative results for BMPs with DMAs; Utilize MS4 benchmark analysis data for MP effectiveness					.
2.5. Conduct 1 to 2 workshops per/year					
3. Partner to achieve TMDL implementation reporting tracking					
3.1. Maintain DMA annual reporting goal and certification of 100%					
3.2. Load DMA reporting data into ACES and EDMS					
3.3. Actively participate in EDMS to sustain TMDL implementation tracking					
3.4. Align EDMS tracking measures with EPA NPS annual report					

Task	Year 2020	Year 2021	Year 2022	Year 2023	Status of [insert month] 2024
4. Water quality, BMPs, and riparian Monitoring & Evaluation for urban/rural DMAs					
4.1. Basin Coordinators continue coordinating with DEQ Headquarters to implement riparian corridor evaluation					
4.2. DEQ Water Quality Status and Trends reports					
4.3. Partner to achieve effectiveness monitoring for riparian restoration; stormwater strategies					
4.4. Increase linear feet of riparian restoration by 20%					
4.5. Increase post-construction by 15%					
5. Update five-year survey for 2024					
5.1. Incorporate control measures and strategies being implemented and not included in previous survey					
5.2. Include quantitative measures for outreach/education strategies					

Appendix F: BMP Pollutant Removal Percentages

This section is a summary of the pollutant removal efficiencies for urban BMPs based on extensive third party monitoring data from a literature search. There are many other factors that affect the performance of BMPs that are not included in this section and should be considered when designing a practice. Some of these factors include the following:

- Geographic location, climate, water table;
- Design criteria, water table, pollutant type and concentration, soil; and
- Practice operation and maintenance

The following were used for the literature search to compile the table data:

- Chesapeake Bay Part 1: Removal of Urban Toxic Contaminants
- International Stormwater Best Management Practices Database
- National Pollutant Removal Performance Database for Stormwater Treatment Practices
- Minnesota Information on Pollutant Removal by BMPs
- EPA Nutrient Policy Data BMP Treatment Clearinghouse
- New Jersey BMP Practices Manual Chapter 4 Pollutant Removal

Refer to **Appendix B** for the web links.

Table 3. Pollutant Removal Percentages for Urban Best Management Practices

Practice	Lead	Iron
Bioretention	76-100	0-25
Wet Pond	50-75	50-75
Wetland	26-50	50-75
Sand Filter	76-100	50-75
Permeable Pavement	76-100	----
Grass Channel	0-25	0-25
Grass Filter	0-25	0-25
Dry Pond	26-50	----

Table 4. Pollutant Removal Percentages for Urban Best Management Practices

Practice	Total Suspended Solids	Total Phosphorous	Total Nitrate	Metals	Bacteria	Hydrocarbons
Infiltration no underdrain, for volume infiltrated	100	100	100	100	100	100
Biofiltration and tree trench/tree box with underdrain	80	---	50	35	95	80
Sand filter	85	50	35	50	80	80
Iron enhanced sand filter	85	77	35	50	80	80
Dry swale	68	---	35	0	80	80
Wet swale	68	0	---	---	0	---
Constructed wet ponds	84	50	30	70	60	80
Constructed wetlands	73	38	30	70	60	80
Permeable pavement	74	45	35	---	---	---
Green roofs	85	0	---	---	---	---
Street sweeping	15.5	---	---	---	---	---

Appendix G: Summary of Water Quality Trends for Willamette Subbasins

The figures represented in the following sections depict water quality trends based on observations at a total of 2,199 monitoring stations across the Willamette Basin (see Figure 1). Note that trend analyses require significantly more data than assessing whether water quality is attaining or not attaining water quality standards. Therefore, DEQ was unable to assess trending status for many stations because of insufficient data. The insufficient data is not displayed in the figures below.

DEQ retrieved water quality data from DEQ's AWQMS Database, which includes data submitted to DEQ from many other organizations. Data were also retrieved from the U.S. Environmental Protection Agency (WQX/Storet) database via the Water Quality Portal. The analysis included data collected between 1999 and 2018 within the Willamette Basin. Parameters included in the query were temperature, pH, dissolved oxygen, Escherichia coli, phosphate-phosphorus, and total suspended solids.

DEQ calculated trends using a Seasonal Kendall test (Hirsch et al. 1982, Hirsch and Slack 1984, and Helsel and Hirsch 2002). A Seasonal Kendall test removes the influence of seasonal fluctuations by calculating a Mann Kendall test (Mann 1945) separately on each season and then comparing the slopes. A significant positive, negative, or steady trend was determined across all seasons and years when the significance of the seasonal slopes had a two-tailed $p \leq 0.20$. A steady trend had a slope equal to zero. Prior to applying the Seasonal Kendall test, data were grouped into monthly "seasons." Multiple observations within any given month were collapsed into a single value using the median. DEQ conducted a trend assessment at a monitoring station if data were available in a minimum of eight different years in the period from 1999 to 2018. Data must have been collected with an underlying regularity (e.g. samples were taken in the same months for at least eight years).

The order of the figures below generally flow downstream from the southern end of the basin to the north.

For details about the status and trends of water quality in the Willamette Basin, access the Water Quality Status and Trends Analysis at:
https://www.oregon.gov/deq/wq/programs/Pages/wqstatustrends.aspx

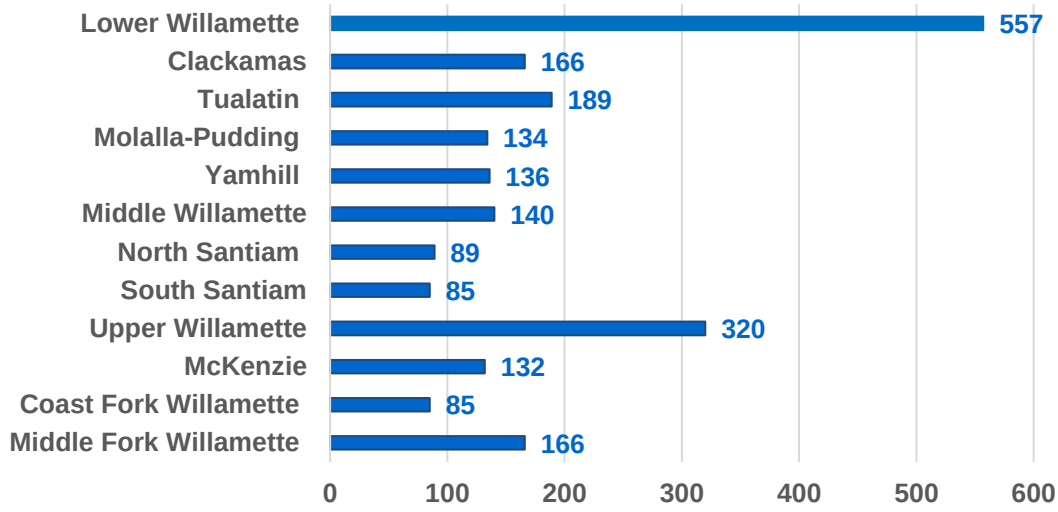

Figure 1: Number of Monitoring Stations by Subbasin (Total = 2,199)

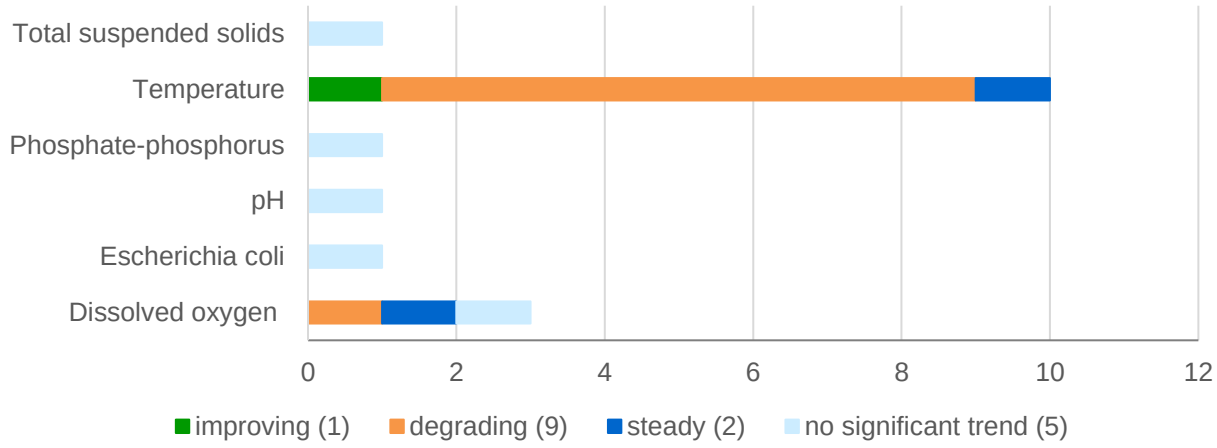

Figure 2: Middle Fork Willamette Subbasin Water Quality Trends (330 trend analyses at 166 stations). The number of stations that had monitoring data that were insufficient for trend analysis included: Total suspended solids (48); Temperature (101); Phosphate- phosphorous (47); pH (41); Escheria coli (19); Dissolved oxygen (57).

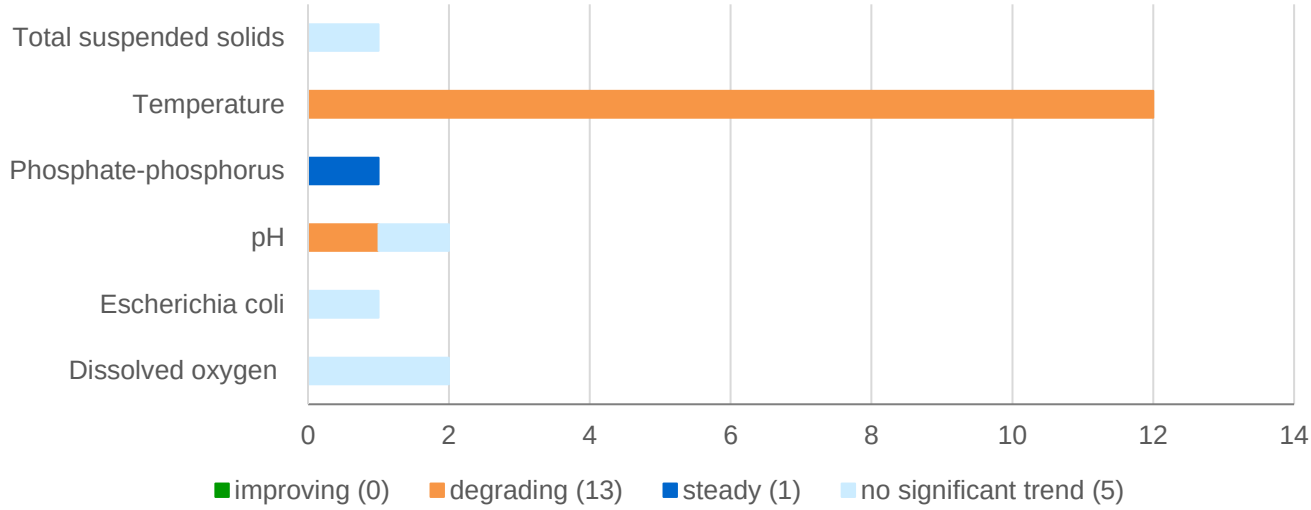

Figure 3: Coast Fork Willamette River Subbasin Water Quality Trends (221 trend analyses at 85 stations). The number of stations that had monitoring data that were insufficient for trend analysis included: Total suspended solids (43); Temperature (28); Phosphate- phosphorous (33); pH (36); Escheria coli (18); Dissolved oxygen (44).

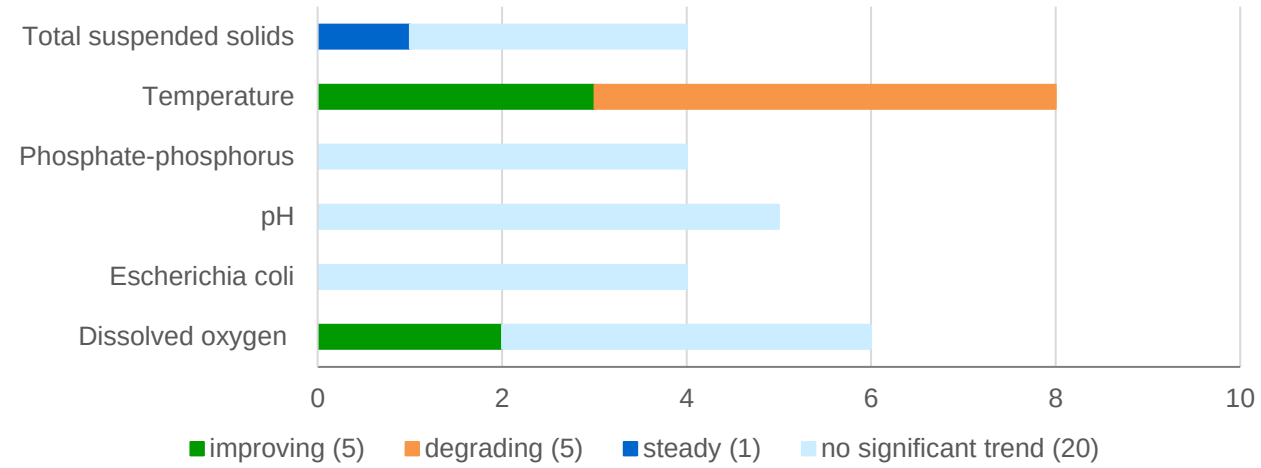

Figure 4: McKenzie River Subbasin Water Quality Trends (248 trend analyses at 132 stations). The number of stations that had monitoring data that were insufficient for analysis included: Total suspended solids (26); Temperature (91); Phosphate- phosphorous (27); pH (40); Escheria coli (3); Dissolved oxygen (30).

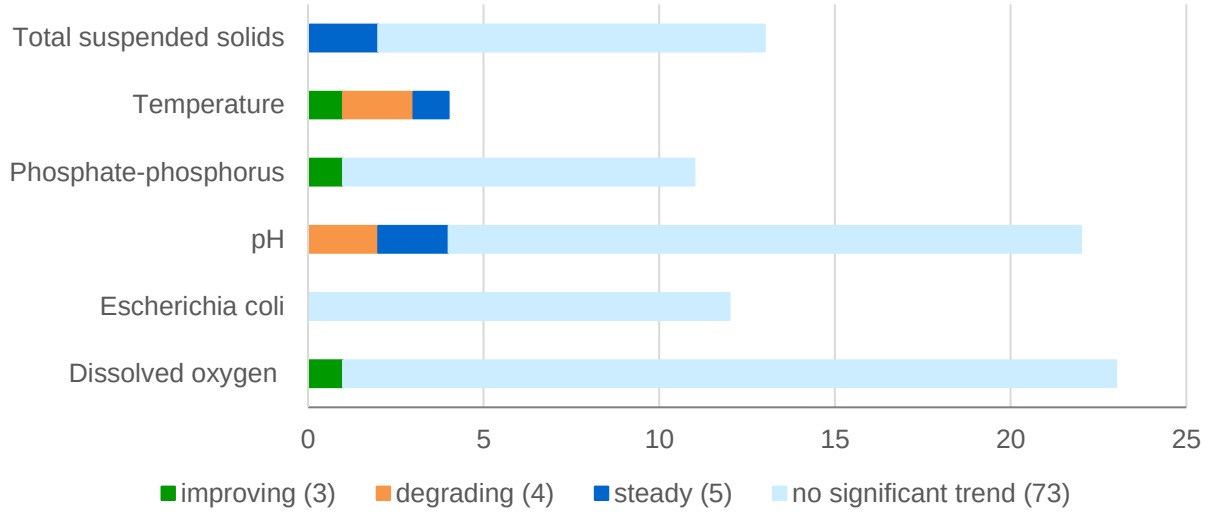

Figure 5: Upper Willamette River Subbasin Water Quality Trends (845 trending analyses at 320 stations). The number of stations that had monitoring data that were insufficient for trend analysis included: Total suspended solids (133); Temperature (118); Phosphate- phosphorous (122); pH (147); Escheria coli (89); Dissolved oxygen (151).

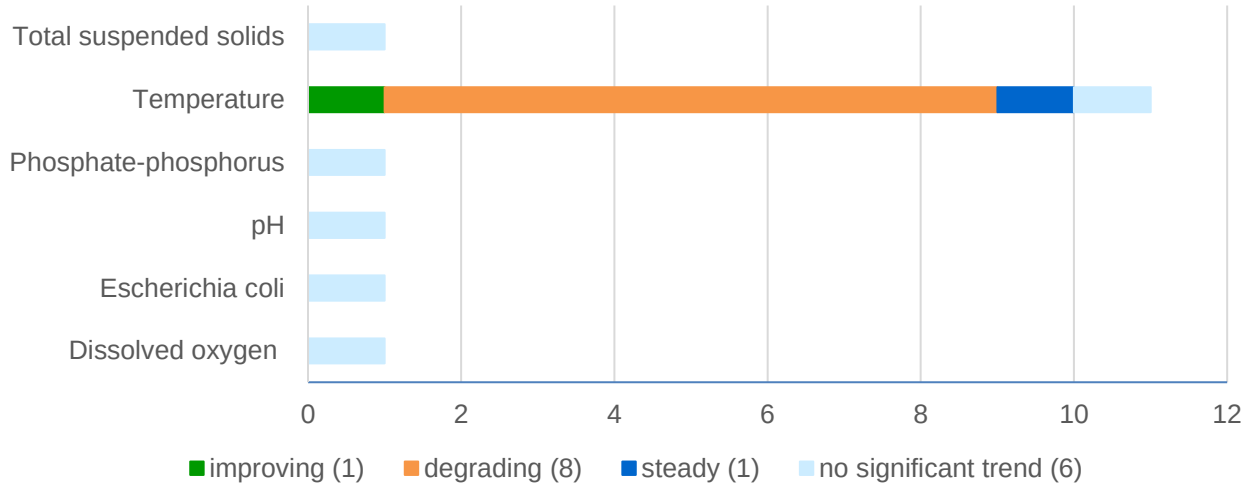

Figure 6: South Santiam River Subbasin Water Quality Trends (183 trending analyses at 85 stations). The number of stations that had monitoring data that were insufficient for trend analysis included: Total suspended solids (32); Temperature (27); Phosphate- phosphorous (37); pH (29); Escheria coli (12); Dissolved oxygen (30).

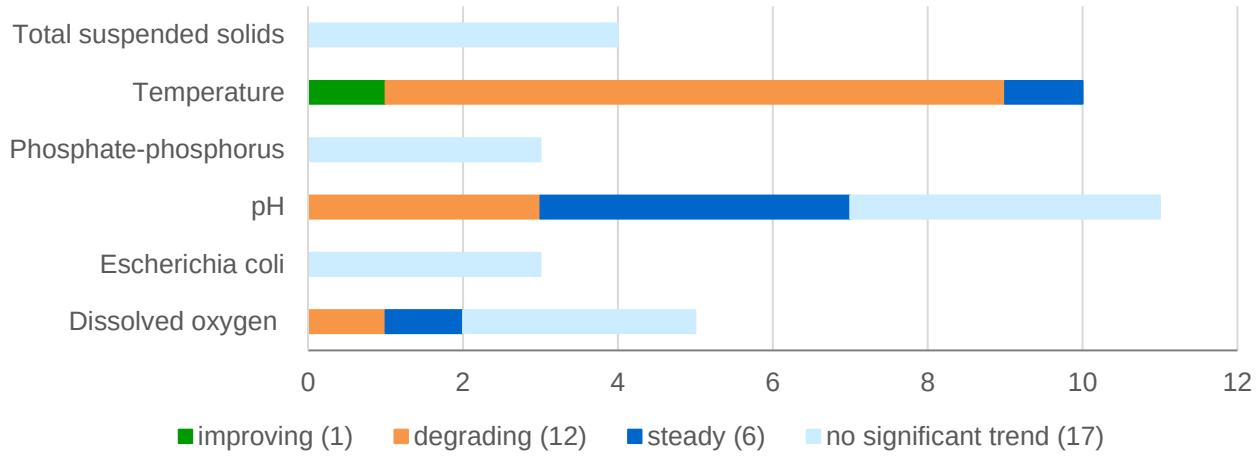

Figure 7: North Santiam River Subbasin Water Quality Trends (188 trending analyses at 89 stations). The number of stations that had monitoring data that were insufficient for trend analysis included: Total suspended solids (12); Temperature (48); Phosphate- phosphorous (21); pH (32); Escheria coli (11); Dissolved oxygen (28).

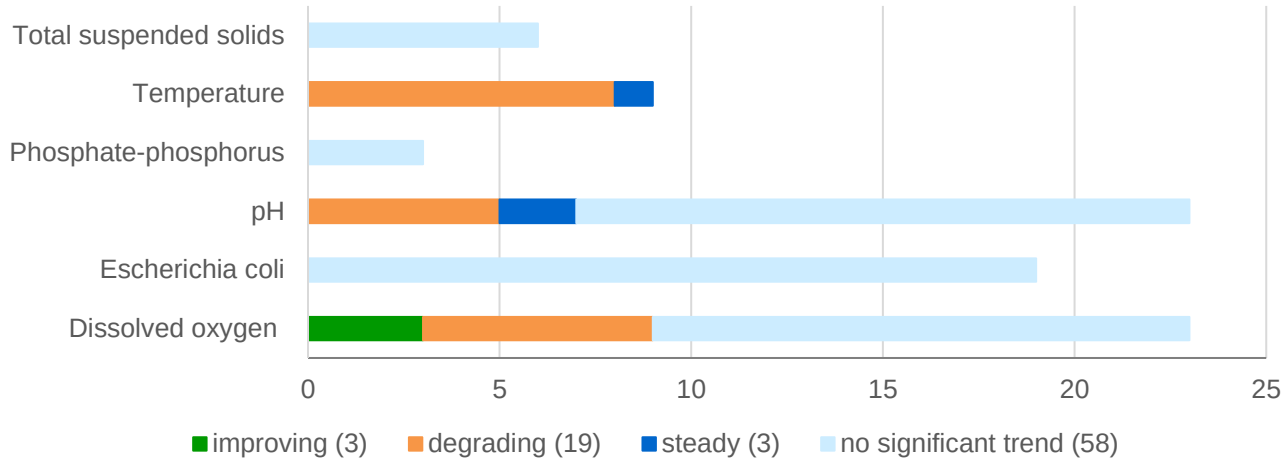

Figure 8: Middle Willamette River Subbasin Water Quality Trends (397 trending analyses at 140 stations). The number of stations that had monitoring data that were insufficient for trend analysis included: Total suspended solids (49); Temperature (29); Phosphate- phosphorous (31); pH (81); Escheria coli (48); Dissolved oxygen (76).

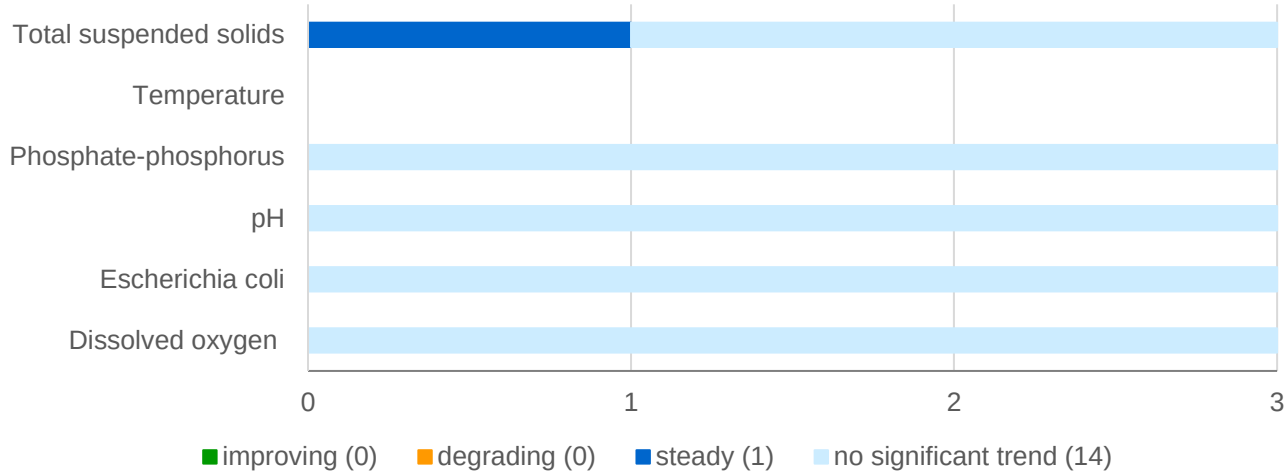

Figure 9: Yamhill River Subbasin Water Quality Trends (412 trending analyses at 136 stations). The number of stations that had monitoring data that were insufficient for trend analysis included: Total suspended solids (51); Temperature (48); Phosphate- phosphorous (48); pH (80); Escheria coli (69); Dissolved oxygen (101).

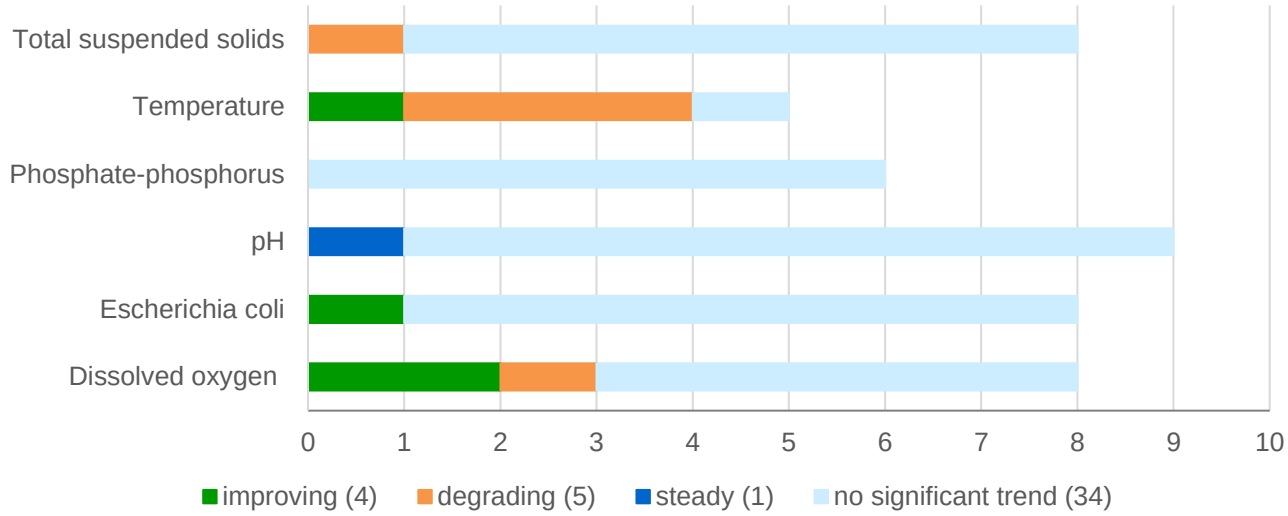

Figure 10: Molalla-Pudding River Subbasin Water Quality Trends (436 trending analyses at 134 stations). The number of stations that had monitoring data that were insufficient for trend analysis included: Total suspended solids (46); Temperature (63); Phosphate- phosphorous (59); pH (90); Escheria coli (53); Dissolved oxygen (81).

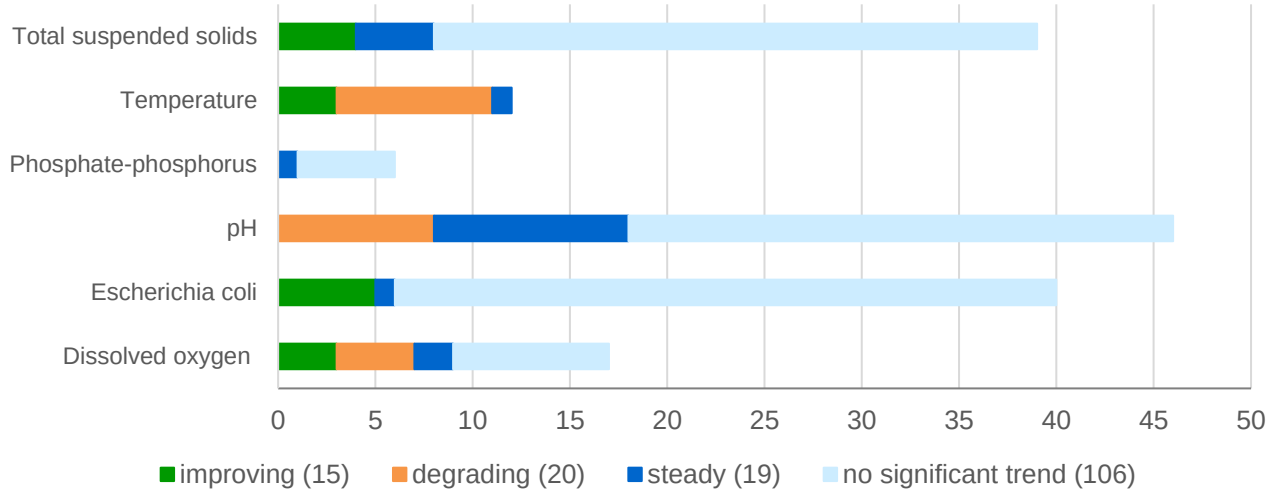

Figure 11: Tualatin River Subbasin Water Quality Trends (563 trending analyses at 189 stations). The number of stations that had monitoring data that were insufficient for trend analysis included: Total suspended solids (60); Temperature (31); Phosphate- phosphorous (38); pH (118); Escheria coli (79); Dissolved oxygen (77).

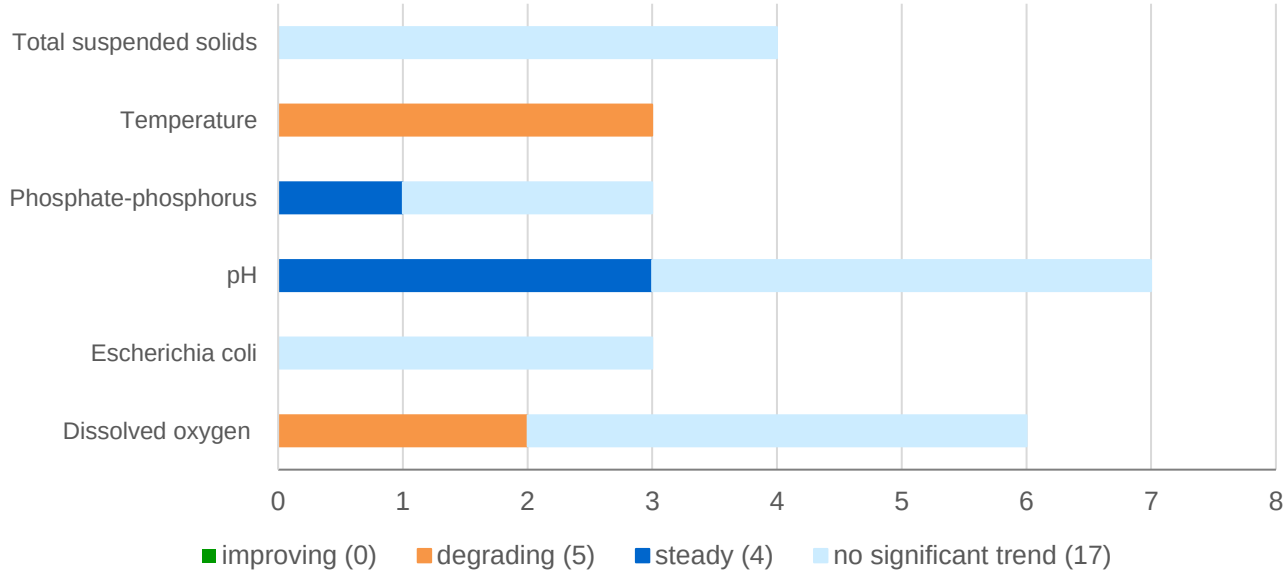

Figure 12: Clackamas River Subbasin Water Quality Trends (379 trend analyses at 166 stations). The number of stations that had monitoring data that were insufficient for trend analysis included: Total suspended solids (58); Temperature (58); Phosphate- phosphorous (48); pH (94); Escheria coli (29); Dissolved oxygen (66).

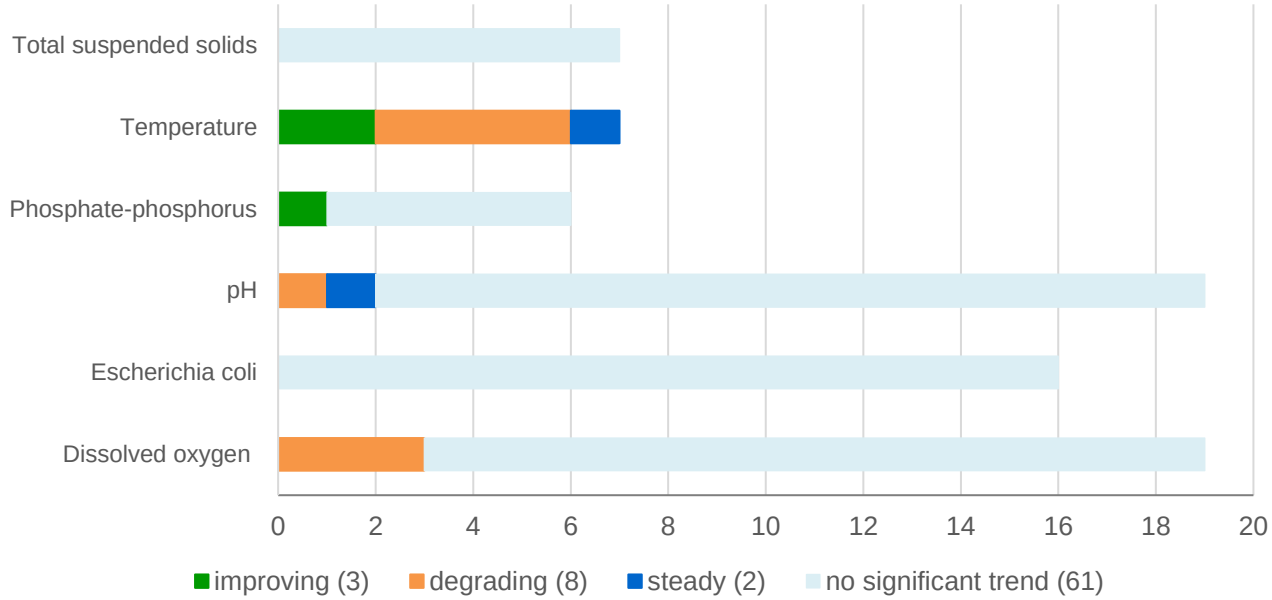

Figure 13: Lower Willamette River Subbasin Water Quality Trends (1,315 trend analyses at 557 stations). The number of stations that had monitoring data that were insufficient for trend analysis included: Total suspended solids (127); Temperature (63); Phosphate- phosphorous (41); pH (391); Escheria coli (291); Dissolved oxygen (328).

Appendix H: Willamette Basin 2013-2018 TMDL implementation review recommendations matrix for tracking cycle two of TMDL implementation

*Note: Carryover task to **Appendix C**

Task	Year 2014	Year 2015	Year 2016	Year 2017	Status as of June 2018
1. Develop guidance for minimum TMDL implementation plan strategies and adequate non-MS4 stormwater and riparian management programs					
1.1. Train DEQ basin coordinators on stormwater regulation and best pratices*		√		√	Stormwater Integration group developed and distributed an iLearn stormwater training in March 2017. Storm Water Integration Group posted revised Guidance for Including Post-Construction Elements in TMDL Implementation Plans to DEQ TMDL Implementation webpage update in December 2016.
1.2. Document key stormwater strategies for non-MS4 DMAs		√		√	Post-Construction Stormwater Manual and Western Region LID guidance cover this (**Appendix A**) Stormwater focus of April 2017 workshop DMA technical workshop June 2018 DMA 5 Year review survey / template outlines strategies

Task	Year 2014	Year 2015	Year 2016	Year 2017	Status as of June 2018
1.3. Adapt riparian buffer widths proposed for agriculture and forestry to urban DMAs		√			New model that quantified existing shade percentage and compared to percent effective potential shade along streams in upper Willamette. (June 2016 update). No update 2017, 2018.
1.4. Inventory DMAs with riparian buffer ordinances			√		Drinking water program has done this for coastal basins, but not in Willamette Basin. (June 2016 - update)
				√	Riparian buffers planned focus of June 2017 DMA technical workshop.
					June 2018 DMA 5 Year review survey / template contains questions for ordinances.
1.5. Develop list of required strategies for implementation plans		√			October 2015 workshop coordinated by Watershed Coordination Team. Focused on milestones and timelines in implementation plans.
			√		Second and third tier priorities included recommending specific BMPs to meet load allocations and updating 2007 Implementation Plan Guidance (June 2016 update)
			√		Five-year Review Report Template (2015) updated to include "Top 8" Implementation Strategies (June 2016 update).
			√		Watershed Coordination Team 2016 priority was coordinating an internal monitoring proposal review and selection process.
					Five-year Review Survey Template (2018) updated to include MS4 Phase II 6 measures and riparian measures.

Task	Year 2014	Year 2015	Year 2016	Year 2017	Status as of June 2018
2. Increase Technical Assistance in bacteria and erosion control strategies					
Inventory bacteria Microbial Source Tracking (MST) and ID projects			√		One completed 319 grant to Clackamas Water Providers (Feb. 2016) for a Pilot Septic System Monitoring Study combining GIS mapping, E. coli sampling, and "qPCR" technique.
2.1. Review results of MST projects			√		Clackamas Water Provider study successfully identified widespread human markers in samples, but could not quantify domestic animal sources.
2.2. Develop guidance or lessons learned from MST projects	-	-	-	-	No action.
2.3. Compile model language from DLCD on post-construction stormwater	√				Post-Cosntruction Storwwater Manual and Low Impact Development guidance have model language. June 2018 Five-year Review Survey Template (2018) updated to include post-construction extent by DMAs
2.4. Increase TA to and oversight of smaller municipalities' implementation of 1200C permits		√	√		Northwest Region stormwater staff hired in 2015 (June 2016 update) Significantly increased stormwater complaint response and enforcement in NWR in 2016.
2.5. In urban watersheds where groups are monitoring bacteria, relate bacteria reduction BMPs in plans/permits to data		√			Annual TMDL Report review for Clackamas County 2016 compared 15/16 data collected for MS4 with pre-TMDL bacteria measurements**.**

Task	Year 2014	Year 2015	Year 2016	Year 2017	Status as of June 2018
2.6. Provide at least one technical-assistance workshop per year by region or DMA category*		√	√	√	Four workshops held between 2015 and June 2016. Workshops: April 12, 2017; June 7, 2017; March 22, 2018 (webinar and workshop) & October 10, 2018
3. Partner to achieve effectiveness monitoring.					
3.1. Inventory who is monitoring what and where in urban areas*					Five-year Review Survey Template (2018) updated to include MS4 monitoring
3.2. Ask ACWA to host a meeting and share their data.					No action
3.3. Inventory 319 and drinking water and clean water SRF funds used in urban areas and types of projects, referencing 319 data in OWEB database					2018 urban 319 projects: City of Scappoose stormwater plan
3.4. Train DEQ basin coordinators in use of social marketing for establishing and confirming effective outreach and education		√		√	Several basin coordinators attended Science Talk Northwest Conference
3.5. Update template for 5-yr reviews to include monitoring and tracking of outreach/education measurable results		√	√		Western Region updated template in 2015 (June 2016 update) Five-year Review Survey Template (2018) continued to include outreach/education. Quantitative results queried for DMAs.

Task	Year 2014	Year 2015	Year 2016	Year 2017	Status as of June 2018
4. Improve internal communication and reporting					
4.1. Survey MS4 DMAs to determine need for combined MS4/TMDL annual reporting form		√	√	√	Western Region did informal surveys at DMA meetings. DMAs want combined reporting. Confirmed preference for combined report timing with Clackamas County, Multnomah County, and other MS4 DMAs in Lower Willamette. (June 2016 and 2017 update) Combined reporting and timing. No form needed.
4.2. Develop combined MS4/TMDL annual reporting form, as appropriate		√			Not needed based on internal and external discussion.
4.3. Develop checklist for internal consultation for TMDL Implementation plan reviews		√		√	MS4 Coordinator and basin coordinators both copied on MS4 submittals. Checklist for TMDL nonpoint source completed in 2008 and revised accordingly in 2017.
5. Review DMA assignments					
5.1. Determine riparian miles within smaller DMAs e.g. <10,000 population		√			Five-year Review Survey Template (2018) updated to collect riparian restoration miles
5.2. Confer on water quality impacts of not requiring TMDL implementation plans and reporting for smaller DMAs			√		Planning efforts scalable to population size and density.