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Technical Memorandum

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Technical Memorandum

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List of Abbreviations

µg	microgram(s)
ACWA	Association of Clean Water Agencies
ATSDR	Agency for Toxic Substances and Disease Registry
BMP	best management practice
CIP	capital improvement project
City	City of West Linn
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DEQ	(Oregon) Department of Environmental Quality
DHS	(Oregon) Department of Human Services
DO	dissolved oxygen
ft^2	square foot/feet
HAZWOPER	Hazardous Waste Operations and Emergency Response
IPM	Integrated Pest Management
kg	kilogram(s)
L	liter(s)
LID	low-impact development
MEP	maximum extent practicable
mg	milligram(s)
MS4	municipal separate storm sewer system
ng	nanogram(s)
NPDES	National Pollutant Discharge Elimination System
OAR	Oregon Administrative Rules
OC	organochlorine
OSHA	Occupational Safety and Health Administration
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCP	pentachlorophenol
RM	river mile
SOP	standard operating procedure
SWMP	Stormwater Management Plan
TM	technical memorandum
TMDL	total maximum daily load
TSS	total suspended solids
UIC	underground injection control
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

Section 1: Introduction

This technical memorandum (TM) provides an evaluation of 303(d)-listed pollutant parameters as they relate to discharges from the City of West Linn's (City) municipal separate storm sewer system (MS4), which is regulated under a National Pollutant Discharge Elimination System (NPDES) MS4 Permit.

This TM includes the following information:

- an evaluation of the likelihood that discharges from the regulated MS4 cause or contribute to water quality degradation as related to specific 303(d) parameters
- an assessment of the effectiveness of the City's existing stormwater program practices in addressing and reducing applicable 303(d)-listed parameters
- an identification of potential stormwater management program revisions that may be considered to address and reduce the 303(d) pollutants to the maximum extent practicable (MEP)

1.1 Summary of Permit Requirements

The NPDES MS4 permits for Phase I communities require a qualitative review of the effective 303(d) list established for the jurisdiction's receiving waters. Pollutant parameters included on the 303(d) list are those that have been found to exceed water quality standards for a water body's established beneficial or designated uses.

In Oregon, the U.S. Environmental Protection Agency (USEPA) has delegated authority to the Oregon Department of Environmental Quality (DEQ) to conduct water quality assessments to determine the status of water bodies in the state with respect to established water standards. DEQ conducts the assessments approximately every 2 years and publishes findings, including the effective 303(d) list.

Receiving waters that are placed on the 303(d) list do not yet have an established total maximum daily load (TMDL), including load or wasteload allocations for the pollutant parameters. TMDLs established for specific pollutant parameters in the Willamette River and Tualatin River watersheds cover the drainage basins in the city. The City is addressing requirements for TMDL parameters through a separate quantitative evaluation of pollutant loads and pollutant load reduction, which is not included in this document.

West Linn is a co-permittee on Clackamas County's NPDES MS4 permit. Specific permit requirements for the 303(d) evaluation are listed in Schedule D.2 of the permit, as follows:

The co-permittee must:

i. Review the applicable pollutants that are on the 2004/2006 303(d) list, or the most recent USEPA list if approved within three years of the issuance date of this permit, that are relevant to the co-permittee's MS4 discharges by November 1, 2015. Based on a review of the most current 303(d) list, evaluate whether there is a reasonable likelihood for stormwater from the MS4 to cause or contribute to water quality degradation of receiving waters.

ii. Evaluate whether the BMPs in the existing SWMP are effective in reducing the 303(d) pollutants. If the co-permittee determines that the BMPs in the existing SWMP are ineffective in reducing the applicable 303(d) pollutants, the co-permittee must describe how the SWMP will be modified or updated to address and reduce these pollutants to the MEP.

iii. By November 1, 2015, submit a report summarizing the results of the review and evaluation, and that identifies any proposed modifications or updates to the SWMP that are necessary to reduce applicable 303(d) pollutants to the MEP.

The City submitted a 303(d) evaluation with its NPDES MS4 Interim Evaluation Report in 2006, and that evaluation has been referenced in developing this TM.

1.2 Summary of TM Organization

The purpose of this TM is to fulfill the NPDES permit requirements for a 303(d) evaluation as listed above.

Section 2 summarizes the 303(d)-listed parameters applicable to the City. Section 3 discusses each parameter or parameter category in additional detail, including:

- a summary of the relationship between regulated MS4 discharge and the listed parameter(s)
- an evaluation of the City's current best management practices (BMPs) to address the listed parameter(s)

Section 4 discusses potential Stormwater Management Plan (SWMP) adjustments for consideration in order to further address 303(d) parameters during the City's permit renewal effort in 2016.

1.3 West Linn Stormwater Management Plan

The City's 2012 SWMP outlines stormwater program activities with respect to NPDES MS4 permit compliance. The SWMP includes BMPs with measurable goals and tracking measures that the City currently implements, or plans to implement within the current permit cycle, to address water quality in MS4 discharges. BMPs are generally implemented citywide across the whole permit area, which for West Linn is defined as all area within the city limits.

The underlying compliance standard for the NPDES MS4 permit and the SWMP under federal and Oregon law is that permittees are required to implement controls to reduce the discharge of the pollutants to the MEP. This means that the City is required to implement *reasonable and available* controls to reduce the discharge of pollutants. Neither USEPA nor DEQ provides a precise definition of MEP, acknowledging that MEP and the resulting activities will be different for each permittee based on a wide range of factors including watershed planning; local concerns; climate; finances; and beneficial uses of receiving water, hydrology, and operations capacity of each municipality.

Since the development of the 2012 SWMP, the City has been continuously evaluating and adaptively managing its stormwater program based on new data, technology, and review of BMPs. In this way, the current SWMPs reflect the City's best professional judgment regarding resource allocation and optimization to reduce or eliminate the discharge of stormwater pollutants from the regulated MS4 to the MEP.

The City's 2012 SWMP and associated BMPs are organized into eight major program elements corresponding to the MS4 NPDES permit. SWMP program elements and BMPs are listed in Table 1 below. Section 3 of this TM identifies BMPs in the 2012 SWMP that are effective in addressing the 303(d)-listed pollutants. While the BMPs are not numbered in the actual SWMP document, they have been numbered here to facilitate reference to individual BMPs throughout this document.

Table 1. West Linn SWMP Summary		
SWMP program element*	BMPs	
1. Illicit Discharge Detection and Elimination	1-1	Implement the Illicit Discharge Elimination Program
	1-2	Conduct Annual Dry Weather Field Screening
	1-3	Implement the Spill Response Program
2. Industrial and Commercial Facilities	2-1	Screen Existing and New Industrial Facilities
	2-2	Conduct Priority Facility Inspections
3. Construction Site Runoff Control	3-1	Implement the Erosion Control Manual
	3-2	Provide Educational Information to Construction Site Operators
	3-3	Conduct Erosion Control Inspections and Enforcement
4. Public Education and Outreach	4-1	Provide Public Education and Outreach Materials regarding Stormwater Management
	4-2	Implement a Pet Waste Program
	4-3	Participate in a Public Education Effectiveness Evaluation
	4-4	Ensure Staff Training for Pest Management
	4-5	Ensure Staff Training in Spill Response
	4-6	Promote Staff Education Related to Environmentally Friendly Solutions
5. Public Involvement	5-1	Provide for Public Participation with Submittals
6. Post-Construction Site Runoff Control	6-1	Implement Community Development Code and Public Works Design Standards for Stormwater Treatment
	6-2	Review and Update Applicable Code and Development Standards related to Stormwater Control
7. Pollution Prevention for Municipal Operations	7-1	Conduct Street Area Repair
	7-2	Maintain Public Streets
	7-3	Implement an Integrated Pest Management Program
	7-4	Implement a Program to Reduce the Impact of Stormwater Runoff from Municipal Facilities
	7-5	Control Infiltration and Cross Connections to the Stormwater Conveyance System
	7-6	Conduct Master Planning for Stormwater Quality Improvement
8. Stormwater Management Facilities Operations and Maintenance Activities	8-1	Conduct Stormwater Conveyance System Cleaning and Maintenance
	8-2	Conduct Catch Basin Cleaning and Maintenance
	8-3	Public Structural Control Facility Cleaning and Maintenance
	8-4	Private Water Quality Facility Maintenance Program

* *As noted above, the BMPs are not numbered in the actual SWMP document, but have been numbered here to facilitate references to individual BMPs in this document.*

Section 2: West Linn 303(d) Water Bodies and Parameters

Per the NPDES MS4 permit, the City must review the 2004/2006 303(d) list unless a more recent list has been approved by USEPA within 3 years of the issuance date of the permit. DEQ's 2010 303(d) list was submitted to USEPA in 2011 and finalized and approved by USEPA in December 2012. Therefore, the 2010 303(d) list is the effective 303(d) list for this evaluation. Applicable 303(d) parameters for West Linn pertain to the Tualatin River, Lower Willamette River, and Middle Willamette River subbasins, including tributaries. The applicable 303(d) parameters are identified in Table 2.

Table 2. 2010 303(d) Parameters Applicable to West Linn			
Water body	River mile	Season	Parameter
Lower Willamette subbasin			
Willamette River	0–54.8	Summer	Chlorophyll a*
Willamette River	0–24.8	Year round	Aldrin
Willamette River	0–24.8	Year round	Biological criteria
Willamette River	0–24.8	Year round	Chlordane*
Willamette River	0–24.8	Year round	Cyanide*
Willamette River	0–24.8	Year round	DDT and DDT metabolite (DDE)
Willamette River	0–24.8	Year round	Dieldrin
Willamette River	0–24.8	Year round	Hexachlorobenzene*
Willamette River	0–24.8	Year round	Iron
Willamette River	0–24.8	Year round	Manganese
Willamette River	0–24.8	Year round	PCBs
Willamette River	0–24.8	Year round	Pentachlorophenol
Willamette River	0–24.8	Year round	Polynuclear aromatic hydrocarbons (PAH)
Middle Willamette subbasin			
Willamette River	24.8–54.8	Year round	Aldrin
Willamette River	24.8–54.8	Year round	Biological criteria
Willamette River	24.8–54.8	Year round	DDT and DDT metabolite (DDE)
Willamette River	24.8–54.8	Year round	Dieldrin
Willamette River	24.8–54.8	Year round	Iron
Willamette River	24.8–54.8	Year round	PCBs
Tualatin River Subbasin			
Tualatin River	0–80.7	Year round	Biological criteria*
Tualatin River	0–80.7	Year round	Iron
Tualatin River	0–80.7	Year round	Manganese
Tualatin River	0–62.6	January 1–May 15	Dissolved oxygen* (spawning: not less than 11.0 mg/L or 95% of saturation)

** Parameter added with the 2010 list.*

The City's MS4 area includes numerous drainage basins within the Lower Willamette, Middle Willamette, and Tualatin subbasins, which are located in the larger Willamette River and Tualatin River watersheds. While the 303(d) parameters vary between the subbasins, the City's stormwater programs and services are conducted on a citywide basis. Therefore, the 303(d) evaluation in Section 3 has been conducted for all MS4 areas within the city of West Linn.

For the purpose of this evaluation, the evaluations of aldrin, chlordane, dichlorodiphenyltrichloroethane (DDT), DDT metabolite, dieldrin, and hexachlorobenzene have been combined in Section 3.4 under the discussion for organochlorine (OC) compounds. Iron and manganese have also been grouped into a combined evaluation in Section 3.9.

Table 3. Relationship between Current BMPs and 303(d) Parameters

S = control of the source of a pollutant entering the MS4 ***T*** = control of the transport mechanism of discharge
I = indirect pollutant reduction benefits

Component	BMP	Summary of activities	Biological criteria	Dissolved oxygen	Chlorophyll a	OC pesticides				PCBs	PAHs	Cyanide	Iron and manganese
						Aldrin/Dieldrin	Chlordane	DDT and DDT metabolite	Hexachloro-benzene				
1. Illicit Discharge Detection and Elimination	1-1 Implement the Illicit Discharge Elimination Program	• Document and implement SOPs for the illicit discharge program • Remove identified illicit discharges • Track and document all identified illicit discharges and abatement measures	S	S	S	I	I	I	I	S	S	I	I
	1-2 Conduct Annual Dry Weather Field Screening	• Conduct dry weather, illicit discharge inspections annually • Develop pollutant parameter action levels to identify illicit discharges • Update mapping of outfalls including priority outfall locations	S	T	S	I	I	I	I	T	T		I
	1-3 Implement the Spill Response Program	• Coordinate emergency response with Tualatin Valley Fire and Rescue • Respond to minor spills • Track spills and response actions	S	S	S	I	I	I	I	S	S	I	I
2. Industrial and Commercial Facilities	2-1 Screen Existing and New Industrial Facilities	• Track the number of existing and new facilities subject to 1200-Z permit • Notify DEQ of businesses with potential for 1200-Z permits	I	I	I	I	I	I	I	I	I	I	I
	2-2 Conduct Priority Facility Inspections	• Inspect identified high-priority facilities once during permit period • Track and document inspections	I	S	S	I	I	I	I	S	S	I	S
3. Construction Site Runoff Control	3-1 Implement the Erosion Control Manual	• Require submittal of erosion control plans for developments greater than 1,000 ft^2 • Require a copy of all 1200-C permit applications for developments 5 acres or greater • Assess new and redevelopment applications for erosion control compliance • Track erosion control plan reviews	S	S	S	S	S	S	S	S	S	S	S
	3-2 Provide Educational Information to Construction Site Operators	• Provide education materials to construction site operators and the public	I	I	I	I	I	I	I	I	I		I
	3-3 Conduct Erosion Control Inspections and Enforcement	• Conduct initial and final inspections at construction sites • Conduct enforcement activities with published three-step process • Require disturbed areas to be permanently stabilized or revegetated prior to final inspection • Conduct at least one inspection during active construction	S	S	S	S	S	S	S	S	S		S
4. Public Education and Outreach	4-1 Provide Public Education and Outreach Materials regarding Stormwater Management	• Promote educational information on City website, newsletter, bill inserts, brochures, and radio advertisements • Contribute funding to Tualatin Basin Public Awareness Committee • Track and document outreach, coordination, and volunteer activities	I	I	I	I	I	I	I	I	I		I
	4-2 Implement a Pet Waste Program	• Monitor pet waste problem areas during routine maintenance and provide educational material in areas identified • Provide pet waste disposal materials in or near City parks	S	S	S								
	4-3 Participate in a Public Education Effectiveness Evaluation	• Participate in the joint, coordinated effort to evaluate public education effectiveness											
	4-4 Ensure Staff Training for Pest Management	• Train staff once every 2 years on application rates and techniques • Track and document training	I	I	I	S	S	S	S				
	4-5 Ensure Staff Training in Spill Response	• Provide annual OSHA HAZWOPER training for employees who participate in spill response • Track and document training	I	I	I					I	I		
	4-6 Promote Staff Education Related to Environmentally Friendly Solutions	• Conduct training for staff on stormwater management issues • Budget for staff participation and attendance at professional meetings and conferences • Coordinate with other local Phase I jurisdictions on regional water quality efforts • Track training and conference attendance	I	I	I					I	I		I

Table 3. Relationship between Current BMPs and 303(d) Parameters

S = control of the source of a pollutant entering the MS4 ***T*** = control of the transport mechanism of discharge ***I*** = indirect pollutant reduction benefits

Component	BMP	Summary of activities	Biological criteria	Dissolved oxygen	Chlorophyll a	OC pesticides				PCBs	PAHs	Cyanide	Iron and manganese
						Aldrin/Dieldrin	Chlordane	DDT and DDT metabolite	Hexachloro-benzene				
5. Public Involvement	5-1 Provide for Public Participation with Submittals	• Provide opportunity for public to comment on SWMP updates, pollutant load reduction bench-marks, monitoring plan, and annual reports											
6. Post-Construction Site Runoff Control	6-1 Implement Community Development Code and Public Works Design Standards for Stormwater Treatment	• Require stormwater treatment in conjunction with provisions outlined in City of Portland Stormwater Management Manual	S	S	T	I	I	I	I	I	I		T
	6-2 Review and Update Applicable Code and Development Standards Related to Stormwater Control	• Review stormwater design standards for compliance with permit language • Review public works development code to reduce or eliminate barriers for LID implementation • Update post-construction stormwater design standards and code	S	S	T					I	I		I
7. Pollution Prevention for Municipal Operations	7-1 Conduct Street Area Repair	• Ensure all maintenance and repair activities implement erosion and sediment control	S	S	S	S	S	S	S	S	S	S	S
	7-2 Maintain Public Streets	• Sweep each street between 3 and 6 times per year • Track and document activities	T	S/T	T	T	T	T	T	T	S/T		
	7-3 Implement an Integrated Pest Management Program	• Use Portland's Integrated Pest Management Practices as a guide for pesticide and fertilizer application • Require certification and licensing for applications in public right-of-way • Track and update modifications to IPM procedures and protocols • Track spending on management chemicals annually	I	I	I	S	S	S	S				
	7-4 Implement a Program to Reduce the Impact of Stormwater Runoff from Municipal Facilities	• Inventory municipal facilities and storage sites • Track, identify, and implement strategies to reduce impact of discharges from facilities	I	S	S					S	S		
	7-5 Control Infiltration and Cross-Connections to the Stormwater Conveyance System	• Investigate and repair sanitary lines • Review new development and redevelopment for potential cross-connections • Follow illicit discharge procedures to inspect and remove cross-connections • Track and document program activities	I	S	I					I	S	S	
	7-6 Conduct Master Planning for Stormwater Quality Improvement	• Ensure that water quality is considered during the development of flood control CIPs • Track updates and modifications to Stormwater Master Plan • Track CIPs implemented per year relative to added water quality benefit • Map location and water quality CIPs as constructed	S	S	S					I	I		I
8. Stormwater Management Facilities Operations and Maintenance Activities	8-1 Conduct Stormwater Conveyance System Cleaning and Maintenance	• Inspect manholes, storm sewers, culverts, and ditches annually • Perform cleaning and repair based on inspection information • Track and document maintenance activities	T	T	T	T	T	T	T	T	T	T	T
	8-2 Conduct Catch Basin Cleaning and Maintenance	• Inspect all public catch basins annually • Conduct cleaning, maintenance, repair, or replacement as identified during inspections • Conduct database tracking of inspection and maintenance activities	T	T	T	T	T	T	T	T	T	T	T
	8-3 Public Structural Control Facility Cleaning and Maintenance	• Inspect and maintain public structural water quality facilities annually • Track and document inspection and maintenance activities • Map facility location and drainage area after construction	T	T	T	T	T	T	T	T	T	T	T
	8-4 Private Water Quality Facility Maintenance Program	• Require new private facilities to submit maintenance agreements to the City • Require private facility owners to submit inspection and maintenance records annually • Identify ownership and responsible parties of existing private facilities that do not have mainte-nance agreements • Provide formalized facility inspection and maintenance documentation to private facility owners • Track and document maintenance agreements and annual reports received	T	T	T	T	T	T	T	T	T	T	T

Section 3: 303(d) Evaluation

This section provides an evaluation of the 303(d) parameters applicable to West Linn. The evaluation includes background and source information for each parameter and a description of the association between the parameter and MS4 discharges. In preparing the evaluation, the City's 2012 SWMP was reviewed. Table 3 summarizes the City's current BMPs and indicates how each BMP is anticipated to prevent the 303(d) parameter from discharging into receiving waters by (1) control of the ***source*** of a pollutant entering the regulated MS4, (2) control or limitation of the ***transport*** of a pollutant through the regulated MS4, or (3) general, assumed pollutant reduction through ***indirect*** means (e.g., education, behaviors, funding, etc.).

3.1 Biological Criteria

Oregon's narrative water quality standard related to biological criteria is simply stated in Oregon Administrative Rules (OAR) 340-041-0011 as follows: "Waters of the State must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities." Currently, there are no numeric criteria for biocriteria. Instead, the *Methodology for Oregon's 2010 Water Quality Report and List of Water Quality Limited Waters* (DEQ, May 2011) includes a narrative assessment protocol. The protocol is based on USEPA guidance that biological community assessments are an indicator of aquatic life beneficial-use support. The protocol uses numeric benchmarks to evaluate biological communities (macroinvertebrates), but does not relate those benchmarks to specific pollutants.

Macroinvertebrates play an important role in maintaining the health of the aquatic ecosystem by processing dead and decaying plant and animal life, and converting these in-stream nutrients into higher levels of energy in the aquatic food web. Macroinvertebrates are also good indicators of overall watershed health, because the overall water and habitat quality determines which types of macroinvertebrates can survive in a body of water.

3.1.1 Relationship between MS4 Discharges and Biological Criteria

Biological communities have long been impacted by historical land management activities, including land clearing, harvesting, mining, and development activities. Current land development activities may impact stream and habitat conditions if proper controls are not in place to limit direct impacts to the receiving waters and riparian corridors. Because biological communities are a function of overall water and habitat quality and not one specific pollutant measurement, it is difficult to point to a causative pollutant discharge or specific source (activity) that has direct impacts on biological criteria. Rather it is the cumulative impacts (both positive and negative) throughout the watershed that may be reflected in macroinvertebrate counts in downstream areas. Because biological criteria are an indicator of cumulative water and habitat quality and not a specific pollutant, no established relationship exists between MS4 discharges and direct biological criteria response.

In addition, the long-term effects of natural events, such as floods, fires, and landslides, periodically alter ecosystems, adding another evaluation variable when trying to determine what might be expected for macroinvertebrate communities.

3.1.2 Current BMPs to Address Biological Criteria

Without a specific, causative pollutant to target, it is difficult to identify specific BMPs that reduce the sources of biological criteria degradation. DEQ's biocriteria TMDL for the Umpqua Basin in southern Oregon states that "…implementing the Waste Load Allocations and Load Allocations for other water quality-limiting parameters, as well as making improvements in habitat and flow conditions, should recover biological communities to expected compositions."

As shown in Table 3, nearly all of the City's stormwater BMPs may be seen as a way to address biological criteria. BMPs that specifically address the physical structure of surface water systems include design standards and development review to require water quality treatment and flow control in private and public projects (BMPs 6-1 and 6-2), maintenance activities to remove trash and sediment from the collection and conveyance systems (BMPs 8-1 and 8-2), stormwater facility maintenance (BMPs 8-3 and 8-4), street sweeping (BMP 7-2), and illicit discharge and spill response (BMPs 1-1 through 1-3) to keep pollutants and trash out of the stream systems. Construction site erosion control standards, plan reviews, and site inspections and enforcement (BMPs 3-1 through 3-3, and BMP 6-1) also help to reduce sediment discharges to the MS4 and downstream areas.

3.2 Dissolved Oxygen

In Oregon, water quality standards for dissolved oxygen (DO) are established to ensure that water bodies provide critical habitat for salmonids and other aquatic species, particularly for spawning, rearing, and migration activities.

A number of factors contribute to fluctuating DO concentrations in a stream system including temperature, flow, organic material, and nutrients or fertilizer discharges. Elevated temperatures result in an increase in biologic activity (plant growth, respiration, and decomposition), which depletes oxygen from the system. Warmer waters also do not hold as much DO as cooler waters. Flow impacts DO levels because running or turbulent water has more exposure to and mixing with the atmosphere, and therefore more DO. Low-flow streams are typically warmer, causing further reduction in DO. The discharge of oxygen-demanding organic waste can deplete DO concentrations through the process of decomposition. Animal waste (including that from wildlife and domestic pets) and nutrients (i.e., fertilizers containing nitrogen and phosphorus) feed aquatic plants and organisms, which require more oxygen for respiration and deplete oxygen when decomposing.

The current water quality standard is based on the identified salmonid and aquatic life habitat for a water body. For West Linn, the Tualatin River has been identified as a water body with active salmonid spawning habitat that is not maintaining the DO concentration criterion of at least 11.0 milligrams per liter (mg/L) between January 1 and May 15.

3.2.1 Relationship between MS4 Discharges and Dissolved Oxygen

Stormwater runoff entering the MS4 can be a contributor of organic waste to receiving waters. Potential sources of organic materials in stormwater runoff include trash and debris, sediment (total and dissolved), landscaping chemicals (pesticides/fertilizers), illicit discharges and dumping, and cross-connections between the sewer and stormwater systems. In addition, organic materials such as leaves, grass, and other plant materials are often conveyed with stormwater runoff through the MS4 system and discharged into receiving waters. Such organic material, when it decomposes, can deplete DO levels.

In addition to organic waste, flow changes may have an impact on DO levels. Development activities that add impervious surfaces can reduce groundwater recharge, which is typically a source of cool water flows in summer months.

3.2.2 Current BMPs to Address Dissolved Oxygen

As shown in Table 3, the City's SWMP includes several BMPs that address sources of organic waste to receiving waters. The illicit discharge program aims primarily to reduce non-stormwater discharges to the MS4. Activities include dry weather screening to identify and remove illicit connections (BMPs 1-1 and 1-2), spill response (BMP 1-3), and cross-connection identification and removal (BMP 7-5). The City's maintenance program facilitates the removal of organic materials through street sweeping and leaf pick-up (BMP 7-2), and catch basin cleaning (BMP 8-2). Erosion control activities (BMPs 3-1, 3-2, 3-3, and 7-1) also reduce the transport of organic materials during construction activities. Installing stormwater treatment systems (BMP 6-1) and maintaining stormwater treatment facilities also reduces the transport of organic materials downstream through the MS4 (BMPs 8-3 and 8-4).

In addition, the City's stormwater design standards (BMP 6-1) prioritize the use of low-impact development (LID) and green infrastructure. LID principles maximize infiltration, which better mimics natural runoff conditions, including groundwater recharge.

3.3 Chlorophyll a

Chlorophyll a is a measure of the portion of algae pigments in the water body that are active and photosynthesizing. Therefore, Chlorophyll a is not a pollutant in itself, but an indicator of aquatic weeds and algae in the water body. Oregon's water quality standard for Chlorophyll a is 0.015 mg/L. Several water quality samples in the Willamette River have exceeded this standard by small amounts.

Aquatic weeds and algae are natural components of aquatic ecosystems. In large quantities they can produce dense mats that can impede activities like swimming and fishing, and may cause odor problems and oxygen depletion. When algae die, they decompose in a process that removes oxygen from the water. As described in Section 3.2, fish and other aquatic organisms cannot survive in water with low DO levels. Animal waste and nutrients (e.g., fertilizers containing nitrogen and phosphorus) feed aquatic plants and organisms, which in turn require more oxygen for respiration and deplete oxygen when decomposing. Elevated temperatures may also result in an increase in biologic activity (plant growth, respiration, and decomposition), which depletes oxygen from the system.

In addition, large quantities of algae (called "blooms") can pose a significant potential threat to human and ecological health. Harmful algae blooms are often composed of microorganisms known as cyanobacteria, which have the potential to produce toxins that can cause adverse health effects on humans and animals through the contamination of waterways used for recreational purposes and as drinking water supplies (USEPA, 2014).

The USEPA added Chlorophyll a to the 2010 303(d) list for the Willamette River from river mile (RM) 0 to 54.8 based on several samples exceeding the 0.015 mg/L water quality standard.

3.3.1 Relationship between MS4 Discharges and Chlorophyll a

Increased levels of Chlorophyll a are indicators of higher algae production, which is generally caused by excess nutrients in water bodies. A direct relationship exists between the amount of phosphorus in a water body and the amount of algae growing in that water body. As phosphorus levels increase, the amount of algae increases. Stormwater runoff entering the MS4 can be a contributor of nutrients into receiving waters. Potential nutrient sources in stormwater runoff include landscaping chemicals (pesticides and fertilizers), animal waste, illicit discharges and dumping, and cross-connections between the sewer and stormwater systems. In addition, landscaping waste such as leaves, grass, and other plant materials may be treated with fertilizers that are then transported through the MS4 and discharged into receiving waters.

3.3.2 Current BMPs to Address Chlorophyll a

As shown in Table 3, the City's SWMP includes several BMPs that address sources of nutrients to receiving waters. The illicit discharge detection and elimination program aims to reduce non-stormwater discharges to the MS4. Activities include dry weather screening to identify illicit connections and illicit discharges (BMPs 1-1 and 1-2) and spill response (BMP 1-3). The industrial and commercial facilities program includes procedures to identify businesses that are storing chemicals, including fertilizers (BMP 2-1), and to inspect pollution prevention activities at high-priority sites (BMP 2-2). The City's education and outreach activities have programs aimed at alternative gardening products and low-volume use of pesticides, herbicides, and fertilizers for both the public and City staff (BMPs 4-1 and 4-6).

The City has two pollution prevention BMPs focused on reducing pollutants associated with the application of pesticides, herbicides, and fertilizers (BMPs 4-4 and 7-3). Other pollution prevention activities include street sweeping and leaf pick-up (BMP 7-2). Maintenance of public and private stormwater facilities, the stormwater conveyance system, and catch basins (BMPs 8-1 through 8-4) are also key management practices to remove nutrients from the MS4 before they are discharged to downstream water bodies.

3.4 Organochlorine Pesticides

OC pesticides cover a large category of pesticides that are persistent in the environment. OC pesticides in the aquatic food chain are now recognized as a widespread problem in streambed sediments (USGS, 1999). The 303(d) list for the Lower Willamette River (between RM 0 and 24.8) includes aldrin, chlordane, DDT, and DDT metabolite (dichlorodiphenyldichloroethylene [DDE]), dieldrin, and hexachlorobenzene.

OC pesticides have common properties that govern their fate and transport in the environment: they are highly persistent, they bioaccumulate in the food chain, and they are highly hydrophobic (i.e., partition out of water to sediment). Furthermore, they volatilize in sufficient quantities so that they are transported by air and deposited as wet or dry deposition on land, resulting in worldwide occurrence at trace levels. National water quality investigations by the U.S. Geological Survey (USGS) have found them to be widespread in streambed sediments (USGS, 1999). Water quality standards for these chemicals are designed to protect human health by limiting the amount present in the food chain of the Willamette River and tributaries, where they can eventually lodge in human-consumable fish. In addition, these chemicals have toxic effects on wildlife.

Aldrin and dieldrin are insecticides commonly used over the last 40 to 60 years to control pests in agricultural, residential, and/or commercial settings. Aldrin and dieldrin are the common names of manufactured insecticides with similar chemical structures. Trade names and synonyms for aldrin include Aldrec, Aldrex, Aldrex 30, Aldrite, Aldrosol, Altox, Compound 118, Drinox, Octalene, and Seedrin. Aldrin and dieldrin were widely used as insecticides on crops until USEPA banned most uses in 1970 and all uses in 1987. Sunlight and bacteria change aldrin to dieldrin, so dieldrin is most commonly found in the environment. Dieldrin binds tightly to soil and is slow to break down in water or evaporate in the air.

DDT was widely used as an insecticide, particularly for agricultural application to control mosquito outbreaks. DDT was banned in 1972 after it was found to significantly impair eggshell development in birds exposed to DDT through the food chain (ATSDR). DDT metabolite, also referred to as DDE, is formed during the breakdown of DDT. DDT metabolite is particularly dangerous because it is fat-soluble like other OC compounds and is rarely excreted from the body. Concentrations of DDT metabolite tend to bioaccumulate and increase throughout life.

Chlordane was sold in the United States until 1988 as an insecticide for crops like corn and citrus, and for use on lawns and domestic gardens. Because of concern about damage to the environment and harm to human health, USEPA banned all uses of chlordane in 1983, except termite control. USEPA banned all uses of chlordane in 1988. USEPA added chlordane to the 2010 303(d) list for the Willamette River based on two exceedances from samples collected at the Portland Harbor cleanup site.

Hexachlorobenzene is a fungicide formerly used as a seed treatment, especially on wheat to control fungal disease. It has been banned in the United States since 1966 and globally since 2004 under the 2001 Stockholm Convention on Persistent Organic Pollutants. USEPA added hexachlorobenzene to the 2010 303(d) list for the Willamette River based on 32 exceedances from samples collected at the Portland Harbor cleanup site.

3.4.1 Relationship between MS4 Discharges and OC Pesticides

The OC pesticides on the 303(d) list are no longer manufactured or approved for use in the United States. Therefore, urban stormwater runoff is not a potential source for new contributions of these pollutants. However, these OC pesticides continue to be of concern as a result of past uses, as they are persistent in the environment and hydrophobic (binding tightly to soil particles). Therefore, legacy sources of the pollutants may be contained in sediments and transported in urban runoff.

Soil erosion can also contribute to elevated OC pesticide loading in the urban environment, which is a potential problem for MS4s with a strong historical or upstream agricultural influence. New development activity and stormwater runoff over exposed soils that were previously used for agricultural purposes could potentially result in the collection and conveyance of these compounds in the MS4.

3.4.2 Current BMPs to Address OC Pesticides

The City does not have control over the availability, sale, or use of products containing OC pesticides. The City does not currently use any of the listed pesticides, nor are they available for public use. The City's pollution prevention program focuses on reducing pollutants associated with the application of pesticides, herbicides, and fertilizers, and regularly reviews and updates the guidance document for integrated pest management practices (BMP 7-3).

If legacy pollutants bound to sediment are introduced into the MS4, the City's stormwater conveyance system and facility maintenance activities (BMPs 8-1 through 8-4) are focused on the removal of trash, debris, and sediment, providing opportunities to remove soil-bound insecticides from catch basins, conveyance systems, and stormwater management facilities. Street sweeping (BMP 7-2) removes sediments before they enter the collection system, and the City's road maintenance practices (BMP 7-1) focus on scheduling maintenance activities in the dry season to limit sediment washed downstream during rain events.

Additionally, implementation of stormwater design standards (BMP 6-1) and erosion and sediment control requirements (BMPs 3-1 through 3-3) help to prevent the transport of sediment and associated legacy pollutants into the MS4 during ground-disturbing activities associated with new development and redevelopment.

3.5 PCBs

Polychlorinated biphenyls (PCBs) are a family of chemicals with widespread industrial uses—for example, as insulators in electrical equipment, as hydraulic fluids, and as a component of carbonless copy paper—until their manufacture was banned in the United States in 1977 because of their deleterious effects on wildlife and human health. PCB-containing equipment was aggressively retrofitted throughout the 1980s and 1990s to remove PCBs, so little equipment containing PCBs remains in use in the United States (ATSDR, 2014). However, PCBs may still be present in building materials, particularly in older institutional and industrial buildings.

PCBs share many common properties with OC pesticides: they are highly persistent, they bioaccumulate in the food chain, and they are highly hydrophobic (i.e., partition out of water to sediment). Water quality standards are designed to protect human health by limiting the amount present in the food chain of the Willamette River and tributaries.

3.5.1 Relationship between MS4 Discharges and PCBs

Sources of PCBs in the environment are related primarily to streambed sediments, which themselves have an upland (soil) source. PCBs in Willamette River sediments were measured in 1997 at 15 micrograms per kilogram (μg/kg) (McCarthy and Gale, 1999) upstream of Portland Harbor. Stormwater runoff is the primary pathway by which aerially deposited toxics in the urban environment reach aquatic systems. Stormwater conveyance, whether in a piped or open-channel system, has traditionally been designed to drain stormwater quickly off impervious surfaces into downstream water bodies in the urban environment.

MS4 systems may be sources of PCBs when older buildings are demolished for redevelopment activities. In addition, elevated urban peak flows can promote re-suspension of PCB-enriched streambed sediments, potentially contributing to water quality degradation in downstream water bodies.

3.5.2 Current BMPs to Address PCBs

The goal of stormwater BMPs should be to reduce the load of PCBs discharging to receiving waters. Sediment-trapping BMPs are expected to be effective at trapping these compounds, as well as BMPs that prevent soil erosion and reduce runoff volumes to limit peak flows that cause instream erosion. As shown in Table 3, the City's primary BMPs that focus on sediment removal are street sweeping (BMP 7-2), catch basin maintenance (BMP 8-2), and stormwater facility maintenance (BMPs 8-3 and 8-4).

Implementation of stormwater design standards (BMP 6-1) and erosion and sediment control requirements (BMPs 3-1 through 3-3, and BMP 6-1) will also help to prevent the transport of sediment and associated legacy pollutants into the MS4 during ground-disturbing activities associated with new development and redevelopment.

3.6 Pentachlorophenol

Pentachlorophenol (PCP) is a pesticide and disinfectant that has many uses, primarily as a wood preservative. The Willamette River listing for PCP is based on samples taken at the McCormick & Baxter Superfund site on the east bank of the Willamette River in Portland, Oregon. The site is a former wood-treating facility, and the Superfund site includes 43 acres of land and 23 acres of contaminated river sediments.

A 2013 DEQ memorandum indicates that the Willamette River from RM 0 to 24.8 for PCP will be delisted from the 2012 303(d) list. The 2012 303(d) list under review with USEPA moves the listing to "Category 4B: Water quality limited, other control measures." The 2012 303(d) list explains that the remedial actions and pollution controls at the McCormick & Baxter Superfund site will result in attainment of Oregon's narrative and numeric water quality standards in the site's vicinity by containing, controlling, and preventing future releases of contaminants into the sediments and water and protecting beneficial uses. In addition, results of monitoring show that contaminant concentrations in crayfish have declined. Based on the monitoring report, the Oregon Department of Human Services (DHS) removed the fish consumption health advisory on February 25, 2010.

Further evaluation of PCP and the relationship to MS4 discharges and BMPs has not been included in this memorandum.

3.7 PAHs

Polynuclear aromatic hydrocarbons (PAHs) are a group of organic hydrocarbon compounds that each have two or more benzene rings. PAHs are typical components in asphalt, petroleum-based fuels, oils, and greases. They are also generated as by-products when carbon compounds are not completely combusted. PAHs are one of the most prominent groups of chemicals that are found in smoke, soot, and engine exhaust and can be released by a range of sources, including furnaces, automobile exhaust, fireplaces, cigarette smoke, coal- and oil-fired power plants, incinerators, forest fires, and volcanic eruptions.

When directly released to the atmosphere, PAHs may attach to small particles and be transported for considerable distances before falling back to earth as dust or in precipitation. PAHs can also enter surface water bodies if they are attached to particles that have been washed from upland oils or off impervious surfaces by stormwater. PAHs have been found in precipitation in pristine, undeveloped areas around the world. Although they are present in low concentrations virtually everywhere, PAHs can occasionally reach elevated concentrations as a result of certain industrial activities, such as areas that are often downwind of an incinerator's gas plume. PAHs can also migrate from a material containing PAHs in high concentrations, such as a creosote-based wood preservative. PAHs can leach from creosote-treated wood in utility poles, railway ties, bridges, and pilings into fresh water, groundwater, and soil.

Some PAHs degrade slowly in the environment, and sediments are a "sink" where these chemicals tend to concentrate. PAHs that are dissolved in water can be "taken up" by plants and then re-released back into water or into soil when the plant dies and decomposes or is burned. Some PAHs can also accumulate in the tissues of certain organisms.

As with other toxics, the water quality criterion for PAHs is designed to protect human health by limiting the amount present in the food chain of the Willamette River and tributaries that can eventually lodge in human-consumable fish. The Oregon standard for protection of human health is 2.8 nanograms per liter (ng/L) for the total concentration of 16 PAH compounds. The Lower Willamette River is on the 303(d) list for PAHs based on an estimated 35-day average concentration during low flows of 52.9 ng/L.

3.7.1 Relationship between MS4 Discharges and PAHs

Stormwater runoff is a likely source of PAH contribution to local water bodies. Automotive exhaust, wood burning, oils, automotive fluids, and industrial activities are all potential sources of PAH contribution to either air or sediments. Rain and stormwater runoff can then carry pollutants downstream. City of Portland stormwater monitoring data from storms monitored between May 1991 and January 1993 found PAH concentrations exceeding MCLs in all samples from urban land uses analyzed for PAHs, though the Portland samples were analyzed for total concentrations of 39 PAH compounds, as opposed to just the 16 that are applicable in evaluating Oregon's water quality standard (WCC, 1993).

These results show that the MS4 system has the potential to transport PAHs that have been collected in stormwater runoff from the urban environment. While most PAHs may enter the MS4 as part of stormwater runoff, stormwater programs should pay particular attention to acute contributions to the MS4 from spills and other direct non-stormwater discharges to the conveyance system.

3.7.2 Current BMPs to Address PAHs

As shown in Table 3, the City's SWMP includes several spill prevention and response BMPs that may provide protection against the transport of a concentrated discharge of fuel, oil, or other substances containing PAHs to the MS4 and downstream surface waters. Primarily, the spill prevention and illicit discharge detention and elimination program (BMPs 1-1 through 1-3) and the industrial stormwater discharge program (BMPs 2-1 and 2-2) work to prevent spills, identify chemical storage sites, and identify high-risk areas to prevent spills to the MS4. In addition, BMP 4-1 provides education to residents about proper disposal for hazardous materials.

In addition, the City's street sweeping activities (BMP 7-2) work to remove accumulated pollutants before they can reach the MS4 and maintenance activities facilitate the removal of floating oils and sediments from roads, catch basins, manholes, drainage ditches, and stormwater management facilities (BMPs 8-1 through 8-4).

3.8 Cyanide

Cyanide is a naturally occurring compound, produced by certain bacteria, fungi, and algae, and is found in a number of plants. Cyanides are found in substantial amounts in certain seeds and fruit stones, such as apricots, apples, and peaches. High levels of exposure can lead to cyanide poisoning, though the most common source of cyanide exposure for the general population is through tobacco smoke.

Cyanide enters air, water, and soil from both natural processes and industrial activities. Cyanide and hydrogen cyanide are used in electroplating, metallurgy, organic chemicals production, photographic developing, manufacture of plastics, fumigation of ships, and some mining processes. Cyanide in the environment is not likely to cause adverse health effects in humans. Most cyanide in surface water will form hydrogen cyanide and evaporate; cyanide in water does not bioaccumulate; cyanide is not classified as a human carcinogen (ATSDR).

3.8.1 Relationship between MS4 Discharges and Cyanide

USEPA added cyanide to the 2010 303(d) list for the Willamette River based on 75 exceedances from samples collected at the Portland Harbor cleanup site. Portland Harbor is the source of significant environmental cleanup efforts to address legacy pollutants from past industrial activities and it is located approximately 12 miles downstream of the City of West Linn.

In 2009, the Oregon Association of Clean Water Agencies (ACWA) published a study characterizing the nature of stormwater across Oregon, based on sampling data collected by municipal agencies. The data consisted of more than 25,000 samples with 45 analytes collected between 1990 and 2008. The data set used for the study included 85 stormwater samples that had been tested for cyanide. None of the stormwater samples had cyanide at levels that exceeded current regulatory limits. Therefore, it is assumed that municipal stormwater discharges from the city are unlikely to be a source of cyanide to the Willamette River.

3.8.2 Current BMPs to Address Cyanide

Municipal stormwater is not considered to be a source of cyanide. Cyanides are fairly mobile in soil and can be removed by several processes. BMPs that are effective at preventing cyanide from entering the stormwater system are those that focus on removing cross-connections that could be sources of non-stormwater discharges. These BMPs include illicit discharge detection and elimination (BMPs 1-1 through 1-3) as well as screening of industrial facilities (BMPs 2-1 and 2-2). BMPs that remove total suspended solids (TSS) could also be effective at removing cyanide compounds. These include conveyance and catch basin cleaning (BMPs 8-1 and 8-2), street sweeping (BMP 7-2), and stormwater facility cleaning (BMPs 8-3 and 8-4).

3.9 Iron and Manganese

Iron and manganese are fundamental components of soils and the rocks from which soils are derived. Typical concentrations of iron and manganese in surficial geological materials of the Willamette River valley are 5 percent (i.e., 50,000 mg/kg) iron and 0.1 percent (i.e., 1,000 mg/kg) manganese (Shacklette and Boerngen, 1984). These concentrations are high compared to national averages because of the prevalence of volcanic or volcanic-derived geological materials. Soil concentrations of these elements vary by soil horizon (i.e., they are typically concentrated in subsoils) and are relatively higher where soils are derived from basalts (e.g., the Columbia River basalts, Troutdale gravels, etc.). Iron concentrations in streambed sediments of the lower and middle Willamette River (below Salem) range from 3.5 to 8.5 percent; 7 percent iron is a typical value for the lower Willamette River (Rice, 1999). These sediment concentrations most likely reflect the influence of iron- (and manganese-) enriched bedrock[1], although there may be some anthropogenic contribution as well.

The instream iron and manganese concentrations on which the Willamette River and Tualatin River 303(d) listings are based are measured as the total recoverable metal fraction. Therefore, some of the resulting exceedances of water quality criteria could be related to elevated suspended sediment concentrations. Total suspended sediment concentrations as low as 5 mg/L could result in an exceedance of the iron criterion,

[1] Iron enrichment in sediments between Columbia River basalt lava flows was sufficient to support turn-of-the-century iron mining in Lake Oswego and Scappoose, for instance (Orr and Orr, 1999).

assuming that the iron content of suspended sediment is equivalent to the iron content of streambed sediments. Similarly, the manganese criterion would be exceeded when total suspended sediment concentrations exceed 50 mg/L. Average TSS concentrations in stormwater runoff range from 53 mg/L in open-space settings to 169 mg/L for transportation land uses[2] (WCC, 1997), suggesting that the ambient water quality criterion for iron is often likely to be exceeded in stormwater.

The numeric human-health water quality criteria for both iron and manganese[3] were withdrawn from Oregon's 2011 water quality standards. The withdrawal of numeric criteria was based on iron and manganese being naturally occurring earth elements. In addition, the previous numeric criteria for iron and manganese were based on USEPA's recommendations for taste and laundry staining effects, not on human-health effects. USEPA issued a letter of approval for withdrawal of the standards on June 9, 2011, and Oregon's revised water quality standards for human-health criteria were approved in 2011.

Despite the change in the water quality standard, the Willamette River and Tualatin River are still listed on the current 303(d) list for iron and manganese because the 2010 303(d) list was developed prior to the approval of the revised water quality standards. Now that the numeric criteria for iron and manganese have been withdrawn, it is anticipated that these two pollutants will be delisted in future publications of the 303(d) list.

3.9.1 Relationship between MS4 Discharges and Iron and Manganese

Given the lack of measured iron and manganese concentrations in urban stormwater in the Portland metropolitan area, the relationship between MS4 discharges and this listed pollutant cannot be quantified. However, qualitative relationships are possible based on gross observations of urban runoff processes. Stormwater conveyance systems have traditionally been designed to drain stormwater quickly off impervious surfaces to downstream receiving waters in the urban environment. This process provides efficient transport of eroded soil that could be deposited on impervious surfaces from air deposition or erosion of bared soil surfaces. Urban runoff can also contribute indirectly to elevated iron or manganese concentrations in the water column by quickly elevating stream flow volumes in receiving waters, resulting in either re-suspension of streambed sediments or accelerated erosion of stream banks.

As described above, iron and manganese concentrations can be elevated above ambient water quality criteria by natural concentrations of these parameters in soils due to typical values of suspended sediment in stormwater runoff and due to erosion of streambed sediments associated with increased runoff volumes.

3.9.2 Current BMPs to Address Iron and Manganese

The goal of stormwater BMPs designed to address iron and manganese should be to reduce the suspended sediment load in receiving waters and to moderate the effects of increased urban runoff volumes. Structural stormwater BMPs that would conceptually be most effective at reducing iron loads would be those that collect and/or trap sediment and those that reduce flow volumes so that sediment transport capacity of the conveyance system is reduced.

Surface infiltration through green infrastructure facilities such as infiltrating rain gardens and stormwater planters, as well as subsurface infiltration via underground injection control (UIC) systems, are the preferred BMPs for treatment of iron- and manganese-rich stormwater, assuming that concentrations of other stormwater pollutants are acceptable for discharge to groundwater. Wetlands, wet ponds, sand filters, and swales are all effective structural BMPs for treating TSS-rich stormwater because they retain sediment and provide some amount of flow attenuation. Detention ponds provide the best flow attenuation of the typical structural

[2] Median concentrations of TSS range from 16 mg/L in open-space areas to 120 mg/L in transportation corridors.

[3] Oregon water quality standards still include a saltwater criterion for total manganese. The saltwater criterion does not apply to the water bodies applicable to the City.

BMPs but may be prone to sediment re-suspension. Proper use and maintenance of erosion- and sediment-control BMPs are necessary during construction activities to reduce sediment entering the stormwater system. Maintenance activities that include the collection of sediments (e.g., street sweeping and catch basin cleaning) should also be effective at reducing the transport of sediment from the regulated MS4 into downstream water bodies.

As shown in Table 3, the City's SWMP already focuses on sediment reduction to the MEP through the use of structural stormwater controls (BMP 6-1). Construction site runoff programs (BMPs 3-1 through 3-3 and BMP 6-1) include design guidance, permitting requirements, and construction site inspections and enforcement to reduce sediment introduced into the MS4. Street sweeping (BMP 7-2) includes collection of sanding materials, reducing sediment loads in the MS4. Finally, structural facility maintenance (BMPs 8-2 through 8-4) addresses sediment removal from structural water quality facilities and catch basins.

It should be noted that while stormwater BMPs can reduce the loads of iron and manganese (measured either directly or using TSS as a surrogate), they may not be sufficient to allow effluent to consistently meet ambient water quality concentrations because of naturally elevated levels in local soils.

Section 4: Summary and Conclusions

In[amm1] most cases, through the implementation of current BMPs, the City is using reasonable and available controls to reduce the discharge of pollutants to the MEP. Potential BMP modifications that may be made to further address pollutants of concern are listed below by pollutant.

It is important to note that SWMP updates will be prepared in conjunction with the City's NPDES MS4 permit renewal application, due in September 2016. At that time, and based on feedback from DEQ regarding anticipated NPDES MS4 permit language changes, the SWMP will be updated to improve functionality, implementation, organization, and revised commitments as appropriate. SWMP modifications will include consideration of the recommendations from this 303(d) evaluation, the results of the MEP evaluation (due in 2016), and a review of City organization and resources.

4.1 Potential BMP Modifications to Address Biological Criteria

The City's SWMP has controls in place to address biological criteria to the MEP. Biological criteria are an indicator of cumulative water and habitat quality. DEQ's biocriteria TMDL for the Umpqua Basin states that "... implementing the Waste Load Allocations and Load Allocations for other water quality-limiting parameters, as well as making improvements in habitat and flow conditions, should recover biological communities to expected compositions." In addition to addressing waste load allocations through the MS4 permit, the City has a TMDL implementation plan to work toward reaching the load allocations for TMDL parameters.

The City should refine its stormwater design standards (BMPs 6-1 and 6-2) in conjunction with recommendations outlined in its hydromodification assessment (June 2015). Such recommendations include refinement of the public works standards to encourage infiltration and LID when site conditions allow, and clarification of the thresholds for projects requiring stormwater management. These modifications will further address water quality and flow alterations. It is recommended that the City's future SWMP updates focus on implementation and enforcement of updated standards. Implementing the City's design standards for new development, redevelopment, and public projects will address biological criteria as well as other listed pollutants. No additional changes to the SWMP are proposed at this time to specifically address biological criteria.

4.2 Potential BMP Modifications to Address Dissolved Oxygen

The City's SWMP has controls in place to reduce discharges of organic waste to the MEP. However, modifications to existing practices (as listed below) could potentially be considered to increase capture rates and improve efficiencies.

DO levels are typically a response to other pollutants such as nutrients, sediments, and elevated temperatures. Therefore, modifications for consideration focus on the potential discharge of organic wastes to the receiving water. Modifications for consideration include the following:

- Increase staff training and public outreach regarding maintenance of structural stormwater control facilities to emphasize proper maintenance of plants and proper disposal of removed vegetation and sediment.
- Adjust BMP 6-2 to focus on successful implementation of the City's stormwater design standards, as described in Section 4.1. Implementation should include proper maintenance actions for water quality and flow control facilities.

4.3 Potential BMP Modifications to Address Chlorophyll a

As discussed in Section 3.3, Chlorophyll a is an indicator of the presence of algae in the water body. Algae production increases with an increase in nutrients and temperature. Therefore, the potential BMP modifications to address Chlorophyll a are the same as those described in Section 4.2 to address DO.

4.4 Potential BMP Modifications to Address OC Pesticides

The City's SWMP has controls in place to reduce sediment discharges of OC pesticides, including aldrin, chlordane, DDT/DDE, dieldrin, and hexachlorobenzene, to the MEP. No new sources of these specific OC pesticides are being introduced into the environment. In most cases, the primary factor in reducing OC pesticides is time. For example, the Molalla-Pudding Subbasin TMDL for pesticides (DEQ, December 2008) states that "DEQ expects that significant [TSS] reductions … and ongoing decay of dieldrin over time should result in the achievement of both aquatic health chronic toxicity and human health based criteria for dieldrin." Therefore, no modifications to the SWMPs are listed for consideration to specifically address OC pesticides.

4.5 Potential BMP Modifications to Address PCBs

The City's SWMP has sufficient controls in place to reduce sediment discharges and TSS (and hence PCBs bound to TSS) to the MEP. Addressing PCBs is a matter of managing sediments as well as historical sources. The City's illicit discharge program includes identification and removal of illegal dump sites, which could be a potential source of older products that could contain PCBs. The City may consider enhancing the stormwater program to address proper disposal of building materials during redevelopment. The enhancements could include changes to the focus of public outreach materials and/or revisions to stormwater design standards to include guidelines on proper material disposal.

4.6 Potential BMP Modifications to Address Pentachlorophenol

Remediation activities at the McCormick & Baxter Superfund site downstream of the City in Portland are expected to result in the attainment of water quality standards for PCP. Therefore, no modifications are recommended to the City's SWMP or BMP elements to address PCP.

4.7 Potential BMP Modifications to Address PAHs

The City's SWMP has controls in place to identify and respond to spills and other potential sources of PAHs to the MEP. The SWMP also has maintenance practices to remove potential pollutants from roadways and the MS4. Therefore, no modifications are recommended to the SWMP and BMP elements to address PAHs.

4.8 Potential BMP Modifications to Address Cyanide

The City's SWMP has controls in place to reduce illicit discharges and cross-connections from industrial sources to the MEP. In addition, municipal stormwater runoff from the City is not a likely contributor to cyanide levels in the Willamette River. Therefore, no modifications are recommended to the SWMP and BMP elements to address cyanide.

4.9 Potential BMP Modifications to Address Iron and Manganese

The City's SWMP has controls in place to reduce sediment discharges and TSS to the MEP. In addition, numeric criteria for iron and manganese have been withdrawn from Oregon's water quality standards. Therefore, no modifications are recommended to the SWMP and BMP elements to address these two pollutants.

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