NWEA

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PHASE I MUNICIPAL STORMWATER PERMIT

National Pollutant Discharge Elimination System and
State Waste Discharge General Permit
for Discharges from
Large and Medium Municipal Separate Storm Sewer Systems

State of Washington
Department of Ecology
Olympia, WA 98504-7600

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1251 et seq.

Until this Permit expires, is modified, or revoked, Permittees that have properly obtained coverage under this Permit are authorized to discharge to waters of the State in accordance with the special and general conditions which follow.

Water Quality Program Manager
Department of Ecology

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SPECIAL CONDITIONS

S1. Permit Coverage and Permittees

A. Geographic Area of Permit Coverage

This Permit covers discharges from large and medium Municipal Separate Storm Sewer Systems (MS4s), as established at Title 40 CFR 122.26, except for the Washington State Department of Transportation's MS4s.

For Secondary Permittees required to obtain coverage under this Permit, the minimum geographic area of coverage includes the portion of the MS4 which is located within the unincorporated areas of Clark, King, Snohomish, and Pierce Counties and the incorporated areas of the cities of Seattle and Tacoma. The Washington State Department of Ecology (Ecology) may establish additional geographic areas of coverage specific to an individual Secondary Permittee.

B. The following cities and counties have submitted a Duty to Reapply-Notice of Intent (NOI) for coverage to Ecology prior to February 1, 2018, and have coverage as Permittees beginning on the effective date of the Permit:

1. The City of Tacoma and the City of Seattle

2. Clark, King, Pierce, and Snohomish Counties

C. The following entities have submitted a Duty to Reapply-Notice of Intent (NOI) for coverage to Ecology prior to February 1, 2018, and have coverage as Secondary Permittees, beginning on the effective date of the Permit:

1. Port of Seattle, excluding Seattle-Tacoma International Airport

2. Port of Tacoma

3. The University of Washington, Seattle; Seattle School District #1; Metropolitan Park District of Tacoma; Washington State Military Department; Tacoma Community College; Washington State Department of Corrections: Larch Corrections Center, and Washington Corrections Center for Women.

D. Unless otherwise noted, the term "Permittee" includes city, county, or town Permittee, port Permittee, Co-Permittee, Secondary Permittee, and New Secondary Permittee.

E. Coverage for New Secondary Permittees

1. Entities meeting the requirements in S1.E.1.a-b, below, are required to apply for and obtain coverage under this Permit. Upon application and coverage, the following entities will have coverage under this Permit as New Secondary Permittees:

a. Active drainage, diking, flood control, or diking and drainage districts located in the Cities or unincorporated portions of the Counties listed in S1.B above, which own or operate MS4s serving non-agricultural land uses; and were not covered by the Permit prior to August 1, 2019.

b. Other owners or operators of MS4s located in the Cities or unincorporated portions of the Counties listed in S1.B above; and were not covered by the Permit prior to August 1, 2019.

2. Application Requirements

a. Submit a Notice of Intent (NOI) for Coverage under National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater General Permit provided on Ecology's website and provide public notice of the application for coverage in accordance with WAC 173-226-130. The NOI shall constitute the application for coverage. Ecology will notify applicants in writing of their status concerning coverage under this Permit within 90 days of Ecology's receipt of a complete NOI.

b. Each Permittee applying as Co-Permittee shall submit a NOI provided on Ecology's website. The NOI shall clearly identify the areas of the MS4 for which the Co-Permittee is responsible.

F. All MS4s owned or operated by Permittees named in S1.B and located in another city or county area requiring coverage under this Permit or either the *Western Washington Phase II Municipal Stormwater Permit* or the *Eastern Washington Phase II Municipal Stormwater Permit* are also covered under this Permit.

S2. AUTHORIZED DISCHARGES

A. This Permit authorizes the discharge of stormwater to surface waters and to groundwaters of the State from MS4s owned or operated by each Permittee covered under this Permit in the geographic area covered by this Permit pursuant to S1.A subject to the following limitations:

1. Discharges to groundwaters of the State through facilities regulated under the Underground Injection Control (UIC) program, Chapter 173-218 WAC, are not authorized under this Permit.

2. Discharges to groundwaters not subject to regulation under the federal Clean Water Act are authorized in this Permit only under state authorities, Chapter 90.48 RCW, the Water Pollution Control Act.

B. This Permit authorizes discharges of non-stormwater flows to surface waters and groundwaters of the State from MS4s owned or operated by each Permittee covered under this Permit, in the geographic area covered pursuant to S1.A, only under one or more of the following conditions:

1. The discharge is authorized by a separate National Pollutant Discharge Elimination System (NPDES) or State Waste Discharge Permit.

2. The discharge is from emergency firefighting activities.

3. The discharge is from another illicit or non-stormwater discharge that is managed by the Permittee as provided in Special Condition S5.C.9., S6.D.3, or S6.E.3.

These discharges are also subject to the limitations in S2.A.1 and S2.A.2, above.

C. This Permit does not relieve entities that cause illicit discharges, including spills of oil or hazardous substances, from responsibilities and liabilities under state and federal laws and regulations pertaining to those discharges.

D. Discharges from MS4s constructed after the effective date of this Permit shall receive all applicable state and local permits and use authorizations, including compliance with Chapter 43.21C RCW (the State Environmental Policy Act).

E. This Permit does not authorize discharges of stormwater to waters within Indian Country as defined in 18 U.S.C. §1151 or to waters subject to water quality standards of Indian Tribes, including portions of the Puyallup River and other waters on trust or restricted lands within the 1873 Survey Area of the Puyallup Tribe of Indians Reservation, except where authority has been specifically delegated to Ecology by the U.S. Environmental Protection Agency. The exclusion of such discharges from this Permit does not waive any rights the State may have with respect to the regulation of the discharges.

S3. RESPONSIBILITIES OF PERMITTEES

A. Each Permittee, Co-Permittee and Secondary Permittee is responsible for compliance with the terms of this Permit for the MS4s that they own or operate.

1. Each Permittee, as listed in S1.B, is required to comply with all conditions of this Permit, except for S6 – *Stormwater Management Program for Secondary Permittees*.
2. The Port of Tacoma and Port of Seattle are required to comply with all conditions of this Permit except for S5 – *Stormwater Management Program* and S6.D – *Stormwater Management Program for Secondary Permittees*.
3. All Secondary Permittees, except for the Port of Tacoma and the Port of Seattle, are required to comply with all conditions of this Permit except for conditions S5 – *Stormwater Management Program*, S6.E – *Stormwater Management Program for the Port of Seattle and Port of Tacoma*, and S8 – *Monitoring and Assessment*.

B. Permittees may rely on another entity to satisfy one or more of the requirements of this Permit. Permittees that are relying on another entity to satisfy one or more or their permit obligations remain responsible for permit compliance if the other entity fails to implement the permit conditions. Where permit responsibilities are shared they shall be documented as follows:

1. Permittees and Co-Permittees that are continuing coverage under this Permit shall submit a statement that describes the permit requirements that will be implemented by other entities. The statement shall be signed by all participating entities. There is no deadline for submitting such a statement, provided that this does not alter implementation deadlines. Permittees and Co-Permittees may amend their statement during the term of the Permit to establish, terminate, or amend their shared responsibilities statement, and submit the amended statements to Ecology.
2. Secondary Permittees shall submit an NOI that describes which requirements they will implement and identify the entities that will implement the other permit requirements in the area served by the Secondary Permittee's MS4. A statement confirming the shared responsibilities, signed by all participating entities, shall accompany the NOI.

Secondary Permittees may amend their NOI, during the term of the Permit, to establish, terminate, or amend shared responsibility arrangements, provided this does not alter implementation deadlines.

C. Unless otherwise noted, all appendices to this Permit are incorporated by this reference as if set forth fully within this Permit.

S4. COMPLIANCE WITH STANDARDS

A. In accordance with RCW 90.48.520, the discharge of toxicants to waters of the State of Washington which would violate any water quality standard, including toxicant standards, sediment criteria, and dilution zone criteria is prohibited. The required response to such discharges is defined in Section S4.F, below.

B. This Permit does not authorize a discharge which would be a violation of Washington State Surface Water Quality Standards (Chapter 173-201A WAC), Groundwater Quality Standards (Chapter 173-200 WAC), Sediment Management Standards (Chapter 173-204 WAC), or human health-based criteria in the National Toxics Rule (40 CFR 131.45). The required response to such discharges is defined in Section S4.F, below.

C. The Permittee shall reduce the discharge of pollutants to the Maximum Extent Practicable (MEP).

D. The Permittee shall use All Known, Available, and Reasonable methods of prevention, control and Treatment (AKART) to prevent and control pollution of waters of the State of Washington.

E. In order to meet the goals of the Clean Water Act (CWA), and comply with S4.A, S4.B, S4.C, and S4.D, each Permittee shall comply with all of the applicable requirements of this Permit as defined in S3 – *Responsibilities of Permittees*.

F. A Permittee remains in compliance with S4 despite any discharges prohibited by S4.A or S4.B, when the Permittee undertakes the following response toward long-term water quality improvement:

1. A Permittee shall notify Ecology in writing within 30 days of becoming aware, based on credible site-specific information that a discharge from the MS4 owned or operated by the Permittee is causing or contributing to a known or likely violation of water quality standards in the receiving water. Written notification provided under this subsection shall, at a minimum, identify the source of the site-specific information, describe the nature and extent of the known or likely violation in the receiving water, and explain the reasons why the MS4 discharge is believed to be causing or contributing to the problem. For ongoing or continuing violations, a single written notification to Ecology will fulfill this requirement.

2. In the event that Ecology determines, based on a notification provided under S4.F.1 or through any other means, that a discharge from a MS4 owned or operated by the Permittee is causing or contributing to a violation of water quality standards in a receiving water, Ecology will notify the Permittee in writing that an adaptive management response outlined in S4.F.3, below, is required unless:

a. Ecology also determines that the violation of water quality standards is already being addressed by a Total Maximum Daily Load (TMDL) or other enforceable water quality cleanup plan; or

b. Ecology concludes the MS4 contribution to the violation will be eliminated through implementation of other permit requirements.

3. Adaptive Management Response

a. Within 60 days of receiving a notification under S4.F.2, or by an alternative date established by Ecology, the Permittee shall review its Stormwater Management Program (SWMP) and submit a report to Ecology. The report shall include:

i. A description of the operational and/or structural Best Management Practices (BMPs) that are currently being implemented to prevent or reduce any pollutants that are causing or contributing to the violation of water quality standards, including a qualitative assessment of the effectiveness of each BMP.

ii. A description of potential additional operational and/or structural BMPs that will or may be implemented in order to apply AKART on a site-specific basis to prevent or reduce any pollutants that are causing or contributing to the violation of water quality standards.

iii. A description of the potential monitoring or other assessment and evaluation efforts that will or may be implemented to monitor, assess, or evaluate the effectiveness of the additional BMPs.

iv. A schedule for implementing the additional BMPs including, as appropriate: funding, training, purchasing, construction, monitoring, and other assessment and evaluation components of implementation.

b. Ecology will, in writing, acknowledge receipt of the report within a reasonable time and notify the Permittee when it expects to complete its review of the report. Ecology will either approve the additional BMPs and implementation schedule or require the Permittee to modify the report as needed to meet AKART on a site-specific basis. If modifications are required, Ecology will specify a reasonable time frame in which the Permittee shall submit and Ecology will review the revised report.

c. The Permittee shall implement the additional BMPs, pursuant to the schedule approved by Ecology, beginning immediately upon receipt of written notification of approval; or, as specified in Appendix 13.

d. The Permittee shall include with each subsequent Annual Report a summary of the status of implementation, and the results of any monitoring, assessment or evaluation efforts conducted during the reporting period. If, based on the information provided under this subsection, Ecology determines that modification of the BMPs or implementation schedule is necessary to meet AKART on a site-specific basis, the Permittee shall make such modifications as Ecology directs. In the event there are ongoing violations of water quality standards despite the implementation of the BMP approach of this Section, the Permittee may be subject to compliance schedules to eliminate the violation under WAC 173-201A-510(4) and

WAC 173-226-180 or other enforcement orders as Ecology deems appropriate during the term of this Permit.

e. A TMDL or other enforceable water quality cleanup plan that has been approved and is being implemented to address the MS4's contribution to the water quality standards violation supersedes and terminates the S4.F.3 implementation plan.

f. Provided the Permittee is implementing the approved adaptive management response under this Section, the Permittee remains in compliance with Condition S4, despite any on-going violations of water quality standards identified under S4.A or B, above.

g. The adaptive management process provided under Section S4.F, is not intended to create a shield for the Permittee from any liability it may face under 42 U.S.C. 9601 *et seq*. or RCW 70.105D.

G. Ecology may modify or revoke and reissue this General Permit in accordance with G14 – *General Permit Modification and Revocation,* if Ecology becomes aware of additional control measures, management practices or other actions beyond what is required in this Permit, that are necessary to:

1. Reduce the discharge of pollutants to the MEP;

2. Comply with the state AKART requirements; or

3. Control the discharge of toxicants to waters of the State of Washington.

S5. STORMWATER MANAGEMENT PROGRAM

A. Each Permittee listed in S1.B shall implement a Stormwater Management Program (SWMP) during the term of this Permit. A SWMP is a set of actions and activities comprising the components listed in S5, and additional actions necessary, to meet the requirements of applicable TMDLs pursuant to S7 – *Compliance with TMDL Requirements* and S8 – *Monitoring and Assessment*.

1. Each Permittee shall prepare written documentation of their SWMP, called the SWMP Plan. The SWMP Plan shall be organized according to the program components in S5.C, or a format approved by Ecology, and shall be updated at least annually for submittal with the Permittee's Annual Report to Ecology (S9 – *Reporting Requirements*). The SWMP Plan shall be written to inform the public of the planned SWMP activities for the upcoming calendar year, and include a description of:

a. Planned activities for each of the program components included in S5.C.

b. Any additional planned actions to meet the requirements of applicable TMDLs pursuant to S7 – *Compliance with TMDL Requirements*.

c. Any additional planned actions to meet the requirements of S8 – *Monitoring and Assessment*.

2. Each Permittee shall track the cost or estimated cost of development and implementation of each component of the SWMP. This information shall be provided to Ecology upon request.

3. Each Permittee shall track the number of inspections, follow-up actions as a result of inspections, official enforcement actions and types of public education activities as required by the respective program component. This information shall be included in the Annual Report.

B. The SWMP shall be designed to reduce the discharge of pollutants from MS4s to the MEP, meet state AKART requirements, and protect water quality.

Permittees are to continue implementation of existing Stormwater Management Programs until they begin implementation of the updated Stormwater Management Program, in accordance with the terms of this Permit, including implementation schedules.

C. The SWMP shall include the components listed below. The requirements of the SWMP shall apply to MS4s, and areas served by MS4s owned or operated by the Permittee. To the extent allowable under state and federal law, all SWMP components are mandatory.

1. Legal Authority

Minimum performance measures:

a. Each Permittee shall be able to demonstrate that they can operate pursuant to legal authority which authorizes or enables the Permittee to control discharges to and from MS4s owned or operated by the Permittee.

b. This legal authority, which may be a combination of statute, ordinance, permit, contracts, orders, interagency agreements, or similar means, shall authorize or enable the Permittee, at a minimum, to:

i. Control through ordinance, order, or similar means, the contribution of pollutants to MS4s owned or operated by the Permittee from stormwater discharges associated with industrial activity, and control the quality of stormwater discharged from sites of industrial activity;

ii. Prohibit through ordinance, order, or similar means, illicit discharges to the MS4 owned or operated by the Permittee;

iii. Control through ordinance, order, or similar means, the discharge of spills and disposal of materials other than stormwater into the MS4s owned or operated by the Permittee;

iv. Control through interagency agreements among co-applicants, the contribution of pollutants from one portion of the MS4 to another portion of the MS4;

v. Require compliance with conditions in ordinances, permits, contracts, or orders; and

vi. Within the limitations of state law, carry out all inspection, surveillance, and monitoring procedures necessary to determine compliance and non-compliance with permit conditions, including the prohibition on illicit discharges to the MS4 and compliance with local ordinances.

2. MS4 Mapping and Documentation

The SWMP shall include an ongoing program for mapping and documenting the MS4.
Minimum performance measures:

a. *Ongoing Mapping*. Each Permittee shall maintain mapping data for the features listed below.

   i. Known MS4 outfalls and known MS4 discharge points.

   ii. Receiving waters, other than groundwater.

   iii. Stormwater treatment and flow control BMPs/facilities owned or operated by the Permittee, including all connections between these BMPs/facilities and tributary conveyances (mapped in accordance with this Section) and all associated emergency overflows.

   iv. Geographic areas served by the Permittee's MS4 that do not discharge stormwater to surface water.

   v. Tributary conveyances to all known outfalls and discharge points with a 24-inch nominal diameter or larger, or an equivalent cross-sectional area for non-pipe systems. For counties, this requirement applies to urban/higher density rural sub-basins. For cities, this requirement applies throughout the city. The following features or attributes (or both) shall be mapped:

      (a) Tributary conveyance type, material, and size where known

      (b) Associated drainage areas

      (c) Land uses

   vi. Connections between the MS4 owned or operated by the Permittee and other municipalities or other public entities.

   vii. All connections to the MS4 authorized or allowed by the Permittee after February 16, 2007. [1]

   viii. Existing, known connections greater than or equal to 8 inches in nominal diameter to tributary conveyances mapped in accordance with S5.C.2.a.v. For Counties, this requirement applies to the area of the county within urban/higher density rural sub-basins mapped under the previous Permit. For cities, this requirement applies throughout the city.

b. *New Mapping*. Each Permittee shall:

   i. No later than January 1, 2020, begin to collect size and material for all known MS4 outfalls during normal course of business (e.g. during field screening, inspection, or maintenance) and update records.

   ii. No later than August 1, 2023, complete mapping of all known connections from the MS4 to a privately-owned stormwater system.

[1] Permittees do not need to map the following residential connections: individual driveways, sump pumps, or roof downspouts.

iii. No later than December 31, 2023, counties shall complete mapping tributary conveyances, as described in S5.C.2.a.v, for 50% of the areas outside the previously mapped urban/higher density rural sub-basins.

c. The required format for mapping is electronic with fully described mapping standards.

d. To the extent consistent with national security laws and directives, each Permittee shall make available to Ecology, upon request, available maps depicting the information required in S5.C.2.a and b, above.

e. Upon request, and to the extent appropriate, Permittees shall provide mapping information to federally recognized Indian Tribes, municipalities, and other Permittees. This Permit does not preclude Permittees from recovering reasonable costs associated with fulfilling mapping information requests by federally recognized Indian Tribes, municipalities, and other Permittees.

3. Coordination

The SWMP shall include coordination mechanisms among departments within each jurisdiction to eliminate barriers to compliance with the terms of this Permit.

The SWMP shall also include coordination mechanisms among entities covered under a municipal stormwater NPDES permit to encourage coordinated stormwater-related policies, programs, and projects within a watershed. Permittees shall document their efforts to establish the required coordination mechanisms.

Minimum performance measures:

a. Update, if needed, and implement an intra-governmental (internal) coordination agreement(s) or Executive Directive(s) to facilitate compliance with the terms of this Permit. Permittees shall include a written description of internal coordination mechanisms in the Annual Report, due no later than March 31, 2020.

b. The SWMP shall include, when needed, coordination mechanisms among entities covered under a municipal stormwater NPDES permit to encourage coordinated stormwater-related policies, programs and projects within adjoining or shared areas, including:

   i. Coordination mechanisms clarifying roles and responsibilities for the control of pollutants between physically interconnected MS4s covered by a municipal stormwater permit.

   ii. Coordinating stormwater management activities for shared water bodies, or watersheds among Permittees to avoid conflicting plans, policies, and regulations.

c. Implement; and within 2 years following the addition of a new Secondary Permittee, establish and implement:

   i. Coordination mechanisms clarifying roles and responsibilities for the control of pollutants between physically interconnected MS4s of the Permittee and any other Permittee covered by a municipal stormwater permit.

ii. Coordinating stormwater management activities for shared waterbodies, among Permittees and Secondary Permittees, as necessary to avoid conflicting plans, policies, and regulations.

4. Public Involvement and Participation

Permittees shall provide ongoing opportunities for public involvement and participation in the Permittee's SWMP and implementation priorities.

Minimum performance measures:

a. Permittees shall create opportunities for the public, including overburdened communities, to participate in the decision-making processes involving the development, implementation, and update of the Permittee's SWMP and SMAP (SMAP applies to counties).

b. Each Permittee shall post on their website their SWMP Plan, and the Annual Report required under S9.A no later than May 31 each year. All other submittals shall be available to the public upon request.

5. Controlling Runoff from New Development, Redevelopment, and Construction Sites

The SWMP shall include a program to prevent and control the impacts of runoff from new development, redevelopment, and construction activities. Refer to Appendix 10 for a list of approved manuals and ordinances. The program shall apply to private and public development, including transportation projects.

Minimum performance measures:

a. Each Permittee shall continue to implement existing programs approved under the *2013 Phase I Municipal Stormwater Permit* until the program required in S5.C.5.b.iv applies. The program required in S5.C.5.b.iv applies to applications[2] submitted prior to July 1, 2021, which have not started construction[3] by July 1, 2026, and:

i. For Clark County, applications submitted prior to January 8, 2016, which have not started construction by July 1, 2021.

ii. For Pierce County, applications submitted prior to December 5, 2015, which have not started construction by July 1, 2021.

iii. For King County, applications submitted prior to April 24, 2016, which have not started construction by July 1, 2021.

iv. For Snohomish County, applications submitted prior to January 22, 2016, which have not started construction by July 1, 2021.

v. For the City of Seattle, applications submitted prior to January 1, 2016, which have not started construction by July 1, 2021.

[2] In this context, "application" means, at a minimum a complete project description, site plan, and, if applicable, SEPA checklist. Permittees may establish additional elements of a completed application.

[3] In this context "started construction" means the site work associated with, and directly related to the approved project has begun. For example: grading the project site to final grade or utility installation. Simply clearing the project site does not constitute the start of construction. Permittees may establish additional requirements related to the start of construction.

vi. For the City of Tacoma, applications submitted prior to November 24, 2015, which have not started construction by July 1, 2021.

b. Site and subdivision scale requirements

i. The minimum requirements, thresholds, and definitions in Appendix 1, or minimum requirements, thresholds, and definitions determined by Ecology to be equivalent to Appendix 1, for new development, redevelopment, and construction sites shall be included in ordinances or other enforceable documents adopted by the local government. Adjustment and variance criteria equivalent to those in Appendix 1 shall be included. More stringent requirements may be used, and/or certain requirements may be tailored to local circumstances through the use of Ecology-approved basin plans or other similar water quality and quantity planning efforts. Such local requirements and thresholds shall provide equal or similar protection of receiving waters and equal or similar levels of pollutant control as compared to Appendix 1.

ii. The local requirements shall include the following requirements, limitations, and criteria that, when used to implement the minimum requirements in Appendix 1, will protect water quality, reduce the discharge of pollutants to the MEP, and satisfy the State requirement under Chapter 90.48 RCW to apply AKART prior to discharge:

(a) Site planning requirements

(b) BMP selection criteria

(c) BMP design criteria

(d) BMP infeasibility criteria

(e) LID competing needs criteria

(f) BMP limitations

Permittees shall document how the criteria and requirements will protect water quality, reduce the discharge of pollutants to the maximum extent practicable, and satisfy the state AKART requirements.

Permittees who choose to use the requirements, limitations, and criteria in the *Stormwater Management Manual for Western Washington* (SWMMWW), or an equivalent manual approved by Ecology, may cite this choice as their sole documentation to meet this requirement.

iii. Ecology review and approval of the local manuals and ordinances is required. The Permittee shall submit draft enforceable requirements, technical standards, and manuals that correspond to updates identified in Appendix 10, Part 2 to Ecology no later than July 1, 2020. Ecology will review and provide written response to the Permittee. If Ecology takes longer than 120 days to provide a written response, the required deadline for adoption and effective date will be automatically extended by the number of calendar days that Ecology exceeds a 120-day period for written response.

(a) The Permittee shall submit the required significant changes to the local programs as required in Appendix 10, Part 2, and in the format described in Table 3.

(b) Additional significant changes shall be submitted for equivalency review with the rationale, and any tests, or documentation to demonstrate that the proposal meets AKART and MEP. Incomplete submittals will not be reviewed. Permittees shall follow the submittal format in Appendix 10, Part 2, Table 4.

iv. No later than July 1, 2021, each Permittee shall adopt and make effective a local program that meets the requirements in S5.C.5.b.i through ii, above. Manuals and ordinances approved under this Section will be listed in Appendix 10, Part 3, following a permit modification.

(a) In the case of circumstances beyond the Permittee's control, such as litigation or administrative appeals that may result in noncompliance with the requirements of this Section, the Permittee shall promptly notify Ecology and submit a written request for an extension.

v. The program shall include the legal authority to inspect private stormwater facilities and enforce maintenance standards for all new development and redevelopment approved under the provisions of this Section.

vi. The program shall include a permitting process with site plan review, inspection, and enforcement capability to meet the following standards for both private and public projects, using qualified personnel:

(a) Review all stormwater site plans submitted to the Permittee for proposed development that meet the thresholds in S5.C.5.b.i, above.

(b) Inspect prior to clearing and construction, all permitted development sites that meet the thresholds in S5.C.5.b.i, and that have a high potential for sediment transport as determined through plan review based on definitions and requirements in Appendix 7. As an alternative to evaluating each site according to Appendix 7, Permittees may choose to inspect all construction sites that meet the minimum thresholds in S5.C.5.b.i.

(c) Inspect all permitted development sites that meet the thresholds in S5.C.5.b.i, above, during construction to verify proper installation and maintenance of required erosion and sediment controls. Enforce as necessary based on the inspection.

(d) Each Permittee shall manage maintenance activities to inspect all permanent stormwater treatment and flow control BMPs/facilities, and catch basins, in new residential developments every six months, until 90% of the lots are constructed (or when construction has stopped and the site is fully stabilized), to identify maintenance needs and enforce compliance with maintenance standards as needed.

(e) Inspect all permitted development sites that meet the thresholds in S5.C.5.b.i upon completion of construction and prior to final approval or occupancy to ensure proper installation of permanent stormwater facilities. Verify that a maintenance plan is completed and responsibility for maintenance is assigned for stormwater treatment and flow control BMPs/facilities. Enforce as necessary based on the inspection.

(f) Compliance with the inspection requirements in (b)-(e) above shall be determined by the presence of an established inspection program designed to inspect all sites that meet the thresholds in S5.C.5.b.i and ii. Compliance during this Permit term shall be determined by achieving at least 80% of required inspections. The inspections may be combined with other inspections provided they are performed using qualified personnel.

(g) The program shall include a procedure for keeping records of inspections and enforcement actions by staff, including inspection reports, warning letters, notices of violations, and other enforcement records. Records of maintenance inspections and maintenance activities shall be maintained.

(h) The program shall include an enforcement strategy to respond to issues of non-compliance.

vii. The program shall make available, as applicable, the link to the electronic *Construction Stormwater General Permit* Notice of Intent (NOI) form for construction activity and, as applicable, a link to the electronic *Industrial Stormwater General Permit* NOI form for industrial activity to representatives of proposed new development and redevelopment. Permittees shall continue to enforce local ordinances controlling runoff from sites that are also covered by stormwater permits issued by Ecology.

viii. Each Permittee shall ensure that all staff whose primary job duties are implementing the program to *Control Stormwater Runoff from New Development, Redevelopment, and Construction Sites*, including permitting, plan review, construction site inspections, and enforcement, are trained to conduct these activities. As determined necessary by the Permittee, follow-up training shall be provided to address changes in procedures, techniques or staffing. Permittees shall document and maintain records of the training provided and the staff trained.

6. Stormwater Planning

Each Permittee shall implement a Stormwater Planning program to inform and assist in the development of policies and strategies as water quality management tools to protect receiving waters.

Minimum performance measures:

a. By August 1, 2020, each Permittee shall convene an inter-disciplinary team to inform and assist in the development, progress, and influence of this program.

b. Coordination with long-range plan updates.

i. Each Permittee shall describe how stormwater management needs and protection/improvement of receiving water health are (or are not) informing the planning update processes and influencing policies and implementation strategies in their jurisdiction. The reporting shall describe the water quality and watershed protection policies, strategies, codes, and other measures intended to protect and improve local receiving water health through planning, or taking into account stormwater management needs or limitations.

(a) On or before March 31, 2021, the Permittee shall respond to the series of Stormwater Planning Annual Report questions that describe how anticipated stormwater impacts on water quality were addressed, if at all, during the 2013-2019 permit term in updates to the Comprehensive Plan (or equivalent) and in other locally initiated or state-mandated long-range land use plans that are used to accommodate growth or transportation.

(b) On or before March 31, 2022, the Permittee shall submit a report, responding to the same questions included in (a) above, describing how water quality is being addressed, if at all, during this permit term in updates to the Comprehensive Plan (or equivalent) and in other locally initiated or state-mandated, long-range land use plans that are used to accommodate growth or transportation.

c. Low impact development code-related requirements

i. Permittees shall continue to require LID Principles and LID BMPs when updating, revising, and developing new local development-related codes, rules, standards, or other enforceable documents, as needed.

The intent shall be to make LID the preferred and commonly-used approach to site development. The local development-related codes, rules, standards, or other enforceable documents shall be designed to minimize impervious surfaces, native vegetation loss, and stormwater runoff in all types of development situations, where feasible.

(a) Annually, each Permittee shall assess and document any newly identified administrative or regulatory barriers to implementation of LID Principles or LID BMPs since local codes were updated in accordance with the 2013 Permit, and the measures developed to address the barriers. If applicable, the report shall also describe mechanisms adopted to encourage or require implementation of LID Principles or LID BMPs.

d. Stormwater Management Action Planning

i. Each county Permittee shall describe in their SWMP how the watershed-scale stormwater plans developed during the 2013 Permit term are being used to inform their S5.C.7 project prioritization and selection.

ii. No later than December 31, 2022, each county Permittee shall develop a Stormwater Management Action Plan (SMAP) for a single sub-basin or catchment area located within the geographic areas for which watershed-scale stormwater plans were developed in the 2013 Permit. The required SMAP content is described in the *Stormwater Management Action Planning Guidance* (Ecology, 2019. Publication 19-10-010). The SMAP shall identify:

(a) Specific short-term actions (*i.e.*, actions or projects to be accomplished within six years).

(b) Specific long-term actions (*i.e.*, actions or projects to be accomplished within seven to 20 years).

(c) Land management/development strategies and/or actions needed for water quality management, if these were not articulated in the watershed-scale stormwater plans. Include these in (a) and (b).

(d) Targeted, enhanced, or customized implementation of stormwater management actions related to permit sections within S5, including:

- IDDE field screening,
- Prioritization of Source Control inspections,
- O&M inspections or enhanced maintenance, or
- Public Education and Outreach behavior change programs

Identified actions shall support other specifically identified stormwater management strategies and actions for the basin overall, or for the catchment area in particular.

(a) A revised and updated implementation schedule and budget sources.

(b) A county Permittee may choose to prepare a SMAP for a catchment area in an alternative watershed by conducting a similar process and considering the range of issues outlined in S5.C.6.d.iii-v and as described in the *Stormwater Management Action Planning Guidance* (Ecology, 2019. Publication 19-10-010).

iii. This Section applies only to a county Permittee that is selecting an alternative watershed pursuant to S5.C.6.d.ii.(f).

Receiving Water Assessment. The Permittee shall document and assess existing information related to their local receiving waters and contributing area conditions to identify which receiving waters are most likely to benefit from stormwater management planning.

By March 31, 2022, the Permittee shall submit a watershed inventory and include a brief description of the relative conditions of the receiving waters and the contributing areas. The watershed inventory shall be submitted as a table with each receiving water name, its total watershed area, the percent of the total watershed area that is in the Permittee's jurisdiction, and the findings of the stormwater influence assessment for each basin. Indicate which receiving waters will be included in the S5.C.6.d.iv prioritization process. Include a map of the delineated basins with references to the watershed inventory table.

(a) Identify which basins are expected to have a relatively low expected Stormwater Management Influence for SMAP. See the guidance document for definition and description of this assessment.

Basins having relatively low expected Stormwater Management Influence for SMAP do not need to be included in S5.C.6.d.iv-v.

iv. This Section applies only to a county Permittee that is selecting an alternative watershed pursuant to S5.C.6.d.ii.(f).

Receiving Water Prioritization. Informed by the assessment of receiving water conditions in (iii), above, and other local and regional information, the

Permittee shall develop and implement a prioritization method and process to determine which receiving waters will receive the most benefit from implementation of stormwater facility retrofits, tailored implementation of SWMP actions, and other land/development management actions (different than the existing new and redevelopment requirements). The retrofits and actions shall be designed to: 1) conserve, protect, or restore receiving waters through stormwater and land management strategies that act as water quality management tools, 2) reduce pollutant loading, and 3) address hydrologic impacts from existing development as well as planned and expected future buildout conditions.

No later than June 30, 2022, document the prioritized and ranked list of receiving waters.

(a) The Permittee shall document the priority ranking process used to identify high priority receiving waters. The Permittee may reference existing local watershed management plan(s) as source(s) of information or rationale for the prioritization.

(b) The ranking process shall include the identification of high priority catchment area(s) for focus of the Stormwater Management Action Plan (SMAP) in S5.C.6.d.v.

v. This Section applies only to a county Permittee that is selecting an alternative watershed pursuant to S5.C.6.d.ii.(f).

Stormwater Management Action Plan (SMAP). No later than December 31, 2022, the Permittee shall develop a SMAP for at least one high priority catchment area from S5.C.6.d.iv that identifies all of the following:

(a) A description of the stormwater facility retrofits needed for the area including the BMP types and preferred locations.

(b) Land management/development strategies and/or actions identified for water quality management.

(c) Targeted, enhanced, or customized implementation of stormwater management actions related to permit sections within S5, including:

- IDDE field screening,
- Prioritization of Source Control inspections,
- O&M inspections or enhanced maintenance, or
- Public Education and Outreach behavior change program.

Actions identified shall be used to support other specifically identified stormwater management strategies and actions for the basin overall, or for the catchment area in particular.

(d) Identification of needed changes to local long-range plans to address SMAP priorities, if applicable.

(e) A proposed implementation schedule and budget sources for:

- Short-term actions (*i.e.*, actions to be accomplished within six years), and
- Long-term actions (*i.e.*, actions to be accomplished within seven to 20 years).

(f) A process and schedule to provide future assessment and feedback to improve the planning process and implementation of procedures or projects.

vi. Permittees selecting an alternative watershed pursuant to S5.C.6.d.ii.(f) may rely on another jurisdiction to meet all or part of SMAP requirements at a watershed scale, provided a SMAP is completed for at least one priority catchment located within the Permittee's jurisdiction.

7. Structural Stormwater Controls

Each Permittee shall implement a Structural Stormwater Control Program to prevent or reduce impacts to waters of the State caused by discharges from the MS4. Impacts that shall be addressed include disturbances to watershed hydrology and stormwater pollutant discharges.

The program shall consider impacts caused by stormwater discharges from areas of existing development; including runoff from highways, streets and roads owned or operated by the Permittee; and areas of new development, where impacts are anticipated as development occurs.

Minimum performance measures:

a. The program shall address impacts that are not adequately controlled by the other required actions of the SWMP.

i. The program shall consider the following projects:

(a) New flow control facilities.

(b) New treatment (or treatment and flow control) facilities.

(c) New LID BMPs.

(d) Retrofit of existing treatment and/or flow control facilities.

(e) Property acquisition for water quality and/or flow control benefits (not associated with future facilities).

(f) Maintenance with capital construction costs ≥ $25,000.

ii. Permittees should consider other projects to address impacts, such as:

(a) Restoration of riparian buffers

(b) Restoration of forest cover.

(c) Floodplain reconnection projects on water bodies that are not flow control exempt per Appendix 1.

(d) Permanent removal of impervious surfaces.

(e) Other actions to address stormwater runoff into or from the MS4 not otherwise required in S5.C.

iii. Permittees may not use in-stream culvert replacement or channel restoration projects for compliance with this requirement.

iv. The Structural Stormwater Control Program may also include a program designed to implement small-scale projects that are not planned in advance.

b. Each Permittee's SWMP Plan shall describe the Structural Stormwater Control Program, including the following:

i. The Structural Stormwater Control Program goals.

ii. The planning process used to develop the Structural Stormwater Control Program, including:

(a) The geographic scale of the planning process.

(b) Issues and regulations addressed.

(c) Steps in the planning process.

(d) Types of characterization information considered.

(e) Amount budgeted for implementation.

(f) The public involvement process.

(g) A description of the prioritization process, procedures and criteria used to select the Structural Stormwater Control projects.

c. With each Annual Report, each Permittee shall provide a list of planned, individual projects scheduled for implementation during this Permit term for the purpose of meeting S5.C.7.d. This list shall include at a minimum the information and formatting specified in Appendix 12.

d. No later than December 31, 2022, each Permittee shall achieve 300 SSC Program Points, calculated per Appendix 12, as follows:

i. 225 design-stage retrofit incentive points, and

ii. 75 complete or maintenance stage incentive points.

A minimum of 75 incentive points is required for complete or maintenance stage projects, additional incentive points for complete or maintenance stage projects may substitute for design-stage incentive points.

8. Source Control Program for Existing Development

a. The Permittee shall implement a program to reduce pollutants in runoff from areas that discharge to the MS4. The program shall include:

i. Application of operational source control BMPs, and if necessary, structural source control BMPs or treatment BMPs/facilities, or both, to pollution generating sources associated with existing land uses and activities.

ii. Inspections of pollutant generating sources at publicly and privately owned institutional, commercial, and industrial sites to enforce implementation of required BMPs to control pollution discharging into the MS4.

iii. Application and enforcement of local ordinances at sites, identified pursuant to S5.C.8.b.ii, including sites with discharges authorized by a separate NPDES permit. Permittees that are in compliance with the terms of this Permit will not be held liable by Ecology for water quality standard violations or receiving water impacts caused by industries and other Permittees covered, or which should be covered under an NPDES permit issued by Ecology.

iv. Practices to reduce polluted runoff from the application of pesticides, herbicides, and fertilizers from the sites identified in the inventory.

b. ***Minimum performance measures***

i. Permittees shall enforce ordinance(s), or other enforceable documents, requiring the application of source control BMPs for pollutant generating sources associated with existing land uses and activities.

Permittees shall update and make effective the ordinance(s), or other enforceable documents, as necessary to meet the requirements of this Section no later than August 1, 2021.

The requirements of this subsection are met by using the source control BMPs in Volume IV of the *Stormwater Management Manual for Western Washington*, or a functionally equivalent manual approved by Ecology. In cases where the manual(s) lack guidance for a specific source of pollutants, the Permittee shall work with the owner/operator to implement or adapt BMPs based on the best professional judgement of the Permittee.

Applicable operational source control BMPs shall be required for all pollutant generating sources. Structural source control BMPs , or treatment BMPs/facilities, or both, shall be required for pollutant generating sources if operational source control BMPs do not prevent illicit discharges or violations of surface water, groundwater, or sediment management standards because of inadequate stormwater controls. Implementation of source control requirements may be done through education and technical assistance programs, provided that formal enforcement authority is available to the Permittee and is used as determined necessary by the Permittee, in accordance with S5.C.8.b.iv, below.

ii. Permittees shall implement a program to identify publicly and privately owned institutional, commercial, and industrial sites which have the potential to generate pollutants to the MS4. The Permittee shall update the inventory at least once every 5 years. The program shall include a source control inventory which lists:

(a) Businesses and/or sites identified based on the presence of activities that are pollutant generating (refer to Appendix 8).

(b) Other pollutant generating sources, based on complaint response, such as home-based businesses and multifamily sites.

iii. Permittees shall implement an inspection program for sites identified pursuant to S5.C.8.b.ii, above.

(a) All identified sites with a business address shall be provided, by mail, telephone, electronic communications, or in-person information about activities that may generate pollutants and the source control requirements applicable to those activities. This information may be provided all at one time or spread out over the permit term to allow for some tailoring and distribution of the information during site inspections.

(b) The Permittee shall annually complete the number of inspections equal to 20% of the businesses and/or sites listed in their source control inventory to assess BMP effectiveness and compliance with source control requirements. The Permittee may count follow up compliance inspections at the same site toward the 20% inspection rate. The Permittee may select which sites to inspect each year and is not required to inspect 100% of sites over a 5-year period. Sites may be prioritized for inspection based on their land use category, potential for pollution generation, proximity to receiving waters, or to address an identified pollution problem within a specific geographic area or sub-basin.

(c) Each Permittee shall inspect 100% of sites identified through credible complaints.

(d) Permittees may count inspections conducted based on complaints, or when the property owner denies entry, to the 20% inspection rate.

iv. Each Permittee shall implement a progressive enforcement policy to require sites to come into compliance with stormwater requirements within a reasonable time period as specified below:

(a) If the Permittee determines, through inspections or otherwise, that a site has failed to adequately implement required BMPs, the Permittee shall take appropriate follow-up action(s), which may include: phone calls, letters, emails, or follow-up inspections.

(b) When a Permittee determines that a site has failed to adequately implement BMPs after a follow-up inspection(s), the Permittee shall take enforcement action as established through authority in its municipal code or ordinances, or through the judicial system.

(c) Each Permittee shall maintain records, including documentation of each site visit, inspection reports, warning letters, notices of violations, and other enforcement records, demonstrating an effort to bring sites into compliance. Each Permittee shall also maintain records of sites that are not inspected because the property owner denies entry.

(d) A Permittee may refer non-emergency violations of local ordinances to Ecology, provided, the Permittee also makes a documented effort of progressive enforcement. At a minimum, a Permittee’s enforcement effort shall include documentation of inspections and warning letters or notices of violation.

v. Permittees shall train staff who are responsible for implementing the Source Control Program to conduct these activities. The ongoing training program shall cover the legal authority for source control, source control BMPs and their proper application, inspection protocols, lessons learned, typical cases, and enforcement procedures. Follow-up training shall be provided as needed to address changes in procedures, techniques, requirements, or staff. Permittees shall document and maintain records of the training provided and the staff trained.

9. Illicit Connections and Illicit Discharges Detection and Elimination

The SWMP shall include an ongoing program designed to prevent, detect, characterize, trace, and eliminate illicit connections and illicit discharges into the MS4.

Minimum performance measures:

a. The program shall include procedures for reporting and correcting or removing illicit connections, spills, and other illicit discharges when they are suspected or identified. The program shall also include procedures for addressing pollutants entering the MS4 from an interconnected, adjoining MS4.

Illicit connections and illicit discharges shall be identified through field screening, inspections, complaints/reports, construction inspections, maintenance inspections, source control inspections, and/or monitoring information, as appropriate.

b. Permittees shall continue to implement an ordinance or other regulatory mechanism to effectively prohibit non-stormwater, illicit discharges, including spills, into the Permittee's MS4.

i. ***Allowable Discharges***: The ordinance or other regulatory mechanism does not need to prohibit the following categories of non-stormwater discharges:

(a) Diverted stream flows

(b) Rising groundwaters

(c) Uncontaminated groundwater infiltration (as defined at 40 CFR 35.2005(b)(20))

(d) Uncontaminated pumped groundwater

(e) Foundation drains

(f) Air conditioning condensation

(g) Irrigation water from agricultural sources that is commingled with urban stormwater

(h) Springs

(i) Uncontaminated water from crawl space pumps

(j) Footing drains

(k) Flows from riparian habitats and wetlands

(l) Non-stormwater discharges authorized by another NPDES or State Waste Discharge permit

(m) Discharges from emergency firefighting activities in accordance with S2 – Authorized *Discharges*

ii. ***Conditionally Allowable Discharges:*** The ordinance or other regulatory mechanism, may allow the following categories of non-stormwater discharges only if the stated conditions are met:

(a) Discharges from potable water sources including, but not limited to, water line flushing, hyperchlorinated water line flushing, fire hydrant system flushing, and pipeline hydrostatic test water. Planned discharges shall be de-chlorinated to a total residual chlorine concentration of 0.1 ppm or less, pH-adjusted if necessary, and volumetrically and velocity controlled to prevent resuspension of sediments in the MS4.

(b) Discharges from lawn watering and other irrigation runoff. These discharges shall be minimized through, at a minimum, public education activities (see S5.C.11) and water conservation efforts.

(c) Dechlorinated swimming pool, spa, and hot tub discharges. The discharges shall be dechlorinated to a total residual chlorine concentration of 0.1 ppm or less, pH-adjusted and reoxygenated if necessary, and volumetrically and velocity controlled to prevent resuspension of sediments in the MS4. Discharges shall be thermally controlled to prevent an increase in temperature of the receiving water. Swimming pool cleaning wastewater and filter backwash shall not be discharged to the MS4.

(d) Street and sidewalk wash water, water used to control dust, and routine external building washdown that does not use detergents. The Permittee shall reduce these discharges through, at a minimum, public education activities (see S5.C.11) and/or water conservation efforts. To avoid washing pollutants into the MS4, Permittees shall minimize the amount of street wash and dust control water used.

(e) Other non-stormwater discharges shall be in compliance with the requirements of a pollution prevention plan reviewed by the Permittee which addresses control of such discharges.

iii. The Permittee shall further address any category of discharges in S5.C.9.b.i or ii, above, if the discharges are identified as significant sources of pollutants to waters of the State.

c. Each Permittee shall implement an ongoing program designed to detect and identify non-stormwater discharges and illicit connections into the Permittee's MS4. The program shall include the following components:

i. Procedures for conducting investigations of the Permittees MS4, including field screening and methods for identifying potential sources. These procedures may also include source control inspections.

The Permittee shall implement a field screening methodology appropriate to the characteristics of the MS4 and water quality concerns. Screening for illicit connections may be conducted using the *Illicit Connection and Illicit Discharge*

Field Screening and Source Tracing Guidance Manual (Herrera Environmental Consultants, Inc., May 2013.); or another method of comparable or improved effectiveness. The Permittee shall document the field screening methodology in the Annual Report.

(a) Each Permittee shall implement an ongoing field screening program of, on average, 12% of the Permittee's known MS4 each year. Permittees shall annually track the total percentage of the MS4 screened beginning August 1, 2019.

ii. A publicly-listed and publicized hotline or other telephone number for public reporting of spills and other illicit discharges.

iii. An ongoing training program for all municipal field staff, who, as part of their normal job responsibilities might come into contact with or otherwise observe an illicit discharge or illicit connection to the MS4, on the identification of an illicit discharge and/or connection, and on the proper procedures for reporting and responding to the illicit discharge and/or connection. Follow-up training shall be provided as needed to address changes in procedures, techniques, requirements, or staffing. Permittees shall document and maintain records of the trainings provided and the staff trained.

d. Each Permittee shall implement an ongoing program designed to address illicit discharges, including spills and illicit connections, into the Permittee's MS4. The program shall include:

i. Procedures for characterizing the nature of, and potential public or environmental threat posed by, any illicit discharges found by or reported to the Permittee. Procedures shall address the evaluation of whether the discharge shall be immediately contained and steps to be taken for containment of the discharge.

ii. Procedures for tracing the source of an illicit discharge; including visual inspections, and when necessary, opening manholes, using mobile cameras, collecting and analyzing water samples, and/or other detailed inspection procedures.

iii. Procedures for eliminating the discharge; including notification of appropriate owners or operators of interconnected MS4s; notification of the property owner; technical assistance; follow-up inspections; and use of the compliance strategy developed pursuant to S5.C.9.d.iv, including-escalating enforcement and legal-actions if the discharge is not eliminated.

iv. Compliance with the provisions in S5.C.9.d.i, ii, and iii, above, shall be achieved by meeting the following timelines:

(a) Immediately respond to all illicit discharges, including spills, which are determined to constitute a threat to human health, welfare, or the environment consistent with General Condition G3.

(b) Investigate (or refer to the appropriate agency with authority to act) within 7 days, on average, any complaints, reports or monitoring information that indicates a potential illicit discharge.

(c) Initiate an investigation within 21 days of any report or discovery of a suspected illicit connection to determine the source of the connection, the nature and volume of discharge through the connection, and the party responsible for the connection.

(d) Upon confirmation of an illicit connection, use enforcement authority in a documented effort to eliminate the illicit connection within 6 months. All known illicit connections to the MS4 shall be eliminated.

e. Permittees shall train staff who are responsible for identification, investigation, termination, cleanup, and reporting of illicit discharges, including spills and illicit connections, to conduct these activities. Follow-up training shall be provided as needed to address changes in procedures, techniques, requirements, or staff. Permittees shall document and maintain records of the training provided and the staff trained.

f. Each Permittee shall either participate in a regional emergency response program, or develop and implement procedures to investigate and respond to spills and improper disposal into the MS4 owned or operated by the Permittee.

g. Recordkeeping: Each Permittee shall track and maintain records of the activities conducted to meet the requirements of this Section. In the Annual Report, each Permittee shall submit data for all of the illicit discharges, spills, and illicit connections, including those that were found by, reported to, or investigated by the Permittee during the previous calendar year. The data shall include the information specified in Appendix 14 and WQWebIDDE. Each Permittee may either use their own system or WQWebIDDE for recording this data. Final submittals shall follow the instructions, timelines, and format as described in Appendix 14.

10. Operation and Maintenance Program

Each Permittee shall implement and document a program to regulate maintenance activities and to conduct maintenance activities by the Permittee to prevent or reduce stormwater impacts.

Minimum performance measures:

a. Maintenance Standards. Each Permittee shall implement maintenance standards that are as protective, or more protective, of facility function than those specified in the *Stormwater Management Manual for Western Washington* (SWMMWW) or a Phase I program approved by Ecology. For facilities which do not have maintenance standards, the Permittee shall develop a maintenance standard. No later than July 1, 2021[4] each Permittee shall update their maintenance standards as necessary to meet the requirements in this Section.

i. The purpose of the maintenance standard is to determine if maintenance is required. The maintenance standard is not a measure of the facility's required condition at all times between inspections. Exceeding the maintenance standard between inspections and/or maintenance is not a permit violation.

[4] If Ecology takes longer than 120 days to provide a written response as outlined in S.5.C.5.b.3, the required deadline for adoption and effective date will be automatically extended by the number of calendar days that Ecology exceeds a 120-day period for written response.

ii. Unless there are circumstances beyond the Permittee's control, when an inspection identifies an exceedance of the maintenance standard, maintenance shall be performed:

(a) Within 1 year for typical maintenance of facilities, except catch basins.

(b) Within 6 months for catch basins.

(c) Within 2 years for maintenance that requires capital construction of less than $25,000.

Circumstances beyond the Permittee's control include denial or delay of access by property owners, denial or delay of necessary permit approvals, and unexpected reallocations of maintenance staff to perform emergency work. For each exceedance of the required timeframe, the Permittee shall document the circumstances and how they were beyond the Permittee's control.

b. Maintenance of stormwater facilities regulated by the Permittee

i. Each Permittee shall evaluate and, if necessary, update existing ordinances or other enforceable documents requiring maintenance of all stormwater treatment and flow control BMPs/facilities regulated by the Permittee (including catch basins that are part of the facilities regulated by the Permittee), in accordance with maintenance standards established under S5.C.10.a, above.

ii. Each Permittee shall implement an on-going inspection program to annually inspect all stormwater treatment and flow control BMPs/facilities regulated by the Permittee to enforce compliance with adopted maintenance standards as needed based on inspection. The inspection program is limited to facilities to which the Permittee can legally gain access, provided the Permittee shall seek access to all stormwater treatment and flow control BMPs/facilities regulated by the Permittee.

Permittees may reduce the inspection frequency based on maintenance records of double the length of time of the proposed inspection frequency. In the absence of maintenance records, the Permittee may substitute written statements to document a specific less frequent inspection schedule. Written statements shall be based on actual inspection and maintenance experience and shall be certified in accordance with G19 – *Certification and Signature*.

iii. Compliance with the inspection requirements of S5.C.10.b.ii, above, shall be determined by the presence of an established inspection program designed to inspect all facilities, and achieving at least 80% of required inspections.

iv. The Permittee shall require cleaning of catch basins regulated by the Permittee if they are found to be out of compliance with established maintenance standards in the course of inspections conducted at facilities under the requirements of S5.C.8 – *Source Control Program for Existing Development*, and S5.C.9 – *Illicit Connections and Illicit Discharges Detection and Elimination*, or if the catch basins are part of the stormwater facilities inspected under the requirements of S5.C.10 – *Operation and Maintenance Program*.

c. Maintenance of stormwater facilities owned or operated by the Permittee

i. Each Permittee shall implement a program to annually inspect all stormwater treatment and flow control BMPs/facilities owned or operated by the Permittee. Permittees shall implement appropriate maintenance action(s) in accordance with adopted maintenance standards.

Permittees may reduce the inspection frequency based on maintenance records of double the length of time of the proposed inspection frequency. In the absence of maintenance records, the Permittee may substitute written statements to document a specific less frequent inspection schedule. Written statements shall be based on actual inspection and maintenance experience and shall be certified in accordance with G19 – *Certification and Signature*.

ii. Each Permittee shall implement a program to conduct spot checks of potentially damaged stormwater treatment and flow control BMPs/facilities after major storm events (24-hour storm event with a 10-year or greater recurrence interval). If spot checks indicate widespread damage/maintenance needs, inspect all stormwater treatment and flow control BMPs/facilities that may be affected. Conduct repairs or take appropriate maintenance action in accordance with maintenance standards established under S5.C.10.a, above, based on the results of the inspections.

iii. Compliance with the inspection requirements of S5.C.10.c.i, and ii, above, shall be determined by the presence of an established inspection program designed to inspect all sites and achieving at least 95% of required inspections.

d. Maintenance of Catch Basins Owned or Operated by the Permittee

i. Each Permittee shall annually inspect all catch basins and inlets owned or operated by the Permittee, or implement alternatives below.

Alternatives to the standard approach of inspecting all catch basins annually: Permittees may apply the following alternatives to all or portions of their system.

(a) The annual catch basin inspection schedule may be changed as appropriate to meet the maintenance standards based on maintenance records of double the length of time of the proposed inspection frequency. In the absence of maintenance records for catch basins, the Permittee may substitute written statements to document a specific, less frequent inspection schedule. Written statements shall be based on actual inspection and maintenance experience and shall be certified in accordance with G19 – *Certification and Signature*.

(b) Annual inspections may be conducted on a "circuit basis" whereby 25% of catch basins and inlets within each circuit are inspected to identify maintenance needs. Include an inspection of the catch basin immediately upstream of any MS4 outfall, discharge point, or connections to public or private storm systems if applicable. Clean all catch basins within a given circuit for which the inspection indicates cleaning is needed to comply with maintenance standards established under S5.C.10.a, above.

(c) The Permittee may clean all pipes, ditches, catch basins, and inlets within a circuit once during the permit term. Circuits selected for this alternative shall drain to a single point.

ii. The disposal of decant water shall be in accordance with the requirements in Appendix 6 – *Street Waste Disposal*.

iii. Compliance with the inspection requirements of S5.C.10.d.i, above, shall be determined by the presence of an established inspection program designed to inspect all catch basins and inlets, or implemented alternative, and achieving at least 95% of required inspections.

e. Each Permittee shall implement practices, policies, and procedures to reduce stormwater impacts associated with runoff from all lands owned or maintained by the Permittee, and road maintenance activities under the functional control of the Permittee. No later than December 31, 2022, document the practices, policies, and procedures. Lands owned or maintained by the Permittee include, but are not limited to: parking lots, streets, roads, highways, buildings, parks, open space, road right-of-way, maintenance yards, and stormwater treatment and flow control BMPs/facilities.

The following activities shall be addressed:

i. Pipe cleaning

ii. Cleaning of culverts that convey stormwater in ditch systems

iii. Ditch maintenance

iv. Street cleaning

v. Road repair and resurfacing, including pavement grinding

vi. Snow and ice control

vii. Utility installation

viii. Maintaining roadside areas, including vegetation management

ix. Dust control

x. Pavement striping maintenance

xi. Application of fertilizers, pesticides, and herbicides according to the instructions for their use, including reducing nutrients and pesticides using alternatives that minimize environmental impacts

xii. Sediment and erosion control

xiii. Landscape maintenance and vegetation disposal

xiv. Trash and pet waste management

xv. Building exterior cleaning and maintenance

f. Implement an ongoing training program for employees of the Permittee who have primary construction, operations, or maintenance job functions that may impact stormwater quality. The training program shall address the importance of protecting water quality, operation and maintenance standards, inspection procedures, relevant SWPPPs, selecting appropriate BMPs, ways to perform their job activities to prevent or minimize impacts to water quality, and procedures for reporting water quality concerns. Follow-up training shall be provided as needed to address changes in procedures, techniques, requirements, or staffing. Permittees shall document and maintain records of the training provided. The staff training records to be kept include dates, activities or course descriptions, names and positions of staff in attendance.

g. Implement a Stormwater Pollution Prevention Plan (SWPPP) for all heavy equipment maintenance or storage yards, and material storage facilities owned or operated by the Permittee in areas subject to this Permit that are not required to have coverage under the General NPDES Permit for Stormwater Discharges Associated with Industrial Activities or another NPDES permit that authorizes stormwater discharges associated with the activity. As necessary, update SWPPPs no later than December 31, 2022, to include the following information. The SWPPP shall include periodic visual observation of discharges from the facility to evaluate the effectiveness of BMPs. At a minimum, the SWPPP shall include:

   i. A detailed description of the operational and structural BMPs in use at the facility and a schedule for implementation of additional BMPs when needed. BMPs selected shall be consistent with the *Stormwater Management Manual for Western Washington*, or Phase I program approved by Ecology. The SWPPP shall be updated as needed to maintain relevancy with the facility.

   ii. At the minimum, annual inspections of the facility, including visual observations of discharges, to evaluate the effectiveness of the BMPs, identify maintenance needs, and determine if additional or different BMPs are needed. The results of these inspections shall be documented in an inspection report or check list.

   iii. An inventory of the materials and equipment stored on-site, and the activities conducted at the facility which may be exposed to precipitation or runoff and could result in stormwater pollution.

   iv. A site map showing the facility's stormwater drainage, discharge points, and areas of potential pollutant exposure.

   v. A plan for preventing and responding to spills at the facility which could result in an illicit discharge.

   vi. A training plan for all personnel responsible for implementing any components of the SWPPP.

h. Maintain records of the activities conducted to meet the requirements of this Section.

11. Education and Outreach Program

The SWMP shall include an education and outreach program designed to:

- Build general awareness about methods to address and reduce stormwater runoff.
- Effect behavior change to reduce or eliminate behaviors and practices that cause or contribute to adverse stormwater impacts.
- Create stewardship opportunities that encourages community engagement in addressing the impacts from stormwater runoff.

Permittees may choose to meet these requirements individually or as a member of a regional group. Regional collaboration on general awareness or behavior change programs, or both, includes Permittees developing a consistent message, determining best methods for communicating the message, and when appropriate, creating strategies to effect behavior change. If a Permittee chooses to adopt one or more elements of a regional program, the Permittee should participate in the regional group and shall implement the adopted element(s) of the regional program in the local jurisdiction

Minimum performance measures:

a. Each Permittee shall implement an education and outreach program for the area served by the MS4. The program design shall be based on local water quality information and target audience characteristics to identify high priority target audiences, subject areas, and/or BMPs. Based on the target audience's demographic, the Permittee shall consider delivering its selected messages in language(s) other than English, as appropriate for the target audience.

   i. ***General awareness***: To build general awareness, Permittees shall target the following audiences and subject areas:

      (a) *Target Audiences*: General Public (including school age children and overburdened communities), and businesses (including home-based and mobile business)

      Subject areas:

      - General impacts of stormwater on surface waters, including impacts from impervious surfaces and of the hazards associated with illicit discharges and improper disposal of waste.
      - LID principles and LID BMPs.

      (b) *Target audiences*: Engineers, contractors, developers, and land use planners.

      Subject areas: Technical standards for stormwater site and erosion control plans.

      - LID principles and LID BMPs.
      - Stormwater treatment and flow control BMPs/facilities.

      (c) Permittees shall provide subject area information to the target audience on an ongoing or strategic schedule.

   ii. ***Behavior change***: To effect behavior change, Permittees shall select, at a minimum, one target audience and one BMP:

      (a) *Target audiences*: Residents, landscapers, and property managers/owners, school-age children, and businesses (including home-based and mobile businesses).

      BMPs

      - Use and storage of automotive chemicals, hazardous cleaning supplies, carwash soaps, and other hazardous materials.

- Prevention of illicit discharges.
- Yard care techniques protective of water quality.
- Use and storage of pesticides and fertilizers and other household chemicals.
- Carpet cleaning.
- Repair and maintenance BMPs for vehicles, equipment, and/or home buildings.
- Pet waste management and disposal.
- LID principles and LID BMPs.
- Stormwater facility maintenance, including LID facilities
- Dumpster and trash compactor maintenance.
- Litter and debris prevention.
- (Audience specific) Source Control BMPs.
- (Audience specific) Locally important, stormwater-related subject area.

iii. No later than July 1, 2020, each Permittee shall conduct a new evaluation of the effectiveness of the ongoing behavior change program (required under S5.C.10.a.ii of the 2013 Permit). Permittees shall document lessons learned and recommendations for which option to select from S5.C.11.a.iv.

Permittees that select option S5.C.11.a.iv.c, below, may forgo this evaluation if it will not add value to the overall behavior change program.

iv. Based on the recommendation from S5.C.11.a.iii, by February 1, 2021, each Permittee shall follow social marketing practices and methods, similar to Community-Based Social Marketing, and develop a campaign that is tailored to the community, including the development of a program evaluation plan. Each Permittee shall:

(a) Develop a strategy and schedule to more effectively implement the existing campaign, or

(b) Develop a strategy and schedule to expand the existing campaign to a new target audience or BMPs, or

(c) Develop a strategy and schedule for a new target audience and BMP behavior change campaign.

v. No later than April 1, 2021, begin to implement the strategy developed in S5.C.11.a.iv.

vi. No later than March 31, 2024, evaluate and report on:

(a) The changes in understanding and adoption of targeted behaviors resulting from the implementation of the strategy; and

(b) Any changes to the campaign in order to be more effective; describe the strategies and process to achieve the results.

vii. Permittees shall use results of the evaluation to continue to direct effective methods for implementation of the ongoing behavior change program.

b. Each Permittee shall provide and advertise stewardship opportunities and/or partner with existing organizations (including non-permittees) to encourage residents to participate in activities or events planned and organized within the community, such as: stream teams, storm drain marking, volunteer monitoring, riparian plantings and education activities.

S6. STORMWATER MANAGEMENT PROGRAM FOR SECONDARY PERMITTEES

A. Secondary Permittees and New Secondary Permittees Coverage

This Section applies to all Secondary Permittees and all New Secondary Permittees whether coverage under this Permit is obtained individually, or as a Co-Permittee with a city, town, county, and/or another Secondary Permittee.

New Secondary Permittees subject to this Permit shall fully meet the requirements of this Section as modified in footnotes in S6.D below, or as established as a condition of coverage by Ecology.

1. To the extent allowable under state, federal and local law, all components are mandatory for each Secondary Permittee covered under this Permit, whether covered as an individual Permittee or as a Co-Permittee.
2. Each Secondary Permittee shall develop and implement a Stormwater Management Program (SWMP). A SWMP is a set of actions and activities comprising the components listed in S6 and any additional actions necessary to meet the requirements of applicable TMDLs pursuant to S7 – *Compliance with TMDL Requirements*, and S8 – *Monitoring and Assessment*. The SWMP shall be designed to reduce the discharge of pollutants from MS4s to the Maximum Extent Practicable (MEP) and protect water quality.
3. Unless an alternate implementation schedule is established by Ecology as a condition of permit coverage, the SWMP shall be developed and implemented in accordance with the schedules contained in this Section and shall be fully developed and implemented no later than four and one-half years from initial permit coverage date. Secondary Permittees that are already implementing some or all of the required SWMP components shall continue implementation of those components.
4. Secondary Permittees may implement parts of their SWMP in accordance with the schedule for cities, towns and counties in S5, provided they have signed a memorandum of understanding or other agreement to jointly implement the activity or activities with one or more jurisdictions listed in S1.B, and submitted a copy of the agreement to Ecology.
5. Each Secondary Permittee shall prepare written documentation of the SWMP, called the SWMP Plan. The SWMP Plan shall include a description of program activities for the upcoming calendar year.
6. Conditions S6.A, S6.B, and S6.C are applicable to all Secondary Permittees covered under this Permit. In addition:
   a. S6.D is applicable to all Secondary Permittees, except the Port of Seattle and the Port of Tacoma.
   b. S6.E is applicable only to the Port of Seattle and the Port of Tacoma.

B. Coordination

Secondary Permittees shall coordinate stormwater-related policies, programs and projects within a watershed and interconnected MS4s. Where relevant and appropriate, the SWMP shall coordinate among departments of the Secondary Permittee to ensure compliance with the terms of this Permit.

C. Legal Authority

To the extent allowable under state law and federal law, each Secondary Permittee shall be able to demonstrate that it can operate pursuant to legal authority which authorizes or enables the Secondary Permittee to control discharges to and from MS4s owned or operated by the Secondary Permittee.

This legal authority may be a combination of statutes, ordinances, permits, contracts, orders, interagency agreements, or similar instruments.

D. Stormwater Management Program for Secondary Permittees

The SWMP for Secondary Permittees shall include the following components.

1. Public Education and Outreach
Each Secondary Permittee shall implement the following stormwater education strategies:

a. Storm drain inlets owned or operated by the Secondary Permittee that are located in maintenance yards, in parking lots, along sidewalks, and at pedestrian access points shall be clearly labeled with the message similar to “Dump no waste – Drains to water body.” [5]

As identified during visual inspection and regular maintenance of storm drain inlets per the requirements of S6.D.3.d and S6.D.6.a.i, below, or as otherwise reported to the Secondary Permittee, any inlet having a label that is no longer clearly visible and/or easily readable shall be re-labeled within 90 days.

b. Each year, beginning no later than three years from the initial date of Permit coverage, public ports, colleges, and universities shall distribute educational information to tenants and residents on the impact of stormwater discharges on receiving waters, and steps that can be taken to reduce pollutants in stormwater runoff. Distribution may be by hard copy or electronic means. Appropriate topics may include, but are not limited to:

i. How stormwater runoff affects local waterbodies.

ii. Proper use and application of pesticides and fertilizers.

iii. Benefits of using well-adapted vegetation.

iv. Alternative equipment washing practices, including cars and trucks that minimize pollutants in stormwater.

v. Benefits of proper vehicle maintenance and alternative transportation choices; proper handling and disposal of vehicle wastes, including the location of hazardous waste collection facilities in the area.

[5] New Secondary Permittees shall label all inlets as described in S6.D.1.a no later than four years from the initial date of permit coverage.

vi. Hazards associated with illicit connections and illicit discharges.

vii. Benefits of litter control and proper disposal of pet waste.

2. Public Involvement and Participation

Each year, no later than May 31, each Secondary Permittee shall:

a. Make the Annual Report available on the Permittee's website.

b. Make available on the Permittee's website the latest updated version of the SWMP Plan.

c. A Secondary Permittee that does not maintain a website may submit their updated SWMP Plan in electronic format to Ecology for posting on Ecology's website.

3. Illicit Discharge Detection and Elimination

Each Secondary Permittee shall:

a. From the initial date of permit coverage, comply with all relevant ordinances, rules, and regulations of the local jurisdiction(s) in which the Secondary Permittee is located that govern non-stormwater discharges.

b. Implement appropriate policies prohibiting illicit discharges[6] and an enforcement plan to ensure compliance with illicit discharge policies.[7] These policies shall address, at a minimum: illicit connections; non-stormwater discharges, including spills of hazardous materials; and improper disposal of pet waste and litter.

i. ***Allowable discharges***: The policies do not need to prohibit the following categories of non-stormwater discharges:

(a) Diverted stream flows

(b) Rising groundwaters

(c) Uncontaminated groundwater infiltration (as defined at 40 CFR 35.2005(b)(20))

(d) Uncontaminated pumped groundwater

(e) Foundation drains

(f) Air conditioning condensation

(g) Irrigation water from agricultural sources that is commingled with urban stormwater

(h) Springs

(i) Uncontaminated water from crawl space pumps

(j) Footing drains

(k) Flows from riparian habitats and wetlands

[6] New Secondary Permittees shall develop and implement appropriate policies prohibiting illicit discharges, and identify possible enforcement mechanisms as described in S6.D.3.b, no later than one year from initial date of permit coverage.

[7] New Secondary Permittees shall develop and implement an enforcement plan as described in S6.D.3.b no later than 18 months from the initial date of permit coverage.

(l) Discharges from emergency firefighting activities in accordance with S2 – *Authorized Discharges*

(m) Non-stormwater discharges authorized by another NPDES or State Waste Discharge permit

ii. ***Conditionally allowable discharges***: The policies may allow the following categories of non-stormwater discharges only if the stated conditions are met and such discharges are allowed by local codes:

(a) Discharges from potable water sources, including but not limited to water line flushing, hyperchlorinated water line flushing, fire hydrant system flushing, and pipeline hydrostatic test water. Planned discharges shall be de-chlorinated to a total residual chlorine concentration of 0.1 ppm or less, pH-adjusted if necessary, and volumetrically and velocity controlled to prevent resuspension of sediments in the MS4.

(b) Discharges from lawn watering and other irrigation runoff. These discharges shall be minimized through, at a minimum, public education activities and water conservation efforts conducted by the Secondary Permittee and/or the local jurisdiction.

(c) Dechlorinated swimming pool, spa, and hot tub discharges. The discharges shall be dechlorinated to a total residual chlorine concentration of 0.1 ppm or less, pH-adjusted and reoxygenated if necessary, and volumetrically and velocity controlled to prevent resuspension of sediments in the MS4. Discharges shall be thermally controlled to prevent an increase in temperature of the receiving water. Swimming pool cleaning wastewater and filter backwash shall not be discharged to the MS4.

(d) Street and sidewalk wash water, water used to control dust, and routine external building washdown that does not use detergents. The Secondary Permittee shall reduce these discharges through, at a minimum, public education activities and/or water conservation efforts conducted by the Secondary Permittee and/or the local jurisdiction. To avoid washing pollutants into the MS4, the Secondary Permittee shall minimize the amount of street wash and dust control water used.

(e) Other non-stormwater discharges shall be in compliance with the requirements of a pollution prevention plan reviewed by the Permittee which addresses control of such discharges.

iii. The Secondary Permittee shall address any category of discharges in S6.D.3.b.i or ii, above, if the discharge is identified as a significant source of pollutants to waters of the State.

c. Maintain a storm sewer system map showing the locations of all known storm drain outfalls and discharge points, labeling the receiving waters (other than groundwater), and delineating the areas contributing runoff to each outfall and discharge point. Make the map (or completed portions of the map) available on request to Ecology and to the extent appropriate to other Permittees. The preferred format for mapping is an electronic format with fully described mapping standards.[8]

d. Conduct field inspections and visually inspect for illicit discharges at all known MS4 outfalls and discharge points. Visually inspect at least one third (on average) of all known outfalls and discharge points each year, beginning no later than two years from the initial date of permit coverage. Implement procedures to identify and remove illicit discharges. Keep records of inspections and follow-up activities.

e. Implement a spill response plan that includes coordination with a qualified spill responder.[9]

f. No later than two years from initial date of permit coverage, provide staff training or coordinate with existing training efforts to educate staff on proper BMPs for preventing illicit discharges, including spills. Train all Permittee staff who, as part of their normal job responsibilities, have a role in preventing such illicit discharges.

4. Construction Site Stormwater Runoff Control

From the initial date of permit coverage, each Secondary Permittee shall:

a. Comply with all relevant ordinances, rules, and regulations of the local jurisdiction(s) in which the Secondary Permittee is located that govern construction phase stormwater pollution prevention measures.

b. Ensure that all construction projects under the functional control of the Secondary Permittee which require a construction stormwater permit obtain coverage under the NPDES General Permit for Stormwater Discharges Associated with Construction Activities, or an individual NPDES permit prior to discharging construction related stormwater.

c. Coordinate with the local jurisdiction regarding projects owned or operated by other entities which discharge into the Secondary Permittee's MS4, to assist the local jurisdiction with achieving compliance with all relevant ordinances, rules, and regulations of the local jurisdiction(s).

d. Provide training or coordinate with existing training efforts to educate relevant staff in erosion and sediment control BMPs and requirements, or hire trained contractors to perform the work.

e. Coordinate, as requested, with Ecology or the local jurisdiction to provide access for inspection of construction sites or other land disturbances, which are under the functional control of the Secondary Permittee during land disturbing activities and/or the construction period.

5. Post-Construction Stormwater Management for New Development and Redevelopment

From the initial date of permit coverage, each Secondary Permittee shall:

[8] New Secondary Permittees shall meet the requirements of S6.D.3.c no later than four and one-half years from the initial date of permit coverage.

[9] New Secondary Permittees shall develop and implement a spill response plan as described in S6.D.3.e no later than four and one-half years from the initial date of permit coverage.

a. Comply with all relevant ordinances, rules, and regulations of the local jurisdiction(s) in which the Secondary Permittee is located that govern post-construction stormwater pollution prevention measures.

b. Coordinate with the local jurisdiction regarding projects owned or operated by other entities which discharge into the Secondary Permittee's MS4, to assist the local jurisdiction with achieving compliance with all relevant ordinances, rules, and regulations of the local jurisdiction(s).

6. Pollution Prevention and Good Housekeeping for Municipal Operations

Each Secondary Permittee shall:

a. Implement a municipal Operation and Maintenance (O&M) Plan to minimize stormwater pollution from activities conducted by the Secondary Permittee. The O&M Plan shall include appropriate pollution prevention and good housekeeping procedures for all of the following operations, activities, and/or types of facilities that are present within the Secondary Permittee's boundaries and under the functional control of the Secondary Permittee.[10]

   i. *Stormwater collection and conveyance systems*, including catch basins, stormwater pipes, open channels, culverts, and stormwater treatment and flow control BMPs/facilities. The O&M Plan shall address, at a minimum: scheduled inspections and maintenance activities, including cleaning and proper disposal of waste removed from the system. Secondary Permittees shall properly maintain stormwater collection and conveyance systems owned or operated by the Secondary Permittee and annually inspect and maintain all stormwater facilities to ensure facility function.

   Secondary Permittees shall establish maintenance standards that are as protective, or more protective, of facility function than those specified in Chapter 4, Volume V of the *Stormwater Management Manual for Western Washington*.

   Secondary Permittees shall review their maintenance standards to ensure they are consistent with the requirements of this Section.

   Secondary Permittees shall conduct spot checks of potentially damaged permanent stormwater treatment and flow control BMPs/facilities following major storm events (24-hour storm event with a 10-year or greater recurrence interval).

   ii. *Roads, highways, and parking lots*. The O&M Plan shall address, but is not limited to: deicing, anti-icing, and snow removal practices; snow disposal areas; material (e.g., salt, sand, or other chemical) storage areas; all-season BMPs to reduce road and parking lot debris and other pollutants from entering the MS4.

   iii. *Vehicle fleets*. The O&M Plan shall address, but is not limited to: storage, washing, and maintenance of Secondary Permittee vehicle fleets; and fueling facilities. Secondary Permittees shall conduct all vehicle and equipment washing

[10] New Secondary Permittees shall develop and implement the Operation and Maintenance Plan described in S6.D.6.a no later than three and a half years from the initial date of permit coverage.

and maintenance in a self-contained covered building or in designated wash and/or maintenance areas.

iv. *External building maintenance*. The O&M Plan shall address, building exterior cleaning and maintenance including cleaning, washing, painting; maintenance and management of dumpsters; other maintenance activities.

v. *Parks and open space*. The O&M Plan shall address, but is not limited to: proper application of fertilizer, pesticides, and herbicides; sediment and erosion control; BMPs for landscape maintenance and vegetation disposal; and trash and pet waste management.

vi. *Material storage facilities, and heavy equipment maintenance or storage yards*. Secondary Permittees shall develop and implement a Stormwater Pollution Prevention Plan to protect water quality at each of these facilities owned or operated by the Secondary Permittee and not covered under the *Industrial Stormwater General Permit* or under another NPDES permit that authorizes stormwater discharges associated with the activity.

vii. *Other facilities* that would reasonably be expected to discharge contaminated runoff. The O&M Plan shall address proper stormwater pollution prevention practices for each facility.

b. From the initial date of permit coverage, Secondary Permittees shall also have permit coverage for all facilities operated by the Secondary Permittee that are required to be covered under the General NPDES Permit for Stormwater Discharges Associated with Industrial Activities or another NPDES permit that authorizes discharges associated with the activity.

c. The O&M Plan shall include sufficient documentation and records as necessary to demonstrate compliance with the O&M Plan requirements in S6.D.6.a.i through vii above.

d. No later than three years from the initial date of permit coverage, Secondary Permittees shall implement a program designed to train all employees whose primary construction, operations, or maintenance job functions may impact stormwater quality. The training shall address:

i. The importance of protecting water quality.

ii. The requirements of this Permit.

iii. Operation and maintenance requirements.

iv. Inspection procedures.

v. Ways to perform their job activities to prevent or minimize impacts to water quality.

vi. Procedures for reporting water quality concerns, including potential illicit discharges (including spills).

E. Stormwater Management Program for the Port of Seattle and Port of Tacoma

Permittees that are already implementing some or all of the Stormwater Management Program (SWMP) components in this Section shall continue implementation of those components of their SWMP.

The SWMP for the Port of Seattle and the Port of Tacoma shall include the following components:

1. **Education Program**
   The SWMP shall include an education program aimed at tenants and Permittee employees. The goal of the education program is to reduce or eliminate behaviors and practices that cause or contribute to adverse stormwater impacts.

   Minimum performance measure:

   a. The Permittee shall make educational materials available to tenants and Permittee employees whose job duties could impact stormwater.

2. **Public Involvement and Participation**
   Each Permittee shall make the latest updated version of the SWMP Plan available to the public. The most recent SWMP Plan and Annual Report shall be posted on the Permittee's website.

3. **Illicit Discharge Detection and Elimination**
   The SWMP shall include a program to identify, detect, remove and prevent illicit connections and illicit discharges, including spills, into the MS4s owned or operated by the Permittee.

   Minimum performance measures:

   a. Comply with all relevant ordinances, rules, and regulations of the local jurisdiction(s) in which the Permittee's MS4 is located that govern non-stormwater discharges.

   b. Implement appropriate policies prohibiting illicit discharges and an enforcement plan to ensure compliance with illicit discharge policies. These policies shall address, at a minimum: illicit connections; non-stormwater discharges, including spills of hazardous materials; and improper disposal of pet waste and litter.

      i. ***Allowable Discharges***: The policies do not need to prohibit the following categories of non-stormwater discharges:

         (a) Diverted stream flows

         (b) Rising groundwaters

         (c) Uncontaminated groundwater infiltration (as defined at 40 CFR 35.2005(b)(20))

         (d) Uncontaminated pumped groundwater

         (e) Foundation drains

         (f) Air conditioning condensation

         (g) Irrigation water from agricultural sources that is commingled with urban stormwater

         (h) Springs

         (i) Uncontaminated water from crawl space pumps

         (j) Footing drains

(k) Flows from riparian habitats and wetlands

(l) Discharges from emergency firefighting activities in accordance with S2 – *Authorized Discharges*

(m) Non-stormwater discharges authorized by another NPDES permit

ii. ***Conditionally Allowable Discharges***: The policies may allow the following categories of non-stormwater discharges only if the stated conditions are met and such discharges are allowed by local codes:

(a) Discharges from potable water sources, including but not limited to, water line flushing, hyperchlorinated water line flushing, fire hydrant system flushing, and pipeline hydrostatic test water. Planned discharges shall be de-chlorinated to a total residual chlorine concentration of 0.1 ppm or less, pH-adjusted if necessary, and volumetrically and velocity controlled to prevent resuspension of sediments in the MS4.

(b) Discharges from lawn watering and other irrigation runoff. These discharges shall be minimized through, at a minimum, public education activities and water conservation efforts conducted by the Permittee and/or the local jurisdiction.

(c) Dechlorinated swimming pool, spa, and hot tub discharges. The discharges shall be dechlorinated to a total residual chlorine concentration of 0.1 ppm or less, pH-adjusted and reoxygenated if necessary, and volumetrically and velocity controlled to prevent resuspension of sediments in the MS4. Discharges shall be thermally controlled to prevent an increase in temperature of the receiving water. Swimming pool cleaning wastewater and filter backwash shall not be discharged to the MS4.

(d) Street and sidewalk wash water, water used to control dust, and routine external building wash down that does not use detergents. The Ports of Seattle and Tacoma shall reduce these discharges through, at a minimum, public education activities and/or water conservation efforts conducted by the Port and/or the local jurisdiction. To avoid washing pollutants into the MS4, the amount of street wash and dust control water used shall be minimized.

(e) Other non-stormwater discharges shall be in compliance with the requirements of a pollution prevention plan reviewed by the Permittee which addresses control of such discharges.

iii. The Permittee shall address any category of discharges in S6.E.3.b.i or ii above if the discharges are identified as significant source of pollutants to waters of the State.

c. The SWMP shall include an ongoing program for gathering, maintaining, and using adequate information to conduct planning, priority setting, and program evaluation activities for Permittee-owned properties. Permittees shall gather and maintain mapping data for the features listed below on an ongoing basis:

i. Known MS4 outfalls and discharge points, receiving waters (other than groundwater), and land uses for property owned by the Permittee, and all other properties served by MS4s known to and owned or operated by the Permittee.

ii. Tributary conveyances (including size, material, and type attributes where known), and the associated drainage areas of MS4 outfalls and discharge points with a 12 inch nominal diameter or larger, or an equivalent cross-sectional area for non-pipe systems.

iii. Known connections greater than or equal to 8 inches in nominal diameter to tributary conveyances mapped in accordance with S6.E.3.c.ii.

iv. To the extent consistent with national security laws and directives, each Permittee shall make available to Ecology upon request, available maps depicting the information required in S6.E.3.c.i through iii, above. The required format for mapping is electronic with fully described mapping standards.

v. Implement a program to document operation and maintenance records for stormwater treatment and flow control BMPs/facilities and catch basins.

vi. Upon request, and to the extent consistent with national security laws and directives, mapping information and operation and maintenance records shall be provided to the city or county in which the Permittee is located.

d. Conduct field screening of at least 20% of the MS4 each year for the purpose of detecting illicit discharges and illicit connections. Field screening methodology shall be appropriate to the characteristics of the MS4 and water quality concerns. Implement procedures to identify and remove any illicit discharges and illicit connections. Keep records of inspections and follow-up activities.

e. Implement a spill response plan that includes coordination with a qualified spill responder.

f. Provide ongoing staff training or coordinate with existing training efforts to educate staff on proper BMPs for preventing illicit discharges, including spills, and for identifying, reporting, and responding as appropriate. Train all Permittee staff who, as part of their normal job responsibilities, have a role in preventing such discharges. Keep records of training provided and staff trained.

4. Construction Site Stormwater Runoff Control

The SWMP shall include a program to reduce pollutants in stormwater runoff from construction activities under the functional control of the Permittee.

Minimum performance measures:

a. Comply with all relevant ordinances, rules, and regulations of the local jurisdiction(s) in which the Permittee is located that govern construction phase stormwater pollution prevention measures. To the extent allowed by local ordinances, rules, and regulations, comply with the applicable minimum technical requirements for new development and redevelopment contained in Appendix 1.

b. Ensure all construction projects under the functional control of the Permittee which require a construction stormwater permit obtain coverage under the NPDES General Permit for Stormwater Discharges Associated with Construction Activities or an individual NPDES permit prior to discharging construction related stormwater.

c. Coordinate with the local jurisdiction(s) regarding projects owned or operated by other entities which discharge into the Permittee's MS4, to assist the local jurisdiction(s) with achieving compliance with all relevant ordinances, rules, and regulations of the local jurisdiction(s).

d. Provide staff training or coordinate with existing training efforts to educate Permittee staff responsible for implementing construction stormwater erosion and sediment control BMPs and requirements, or hire trained contractors to perform the work.

e. Coordinate as requested with Ecology or the local jurisdiction to provide access for inspection of construction sites or other land disturbances that are under the functional control of the Permittee during active land disturbing activities and/or the construction period.

5. **Post-Construction Stormwater Management for New Development and Redevelopment**

The SWMP shall include a program to address post-construction stormwater runoff from new development and redevelopment projects. The program shall establish controls to prevent or minimize water quality impacts.

Minimum performance measures:

a. Comply with all relevant ordinances, rules, and regulations of the local jurisdiction(s) in which the Permittee is located that govern post-construction stormwater pollution prevention measures, including proper operation and maintenance of the MS4. To the extent allowed by local ordinances, rules, and regulations, comply with the applicable the minimum technical requirements for new development and redevelopment contained in Appendix 1.

b. Coordinate with the local jurisdiction regarding projects owned and operated by other entities which discharge into the Permittee's MS4, to assist the local jurisdiction in achieving compliance with all relevant ordinances, rules, and regulations of the local jurisdiction(s).

6. **Operation and Maintenance Program**

The SWMP shall include an operation and maintenance program for all stormwater treatment and flow control BMPs/facilities, and catch basins to ensure that BMPs continue to function properly.

Minimum performance measures:

a. Each Permittee shall implement an Operation and Maintenance (O&M) manual for all stormwater treatment and flow control BMPs/facilities and catch basins that are under the functional control of the Permittee and which discharge stormwater to its MS4, or to an interconnected MS4.

   i. Retain a copy of the O&M manual in the appropriate Permittee department and routinely update following discovery or construction of new stormwater facilities.

   ii. The operation and maintenance manual shall establish facility-specific maintenance standards that are as protective, or more protective, than those specified in the *Stormwater Management Manual for Western Washington*. For existing stormwater facilities which do not have maintenance standards, the Permittee shall develop a maintenance standard. Each Permittee shall update maintenance standards, as necessary, to meet the requirements of this Section.

iii. The purpose of the maintenance standard is to determine if maintenance is required. The maintenance standard is not a measure of the facility's required condition at all times between inspections. Exceeding the maintenance standards between inspections and/or maintenance is not a permit violation. Maintenance actions shall be performed within the time frames specified in S6.E.6.b.ii.

b. The Permittee will manage maintenance activities to inspect all stormwater facilities listed in the O&M manual annually, and take appropriate maintenance action in accordance with the O&M manual.

i. The Permittee may change the inspection frequency to less than annually, provided the maintenance standards are still met. Reducing the annual inspection frequency shall be based on maintenance records of double the length of time of the proposed inspection frequency. In the absence of maintenance records, the Permittee may substitute written statements to document a specific less frequent inspection schedule. Written statements shall be based on actual inspection and maintenance experience and shall be certified in accordance with G19 – *Certification and Signature*.

ii. Unless there are circumstances beyond the Permittees control, when an inspection identifies an exceedance of the maintenance standard, maintenance shall be performed:

(a) Within 1 year for wet pool facilities and retention/detention ponds.

(b) Within 1 year for typical maintenance of facilities, except catch basins.

(c) Within 6 months for catch basins.

(d) Within 2 years for maintenance that requires capital construction of less than $25,000.

Circumstances beyond the Permittee's control include denial or delay of access by property owners, denial or delay of necessary permit approvals, and unexpected reallocations of maintenance staff to perform emergency work. For each exceedance of the required timeframe, the Permittee shall document the circumstances and how they were beyond their control.

c. The Permittee shall provide appropriate training for Permittee maintenance staff.

d. The Permittee will maintain records of inspections and maintenance activities.

7. Source Control in Existing Developed Areas

The SWMP shall include the development and implementation of one or more Stormwater Pollution Prevention Plans (SWPPPs). A SWPPP is a documented plan to identify and implement measures to prevent and control the contamination of discharges of stormwater to surface or groundwater. SWPPP(s) shall be prepared and implemented for all Permittee-owned lands, except environmental mitigation sites owned by the Permittee, that are not covered by a NPDES permit issued by Ecology that authorizes stormwater discharges.

Minimum performance measures:

a. SWPPP(s) shall be updated as necessary to reflect changes at the facility.

b. The SWPPP(s) shall include a facility assessment including a site plan, identification of pollutant sources, and description of the drainage system.

c. The SWPPP(s) shall include a description of the source control BMPs used or proposed for use by the Permittee. Source control BMPs shall be selected from the *Stormwater Management Manual for Western Washington* (or an equivalent manual approved by Ecology). Implementation of non-structural BMPs shall begin immediately after the pollution prevention plan is developed. Where necessary, a schedule for implementation of structural BMPs shall be included in the SWPPP(s).

d. The Permittee shall maintain a list of sites covered by the SWPPP(s) required under this Permit. At least 20% of the listed sites shall be inspected annually.

e. The SWPPP(s) shall include policies and procedures to reduce pollutants associated with the application of pesticides, herbicides and fertilizer.

f. The SWPPP(s) shall include measures to prevent, identify and respond to illicit discharges, including illicit connections, spills and improper disposal. When the Permittee submits a notification pursuant to G3, the Permittee shall also notify the city or county it is located in.

g. The SWPPP(s) shall include a component related to inspection and maintenance of stormwater facilities and catch basins that is consistent with the Permittee's O&M Program, as specified in S6.E.6 above.

8. Monitoring Program
Monitoring requirements for the Port of Seattle and Port of Tacoma are included in Special Condition S8.

S7. COMPLIANCE WITH TOTAL MAXIMUM DAILY LOAD REQUIREMENTS

The following requirements apply if an applicable Total Maximum Daily Load (TMDL) is approved for stormwater discharges from MS4s owned or operated by the Permittee. Applicable TMDLs are TMDLs which have been approved by EPA on or before the issuance date of this Permit, or prior to the date that Ecology issues coverage under this Permit, whichever is later.

A. For applicable TMDLs listed in Appendix 2, affected Permittees shall comply with the specific requirements identified in Appendix 2. Each Permittee shall keep records of all actions required by this Permit that are relevant to applicable TMDLs within their jurisdiction. The status of the TMDL implementation shall be included as part of the Annual Report submitted to Ecology. Each Annual Report shall include a summary of relevant SWMP and Appendix 2 activities conducted in the TMDL area to address the applicable TMDL parameter(s).

B. For applicable TMDLs not listed in Appendix 2, compliance with this Permit shall constitute compliance with those TMDLs.

C. For TMDLs that are approved by EPA after this Permit is issued, Ecology may establish TMDL-related permit requirements through future permit modification if Ecology determines implementation of actions, monitoring or reporting necessary to demonstrate reasonable further progress toward achieving TMDL waste load allocations, and other targets, are not occurring and shall be implemented during the term of this Permit or when this Permit is reissued. Permittees are encouraged to participate in development of TMDLs within their jurisdiction and to begin implementation.

S8. MONITORING AND ASSESSMENT

A. Regional Status and Trends Monitoring

1. King and Snohomish Counties, the Cities of Seattle and Tacoma, and the Ports of Seattle and Tacoma chose S8.B *Status and Trends Monitoring*, Option #1 in the *Phase I Municipal Stormwater Permit,* August 1, 2013 – July 31, 2018 (extended to July 31, 2019). These Permittees shall make a one-time payment into the collective fund to implement regional small streams and marine nearshore areas status and trends monitoring in Puget Sound. This payment is due on or before December 1, 2019. Submit payment according to Section S8.D.

2. King, Pierce, and Snohomish Counties, the Cities of Seattle and Tacoma, and the Ports of Seattle and Tacoma shall notify Ecology in writing which of the following two options for regional status and trends monitoring (S8.A.2.a or S8.A.2.b) the Permittee chooses to carry out during this Permit term. The written notification with G19 signature is due to Ecology no later than December 1, 2019.

a. Make annual payments into a collective fund to implement regional receiving water status and trends monitoring of small streams and marine nearshore areas in Puget Sound. The annual payments into the collective fund are due on or before August 15 each year beginning in 2020. Submit payments according to Section S8.D.

Or

b. Conduct stormwater discharge monitoring per the requirements in S8.C.

Either option will fully satisfy the Permittee's obligations under this Section (S8.A.2). Each Permittee shall select a single option for this permit term.

3. Clark County shall:

a. Prepare to conduct regional urban streams status and trends monitoring in the Lower Columbia River Basin. No later than June 30, 2020, Clark County shall submit a completed version of the *Quality Assurance Project Plan for Status and Trends Monitoring of Urban Streams in Clark and Cowlitz Counties in the Lower Columbia River Region* – [Template for] Clark County, Lead Entity, June 30, 2019 (July 1, 2019 version 1.0, LC Urban Streams QAPP Template), to Ecology for review and approval.

i. Submit the "Site verification report and final Table 6 and Figure 2" listed in Table 2 of the LC Urban Streams QAPP Template on or before January 31, 2020, to Ecology for review and approval.

ii. Submit the "Extended monitoring report and final Tables 7 and 11" listed in Table 2 of the LC Urban Streams QAPP Template on or before March 31, 2020, to Ecology for review and approval.

b. Notify Ecology in writing which of the following two options for regional status and trends monitoring (S8.A.3.b.i or S8.A.3.b.ii) the County chooses to carry out during this permit term. The written notification with G19 signature is due to Ecology no later than December 1, 2019.

   i. Make annual payments into a collective fund to implement regional urban streams status and trends monitoring in Clark and Cowlitz Counties in the Lower Columbia River Basin. The annual payments into the collective fund are due on or before August 15 each year beginning in 2020. Submit payments according to Section S8.D below.

      Or

   ii. Conduct stormwater discharge monitoring per the requirements in S8.C.

   Either option will fully satisfy the County's obligations under this Section (S8.A.3.b). Clark County shall select a single option for the duration of this Permit.

B. Stormwater Management Program Effectiveness and Source Identification Studies

1. Clark, King, Pierce, and Snohomish Counties, the City of Seattle, and the Ports of Seattle and Tacoma chose S8.C *Effectiveness Studies,* Option #1 or Option #3 in the *Phase I Municipal Stormwater Permit* August 1, 2013 – July 31, 2018 (extended to July 31, 2019). These Permittees shall pay into the collective fund to implement effectiveness studies and source identification studies. The payment is due before on or before December 1, 2019. Submit payment according to Section S8.D.

2. Clark, King, Pierce, and Snohomish Counties, the Cities of Seattle and Tacoma, and the Ports of Seattle and Tacoma shall notify Ecology in writing which of the following three options (S8.B.2.a or S8.B.2.b or S8.B.2.c) for effectiveness and source identification studies the Permittee chooses to carry out during this permit term.

   a. Make annual payments into a collective fund to implement effectiveness and source identification studies. The annual payments into the collective fund are due on or before August 15 each year beginning in 2020. Submit payments according to Section S8.D.

      Or

   b. Conduct stormwater discharge monitoring per the requirements in S8.C.

      Or

   c. **Both:** make annual payments into a collective fund to implement regional effectiveness and source identification studies ***and*** independently conduct a Stormwater Management Program (SWMP) effectiveness study approved by Ecology.

      i. Permittees selecting this option shall make payments equal to one-half of the amounts listed in Appendix 11 for S8.B. The annual payments are due are due on or before August 15 each year beginning in 2020. Submit payments according to Section S8.D.

      ii. The SWMP effectiveness study shall be conducted in accordance with the requirements below:

(a) Write a detailed proposal describing: the purpose, objectives, design, and methods of the independent effectiveness study; anticipated outcomes including the question that will be answered; expected modifications to the Permittee's SWMP; relevance to other Permittees; and plans for sharing the findings with other Permittees. The proposal shall be prepared in accordance with the *SWMP Effectiveness Study Proposal and QAPP Template* (July 1, 2019, version 1.0) and submitted no later than February 2, 2020, to Ecology for review and approval.

(b) Within 120 days of Ecology's approval of the detailed proposal, submit a draft QAPP to Ecology. The QAPP shall be prepared in accordance with the *SWMP Effectiveness Study Proposal and QAPP template* (July 1, 2019, version 1.0). Within 60 days of receiving Ecology's comments, submit a final QAPP to Ecology for review and approval.

(c) Implement the study in accordance with the schedule in the approved final QAPP. Data and analyses shall be reported annually in accordance with the Ecology-approved QAPP.

Any of these three options (S8.B.2.a or S8.B.2.b or S8.B.2.c) will fully satisfy the Permittee's obligations under this Section (S8.B.2). Each Permittee shall select a single option for this permit term.

3. All Permittees shall provide information as requested for effectiveness and source identification studies that are under contract with Ecology as active Stormwater Action Monitoring (SAM) projects. These requests will be limited to records of SWMP activities and associated data tracked and/or maintained in accordance with S5 – *Stormwater Management Program* and/or S9 – *Reporting Requirements*. A maximum of three requests during the permit term from the SAM Coordinator will be transmitted to the Permittee's permit coordinator via Ecology's regional permit manager. The Permittee shall have 90 days to provide the requested information.

C. Stormwater Discharge Monitoring

1. No later than June 30, 2020, Clark County and the City of Tacoma shall submit data and a final report for the stormwater discharge monitoring that was conducted pursuant to S8.B.2 (Clark County) and S8.C *Effectiveness Studies*, Option #2 (Tacoma) in the *Phase I Municipal Stormwater Permit,* August 1, 2013 – July 31, 2018 (extended to July 31, 2019).

2. This Section applies only to Permittees who choose to conduct stormwater discharge monitoring per S8.A.2.b, S8.A.3.b.ii, and/or S8.B.2.b in lieu of participation in the *Regional Status and Trends Monitoring* and/or Effectiveness and Source Identification Studies. These Permittees shall conduct monitoring in accordance with Appendix 9 and an Ecology-approved QAPP as follows:

a. Cities and counties who choose the option to conduct stormwater discharge monitoring for either S8.A regional status and trends monitoring or S8.B effectiveness and source identification studies shall monitor five independent discharge locations; ports shall monitor two independent discharge locations. Permittees are encouraged to continue monitoring at locations monitored under S8.C.2 of the *Phase I Municipal Stormwater Permit* August 1, 2013 – July 31, 2018 (extended to July 31, 2019) and/or S8.D of the *Phase I Municipal Stormwater Permit,* February 16, 2007 – February 15, 2012.

i. Cities and counties who choose the option to conduct stormwater discharge monitoring for ***both*** S8.A *Regional Status and Trends Monitoring* and S8.B *Effectiveness and Source Identification Studies,* shall conduct this monitoring at a total of ten locations; at least seven locations shall be independent (up to three locations may be nested in other basins).

ii. Ports who choose the option to conduct stormwater discharge monitoring for ***both*** S8.A and S8.B shall conduct this monitoring at four independent locations.

b. No later than February 1, 2020, each Permittee shall submit a draft Stormwater Discharge Monitoring QAPP to Ecology for review and approval. The QAPP shall be prepared in accordance with the requirements in Appendix 9. The final QAPP shall be submitted to Ecology for approval as soon as possible following finalization, and before August 15, 2020, or within 60 days of receiving Ecology's comments on the draft QAPP (whichever is later).

c. Flow monitoring at new discharge monitoring locations shall begin no later than October 1, 2020, or within 30 days of receiving Ecology's approval of the final QAPP (whichever is later). Stormwater discharge monitoring shall be fully implemented no later than October 1, 2020, at previous or existing discharge monitoring locations and no later than October 1, 2021, at new discharge monitoring locations.

d. Data and analyses shall be reported annually in accordance with the Ecology-approved QAPP. Each Permittee shall enter into the Department's Environmental Information Management (EIM) database, all water and solids concentration data collected pursuant to Appendix 9.

D. Payments into the Collective Funds

1. This Section applies to all Permittees who choose to make annual payments into the collective funds for S8.A *Regional Status and Trends Monitoring* and/or S8.B *Effectiveness and Source Identification Studies*.

2. Each Permittee's S8.A and S8.B payment amounts are listed in Appendix 11.

a. For the S8.B.1 payment due on December 1, 2019, Clark County and the City of Seattle shall pay half the amount indicated for S8.B in Appendix 11.

b. For annual payments for S8.B.2 due on August 15, 2020 and thereafter, Permittees that choose option S8.B.2.c shall pay half the amount indicated for S8.B in Appendix 11.

3. Mail payments according to the instructions in the invoice sent to the Permittee approximately three months in advance of each payment due date, or via United States Postal Service to:

Department of Ecology Cashiering Unit
P.O. Box 47611
Olympia, WA 98405-7611

S9. REPORTING REQUIREMENTS

A. No later than March 31 of each year, each Permittee shall submit an Annual Report. The reporting period for the first Annual Report will be from January 1, 2019, through December 31, 2019. The reporting period for all subsequent Annual Reports shall be the previous calendar year unless otherwise specified.

Permittees shall submit Annual Reports electronically using Ecology's Water Quality Permitting Portal (WQWebPortal) available on Ecology's website unless otherwise directed by Ecology.

Permittees unable to submit electronically through Ecology's WQWebPortal shall contact Ecology to request a waiver and obtain instructions on how to submit an Annual Report in an alternative format.

B. Each Permittee is required to keep all records related to this Permit and the SWMP for at least five years.

C. Each Permittee shall make all records related to this Permit and the Permittee's SWMP available to the public at reasonable times during business hours. The Permittee will provide a copy of the most recent Annual Report to any individual or entity, upon request.

1. A reasonable charge may be assessed by the Permittee for making photocopies of records.
2. The Permittee may require reasonable advance notice of intent to review records related to this Permit.

D. The Annual Report for Permittees listed in S1.B shall include the following:

1. A copy of the Permittee's current SWMP Plan as required by S5.A.1.
2. Submittal of the Annual Report form as provided by Ecology pursuant to S9.A, describing the status of implementation of the requirements of this Permit during the reporting period.
3. Attachments to the Annual Report form including summaries, descriptions, reports, and other information as required, or as applicable, to meet the requirements of this Permit during the reporting period, or as a required submittal. Refer to Appendix 3 for Annual Report questions.
4. If applicable, notice that the MS4 is relying on another governmental entity to satisfy any of the obligations under the Permit.
5. Certification and signature pursuant to G19.D, and notification of any changes to authorization pursuant to G19.C.
6. A notification of any annexations, incorporations, or jurisdictional boundary changes resulting in an increase or decrease in the Permittee's geographic area of permit coverage during the reporting period.

E. Annual Report for Secondary Permittees, including the Port of Seattle and the Port of Tacoma. Each Annual Report shall include the following:

1. Submittal of the Annual Report as provided by Ecology pursuant to S9.A, describing the status of implementation of the requirements of this Permit during the reporting period.

2. Attachments to the Annual Report form including summaries, descriptions, reports, and other information as required, or as applicable, to meet the requirements of this Permit during the reporting period. Refer to Appendix 4 for Annual Report questions for Secondary Permittees, and Appendix 5 for Annual Report questions for the Ports of Seattle and Tacoma.
3. If applicable, notice that the MS4 is relying on another governmental entity to satisfy any of the obligations under this Permit.
4. Certification and signature pursuant to G19.D, and notification of any changes to authorization pursuant to G19.C.
5. A notification of any jurisdictional boundary changes resulting in an increase or decrease in the Permittee's geographic area of permit coverage during the reporting period.

GENERAL CONDITIONS

G1. DISCHARGE VIOLATIONS

All discharges and activities authorized by this Permit shall be consistent with the terms and conditions of this Permit.

G2. PROPER OPERATION AND MAINTENANCE

The Permittee shall at all times properly operate and maintain all facilities and systems of collection, treatment, and control (and related appurtenances) which are installed or used by the Permittee for pollution control to achieve compliance with the terms and conditions of this Permit.

G3. NOTIFICATION OF DISCHARGE INCLUDING SPILLS

If a Permittee has knowledge of a discharge, including spill(s), into or from a MS4, which could constitute a threat to human health, welfare, or the environment, the Permittee, shall:

A. Take appropriate action to correct or minimize the threat to human health, welfare and/or the environment.

B. Notify the Ecology regional office and other appropriate spill response authorities immediately but in no case later than within 24 hours of obtaining that knowledge.

C. Immediately report spills or other discharges which might cause bacterial contamination of marine waters, such as discharges resulting from broken sewer lines and failing onsite septic systems, to the Ecology regional office and to the Department of Health, Shellfish Program.

D. Immediately report spills or discharges of oils or hazardous substances to the Ecology regional office and to the Washington Emergency Management Division, (800) 258-5990.

G4. BYPASS PROHIBITED

The intentional bypass of stormwater from all or any portion of a stormwater treatment BMP whenever the design capacity of the treatment BMP is not exceeded, is prohibited unless the following conditions are met:

A. Bypass is: (1) unavoidable to prevent loss of life, personal injury, or severe property damage; or (2) necessary to perform construction or maintenance-related activities essential to meet the requirements of the Clean Water Act (CWA); *and*

B. There are no feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated stormwater, or maintenance during normal dry periods.

"Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss.

G5. RIGHT OF ENTRY

The Permittee shall allow an authorized representative of Ecology, upon the presentation of credentials and such other documents as may be required by law at reasonable times:

A. To enter upon the Permittee's premises where a discharge is located or where any records shall be kept under the terms and conditions of this Permit;

B. To have access to, and copy at reasonable cost and at reasonable times, any records that shall be kept under the terms of the Permit;

C. To inspect at reasonable times any monitoring equipment or method of monitoring required in the Permit;

D. To inspect at reasonable times any collection, treatment, pollution management, or discharge facilities; ***and***

E. To sample at reasonable times any discharge of pollutants.

G6. DUTY TO MITIGATE

The Permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this Permit, which has a reasonable likelihood of adversely affecting human health or the environment.

G7. PROPERTY RIGHTS

This Permit does not convey any property rights of any sort, or any exclusive privilege.

G8. COMPLIANCE WITH OTHER LAWS AND STATUTES

Nothing in the Permit shall be construed as excusing the Permittee from compliance with any other applicable federal, state, or local statutes, ordinances, or regulations.

G9. MONITORING

A. ***Representative Sampling****:* Samples and measurements taken to meet the requirements of this Permit shall be representative of the volume and nature of the monitored discharge, including representative sampling of any unusual discharge or discharge condition, including bypasses, upsets, and maintenance-related conditions affecting effluent quality.

B. ***Records Retention****:* The Permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original recordings for continuous monitoring instrumentation, copies of all reports required by this Permit, and records of all data used to complete the application for this Permit, for a period of at least five years. This period of retention shall be extended during the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by Ecology. On request, monitoring data and analysis shall be provided to Ecology.

C. ***Recording of Results****:* For each measurement or sample taken, the Permittee shall record the following information: (1) the date, exact place and time of sampling; (2) the individual who performed the sampling or measurement; (3) the dates the analyses were performed; (4) who performed the analyses; (5) the analytical techniques or methods used; and (6) the results of all analyses.

D. ***Test Procedures****:* All sampling and analytical methods used to meet the monitoring requirements in this Permit shall conform to the Guidelines Establishing Test Procedures for the Analysis of Pollutants contained in 40 CFR Part 136, unless otherwise specified in this Permit or approved in writing by Ecology.

E. ***Flow Measurement****:* Where flow measurements are required by other conditions of this Permit, appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated, and maintained to ensure that the accuracy of the measurements are consistent with the accepted industry standard for that type of device. Frequency of calibration shall be in conformance with manufacturer's recommendations or at a minimum frequency of at least one calibration per year. Calibration records should be maintained for a minimum of three years.

F. ***Lab Accreditation****:* All monitoring data, except for flow, temperature, conductivity, pH, total residual chlorine, and other exceptions approved by Ecology, shall be prepared by a laboratory registered or accredited under the provisions of, Accreditation of Environmental Laboratories, Chapter 173-50 WAC. Soils and hazardous waste data are exempted from this requirement pending accreditation of laboratories for analysis of these media by Ecology. Quick methods of field detection of pollutants including nutrients, surfactants, salinity, and other parameters are exempted from this requirement when the purpose of the sampling is identification and removal of a suspected illicit discharge.

G. ***Additional Monitoring****:* Ecology may establish specific monitoring requirements in addition to those contained in this Permit by administrative order or permit modification.

G10. REMOVED SUBSTANCES

With the exception of decant from street waste vehicles, the Permittee shall not allow collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of stormwater to be resuspended or reintroduced to the MS4 or to waters of the State. Decant from street waste vehicles resulting from cleaning stormwater facilities may be reintroduced only when other practical means are not available and only in accordance with the *Street Waste Disposal Guidelines* in Appendix 6. Solids generated from maintenance of the MS4 may be reclaimed, recycled, or reused when allowed by local codes and ordinances. Soils that are identified as contaminated pursuant to Chapter 173-350 WAC shall be disposed at a qualified solid waste disposal facility (see Appendix 6).

G11. SEVERABILITY

The provisions of this Permit are severable, and if any provision of this Permit, or the application of any provision of this Permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this Permit shall not be affected thereby.

G12. REVOCATION OF COVERAGE

The director may terminate coverage under this General Permit in accordance with Chapter 43.21B RCW and Chapter 173-226 WAC. Cases where coverage may be terminated include, but are not limited to the following:

A. Violation of any term or condition of this General Permit.

B. Obtaining coverage under this General Permit by misrepresentation or failure to disclose fully all relevant facts.

C. A change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge.

D. A determination that the permitted activity endangers human health or the environment, or contributes significantly to water quality standards violations.

E. Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.

F. Nonpayment of permit fees assessed pursuant to RCW 90.48.465.

Revocation of coverage under this General Permit may be initiated by Ecology or requested by any interested person.

G13. TRANSFER OF COVERAGE

The director may require any discharger authorized by this General Permit to apply for and obtain an individual permit in accordance with Chapter 43.21B RCW and Chapter 173-226 WAC.

G14. GENERAL PERMIT MODIFICATION AND REVOCATION

This General Permit may be modified, revoked and reissued, or terminated in accordance with the provisions of WAC 173-226-230. Grounds for modification, revocation and reissuance, or termination include, but are not limited to, any of the following:

A. A change occurs in the technology or practices for control or abatement of pollutants applicable to the category of dischargers covered under this General Permit.

B. Effluent limitation guidelines or standards are promulgated pursuant to the CWA or Chapter 90.48 RCW, for the category of dischargers covered under this General Permit.

C. A water quality management plan containing requirements applicable to the category of dischargers covered under this General Permit is approved.

D. Information is obtained which indicates that cumulative effects on the environment from dischargers covered under this General Permit are unacceptable.

E. Changes made to State law reference this Permit.

G15. REPORTING A CAUSE FOR MODIFICATION OR REVOCATION

A Permittee who knows or has reason to believe that any activity has occurred or will occur which would constitute cause for modification or revocation and reissuance under Condition G12, G14, or 40 CFR 122.62 shall report such plans, or such information, to Ecology so that a decision can be made on whether action to modify, or revoke and reissue this Permit will be required. Ecology may then require submission of a new or amended application. Submission of such application does not relieve the Permittee of the duty to comply with this Permit until it is modified or reissued.

G16. APPEALS

A. The terms and conditions of this General Permit, as they apply to the appropriate class of dischargers, are subject to appeal within thirty days of issuance of this General Permit, in accordance with Chapter 43.21B RCW, and Chapter 173-226 WAC.

B. The terms and conditions of this General Permit, as they apply to an individual discharger, can be appealed, in accordance with Chapter 43.21B RCW, within thirty days of the effective date of coverage of that discharger. Consideration of an appeal of general permit coverage of an individual discharger is limited to the General Permit's applicability or nonapplicability to that individual discharger.

C. The appeal of general permit coverage of an individual discharger does not affect any other dischargers covered under this General Permit. If the terms and conditions of this General Permit are found to be inapplicable to any individual discharger(s), the matter shall be remanded to Ecology for consideration of issuance of an individual permit or permits.

D. Modifications of this Permit can be appealed in accordance with Chapter 43.21B RCW and Chapter 173-226 WAC.

G17. PENALTIES

40 CFR 122.41(a)(2) and (3), 40 CFR 122.41(j)(5), and 40 CFR 122.41(k)(2) are hereby incorporated into this Permit by reference.

G18. DUTY TO REAPPLY

The Permittee shall apply for permit renewal at least 180 days prior to the specified expiration date of this Permit.

G19. CERTIFICATION AND SIGNATURE

All formal submittals to Ecology shall be signed and certified.

A. All permit applications shall be signed by either a principal executive officer or ranking elected official.

B. All formal submittals required by this Permit shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

1. The authorization is made in writing by a person described above and submitted to Ecology, ***and***
2. The authorization specifies either an individual or a position having responsibility for the overall development and implementation of the Stormwater Management Program. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

C. Changes to authorization. If an authorization under General Condition G19.B.2 is no longer accurate because a different individual or position has responsibility for the overall development and implementation of the Stormwater Management Program, a new authorization satisfying the requirements of General Condition G19.B.2 shall be submitted to Ecology prior to or together with any reports, information, or applications to be signed by an authorized representative.

D. Certification. Any person signing a formal submittal under this Permit shall make the following certification:

> "I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for willful violations."

G20. NON-COMPLIANCE NOTIFICATION

In the event a Permittee is unable to comply with any of the terms and conditions of this Permit, the Permittee shall:

A. Notify Ecology of the failure to comply with the permit terms and conditions in writing within 30 days of becoming aware that the non-compliance has occurred. The written notification to Ecology shall include all of the following:

1. A description of the non-compliance, including the reference(s).
2. Beginning and ending dates of the non-compliance, or if the Permittee has not corrected the non-compliance, the anticipated date of correction.
3. Steps taken or planned to reduce, eliminate, or prevent reoccurrence of the non-compliance.

B. Take appropriate action to stop or correct the condition of non-compliance.

G21. UPSETS

Permittees shall meet the conditions of 40 CFR 122.41(n) regarding “Upsets.” The conditions are as follows:

A. ***Definition***. “Upset” means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

B. ***Effect of an upset***. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of paragraph (C) of this condition are met. Any determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, will not constitute final administrative action subject to judicial review.

C. ***Conditions necessary for demonstration of upset***. A Permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed contemporaneous operating logs, or other relevant evidence that:

1. An upset occurred and that the Permittee can identify the cause(s) of the upset;

2. The permitted facility was at the time being properly operated; and
3. The Permittee submitted notice of the upset as required in 40 CFR 122.41(l)(6)(ii)(B) (24-hour notice of noncompliance).
4. The Permittee complied with any remedial measures required under 40 CFR 122.41(d) (Duty to Mitigate).

D. ***Burden of proof***. In any enforcement proceeding, the Permittee seeking to establish the occurrence of an upset has the burden of proof.

DEFINITIONS AND ACRONYMS

This Section includes definitions for terms used in the body of the Permit and in all the appendices except Appendix 1. Terms defined in Appendix 1 are necessary to implement requirements related to Appendix 1.

40 CFR means Title 40 of the Code of Federal Regulations, which is the codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the federal government.

AKART means All Known, Available and Reasonable methods of prevention, control and Treatment. See also State Water Pollution Control Act, Chapter 90.48.010 and 90.48.520 RCW.

All Known, Available and Reasonable methods of prevention, control and Treatment refers to the State Water Pollution Control Act, Chapter 90.48.010 and 90.48.520 RCW.

Applicable TMDL means a TMDL which has been approved by EPA on or before the issuance date of this Permit, or prior to the date that Ecology issues coverage under this Permit, whichever is later.

Beneficial Uses means uses of waters of the State, which include but are not limited to: use for domestic, stock watering, industrial, commercial, agricultural, irrigation, mining, fish and wildlife maintenance and enhancement, recreation, generation of electric power and preservation of environmental and aesthetic values, and all other uses compatible with the enjoyment of the public waters of the State.

Best Management Practices are the schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices approved by Ecology that, when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to waters of Washington State.

B-IBI means Benthic Index of Biotic Integrity.

BMP means Best Management Practice.

Bypass means the diversion of stormwater from any portion of a stormwater treatment facility.

Circuit means a portion of a MS4 discharging to a single point or serving a discrete area determined by traffic volumes, land use, topography, or the configuration of the MS4.

Component or Program Component means an element of the Stormwater Management Program listed in Special Condition S5 – *Stormwater Management Program for Permittees* or S6 – *Stormwater Management Program for Secondary Permittees*, or S7 – *Compliance with Total Maximum Daily Load Requirements*, or S8 – *Monitoring and Assessment*.

Community-based social marketing is a social marketing methodology and employs a systematic way to change the behavior of communities to reduce their impact on the environment. Realizing that providing information is usually not sufficient to initiate behavior change, community-based social marketing uses tools and findings from social psychology to discover the perceived barriers to behavior change and ways of overcoming these barriers.

Conveyance System means that portion of the municipal separate storm sewer system designed or used for conveying stormwater.

Co-Permittee means an owner or operator of a MS4 which is in a cooperative agreement with at least one other applicant for coverage under this Permit. A Co-Permittee is an owner or operator of a regulated MS4 located within or in proximity to another regulated MS4. A Co-Permittee is only responsible for permit conditions relating to the discharges from the MS4 the Co-Permittee owns or operates. See also 40 CFR 122.26(b)(1).

CWA means the federal Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972) Pub.L. 92-500, as amended Pub. L. 95-217, Pub. L. 95-576, Pub. L. (6-483 and Pub. L. 97-117, 33 U.S.C. 1251 *et seq*.).

Director means the Director of the Washington State Department of Ecology, or an authorized representative.

Discharge Point means the location where a discharge leaves the Permittee's MS4 through the Permittee's MS4 facilities/BMPs designed to infiltrate.

Entity means a governmental body, or a public or private organization.

EPA means the U.S. Environmental Protection Agency.

Fully Stabilized means the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as riprap, gabions or geotextiles) which prevents erosion.

General Permit means a permit which covers multiple dischargers of a point source category within a designated geographical area, in lieu of individual permits being issued to each discharger.

Groundwater means water in a saturated zone or stratum beneath the surface of the land or below a surface water body. Refer to Chapter 173-200 WAC.

Hazardous Substance means any liquid, solid, gas, or sludge, including any material, substance, product, commodity, or waste, regardless of quantity, that exhibits any of the physical, chemical, or biological properties described in WAC 173-303-090 or WAC 173-303-100.

Heavy Equipment Maintenance or Storage Yard means an uncovered area where any heavy equipment, such as mowing equipment, excavators, dump trucks, backhoes, or bulldozers are washed or maintained, or where at least five pieces of heavy equipment are stored on a long term basis.

Highway means a main public road connecting towns and cities.

Hydraulically Near means runoff from the site discharges to the sensitive feature without significant natural attenuation of flows that allows for suspended solids removal. See Appendix 7 Determining Construction Site Sediment Damage Potential for a more detailed definition.

Hyperchlorinated means water that contains more than 10 mg/Liter chlorine.

Illicit Connection means any infrastructure connection to the MS4 that is not intended, permitted, or used for collecting and conveying stormwater or non-stormwater discharges allowed as specified in this Permit (S5.C.9, S6.D.3, and S6.E.3). Examples include sanitary sewer connections, floor drains, channels, pipelines, conduits, inlets, or outlets that are connected directly to the MS4.

Illicit Discharge means any discharge to a MS4 that is not composed entirely of stormwater or of non-stormwater discharges allowed as specified in this Permit (S5.C.9, S6.D.3 and S6.E.3).

Impervious Surface means a non-vegetated surface area that either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development. A non-vegetated surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or stormwater areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled, macadam or other surfaces which similarly impede the natural infiltration of stormwater.

Land Disturbing Activity means any activity that results in a change in the existing soil cover (both vegetative and non-vegetative) and/or the existing soil topography. Land disturbing activities include, but are not limited to clearing, grading, filling and excavation. Compaction that is associated with stabilization of structures and road construction shall also be considered land disturbing activity. Vegetation maintenance practices, including landscape maintenance and gardening, are not considered land disturbing activity. Stormwater facility maintenance is not considered land disturbing activity if conducted according to established standards and procedures.

LID means Low Impact Development.

LID BMP means Low Impact Development Best Management Practices.

LID Principles means land use management strategies that emphasize conservation, use of on-site natural features, and site planning to minimize impervious surfaces, native vegetation loss, and stormwater runoff.

Low Impact Development means a stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices that are integrated into a project design.

Low Impact Development Best Management Practices means distributed stormwater management practices, integrated into a project design, that emphasize pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration. LID BMPs include, but are not limited to, bioretention, rain gardens, permeable pavements, roof downspout controls, dispersion, soil quality and depth, vegetated roofs, minimum excavation foundations, and water re-use.

Material Storage Facilities means an uncovered area where bulk materials (liquid, solid, granular, etc.) are stored in piles, barrels, tanks, bins, crates, or other means.

Maximum Extent Practicable refers to paragraph 402(p)(3)(B)(iii) of the federal Clean Water Act which reads as follows: Permits for discharges from municipal storm sewers shall require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques, and system, design, and engineering methods, and other such provisions as the Administrator or the State determines appropriate for the control of such pollutants.

MEP means Maximum Extent Practicable.

MS4 means Municipal Separate Storm Sewer System.

Municipal Separate Storm Sewer System means a conveyance, or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains):

(i) Owned or operated by a state, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State Law) having jurisdiction over disposal of wastes, stormwater, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under Section 208 of the CWA that discharges to waters of the State.

(ii) Designed or used for collecting or conveying stormwater.

(iii) Which is not a combined sewer.

(iv) Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2.

(v) Which is defined as “large” or “medium” or “small” or otherwise designated by Ecology pursuant to 40 CFR 122.26.

National Pollutant Discharge Elimination System means the national program for issuing, modifying, revoking, and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 402, 318, and 405 of the Federal Clean Water Act, for the discharge of pollutants to surface waters of the State from point sources. These permits are referred to as NPDES permits and, in Washington State, are administered by the Washington Department of Ecology.

Native Vegetation means vegetation comprised of plant species, other than noxious weeds, that are indigenous to the coastal region of the Pacific Northwest and which reasonably could have been expected to naturally occur on the site. Examples include trees such as Douglas Fir, western hemlock, western red cedar, alder, big-leaf maple; shrubs such as willow, elderberry, salmonberry, and salal; and herbaceous plants such as sword fern, foam flower, and fireweed.

New Development means land disturbing activities, including Class IV-General Forest Practices that are conversions from timber land to other uses; structural development, including construction or installation of a building or other structure; creation of hard surfaces; and subdivision, short subdivision and binding site plans, as defined and applied in Chapter 58.17 RCW. Projects meeting the definition of redevelopment shall not be considered new development. Refer to Appendix 1 for a definition of hard surfaces.

New Secondary Permittee means a Secondary Permittee that is covered under a Municipal Stormwater General Permit and was not covered by the Permit prior to July 1, 2019.

NOI means Notice of Intent.

Notice of Intent means the application for, or a request for coverage under a General NPDES Permit pursuant to WAC 173-226-200.

Notice of Intent for Construction Activity means the application form for coverage under the Construction Stormwater General Permit.

Notice of Intent for Industrial Activity means the application form for coverage under the General Permit for Stormwater Discharges Associated with Industrial Activities.

NPDES means National Pollutant Discharge Elimination System.

O&M means operation and maintenance.

Outfall means point source as defined by 40 CFR 122.2 at the point where a discharge means a point source as defined by 40 CFR 122.2 at the point where a discharge leaves the Permittee’s MS4 and enters a surface receiving waterbody or surface receiving waters. Outfall does not include pipes, tunnels, or other conveyances which connect segments of the same stream or other surface waters and are used to convey primarily surface waters (i.e., culverts).

Overburdened Community means minority, low-income, tribal, or indigenous populations or geographic locations in Washington State that potentially experience disproportionate environmental harms and risks. This disproportionality can be as a result of greater vulnerability to environmental hazards, lack of opportunity for public participation, or other factors. Increased vulnerability may be attributable to an accumulation of negative or lack of positive environmental, health, economic, or social conditions within these populations or places. The term describes situations where multiple factors, including both environmental and socio-economic stressors, may act cumulatively to affect health and the environment and contribute to persistent environmental health disparities.

Permittee unless otherwise noted, includes city, town, or county Permittee, port Permittee, Co-Permittee, Secondary Permittee, and New Secondary Permittee.

Physically Interconnected means that one MS4 is connected to another storm sewer system in such a way that it allows for direct discharges to the second system. For example, the roads with drainage systems and municipal streets of one entity are physically connected directly to a storm sewer system belonging to another entity.

Project Site means that portion of a property, properties, or right-of-ways subject to land disturbing activities, new hard surfaces, or replaced hard surfaces. Refer to Appendix 1 for a definition of hard surfaces.

QAPP means Quality Assurance Project Plan.

Qualified Personnel means someone who has had professional training in the aspects of stormwater management for which they are responsible and are under the functional control of the Permittee. Qualified Personnel may be staff members, contractors, or volunteers.

Quality Assurance Project Plan means a document that describes the objectives of an environmental study and the procedures to be followed to achieve those objectives.

RCW means the Revised Code of Washington State.

Receiving Waterbody or **Receiving Waters** means naturally and/or reconstructed naturally occurring surface water bodies, such as creeks, streams, rivers, lakes, wetlands, estuaries, and marine waters, or groundwater, to which a MS4 discharges.

Redevelopment means, on a site that is already substantially developed (i.e., has 35% or more of existing hard surface coverage), the creation or addition of hard surfaces; the expansion of a building footprint or addition or replacement of a structure; structural development including construction, installation or expansion of a building or other structure; replacement of hard surface that is not part of a routine maintenance activity; and land disturbing activities. Refer to Appendix 1 for a definition of hard surfaces.

Runoff is water that travels across the land surface and discharges to water bodies either directly or through a collection and conveyance system. See also “Stormwater.”

SAM means Stormwater Action Monitoring

Secondary Permittee is an operator of a MS4 which is not a city, town, or county. Secondary Permittees include special purpose districts and other public entities that meet the criteria inS1.E.1.

Sediment/Erosion-Sensitive Feature means an area subject to significant degradation due to the effect of construction runoff, or areas requiring special protection to prevent erosion. See Appendix 7 Determining Construction Site Sediment Transport Potential for a more detailed definition.

Shared Waterbodies means waterbodies, including downstream segments, lakes and estuaries, that receive discharges from more than one Permittee.

Significant Contributor means a discharge that contributes a loading of pollutants considered to be sufficient to cause or exacerbate the deterioration of receiving water quality or instream habitat conditions.

Source Control BMP means a structure or operation that is intended to prevent pollutants from coming into contact with stormwater through physical separation of areas or careful management of activities that are sources of pollutants. The SWMMWW separates source control BMPs into two types. Structural Source Control BMPs are physical, structural, or mechanical devices, or facilities that are intended to prevent pollutants from entering stormwater. Operational BMPs are non-structural practices that prevent or reduce pollutants from entering stormwater.

Stormwater means runoff during and following precipitation and snowmelt events, including surface runoff, drainage, and interflow.

Stormwater Action Monitoring is the regional stormwater monitoring program for western Washington. This means, for all of western Washington, a stormwater-focused monitoring and assessment program consisting of: status and trends monitoring in small streams and marine nearshore areas, Stormwater Management Program effectiveness studies, and source identification projects. The priorities and scope for SAM are set by a formal stakeholder group that selects the studies and oversees the program's administration.

Stormwater Associated with Industrial and Construction Activity means the discharge from any conveyance which is used for collecting and conveying stormwater, which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant, or associated with clearing, grading and/or excavation, and is required to have an NPDES permit in accordance with 40 CFR 122.26.

Stormwater Facilities Regulated by the Permittee means permanent stormwater treatment and flow control BMPs/facilities located in the geographic area covered by the Permit and which are not owned by the Permittee, and are known by the Permittee to discharge into MS4 owned or operated by the Permittee.

Stormwater facility retrofits means both: projects that retrofit existing treatment and/or flow control facilities; and new flow control or treatment facilities or BMPs that will address impacts from existing development.

Stormwater Management Program means a set of actions and activities designed to reduce the discharge of pollutants from the MS4 to the MEP and to protect water quality, and comprising the components listed in S5 or S6 of this Permit and any additional actions necessary to meet the requirements of applicable TMDLs pursuant to S7 Compliance with TMDL Requirements, and S8 Monitoring and Assessment.

Stormwater Treatment and Flow Control BMPs/Facilities means detention facilities, permanent treatment BMPs/facilities; and bioretention, vegetated roofs, and permeable pavements that help meet minimum requirement #6 (treatment), #7 (flow control), or both.

Surface Waters includes lakes, rivers, ponds, streams, inland waters, salt waters, and all other surface waters and water courses within the jurisdiction of the State of Washington.

SWMMWW and ***Stormwater Management Manual for Western Washington*** means the technical manual (Publication No. 04-10-055) published by the Department of Ecology in 2019.

SWMP means Stormwater Management Program.

TMDL means Total Maximum Daily Load.

Total Maximum Daily Load means a water cleanup plan. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation shall include a margin of safety to ensure that the water body can be used for the purposes the state has designated. The calculation shall also account for seasonable variation in water quality. Water quality standards are set by states, territories, and tribes. They identify the uses for each water body, for example, drinking water supply, contact recreation (swimming), and aquatic life support (fishing), and the scientific criteria to support that use. The Clean Water Act, Section 303, establishes the water quality standards and TMDL programs.

Tributary Conveyance means pipes, ditches, catch basins, and inlets owned or operated by the Permittee and designed or used for collecting and conveying stormwater.

UGA means Urban Growth Area.

Urban Growth Area means those areas designated by a county pursuant to RCW 36.70A.110.

Urban/Higher Density Rural Sub-Basins means all areas within or proposed to be within the UGA, or any sub-basin outside the UGA with 50% or more area comprised of lots less than 5 acres.

Vehicle Maintenance or Storage Facility means an uncovered area where any vehicles are regularly washed or maintained, or where at least 10 vehicles are stored.

Water Quality Standards means Surface Water Quality Standards, Chapter 173-201A WAC, Groundwater Quality Standards, Chapter 173-200 WAC, and Sediment Management Standards, Chapter 173-204 WAC.

Waters of the State includes those waters as defined as *Waters of the United States* in 40 CFR Subpart 122.2 within the geographic boundaries of Washington State and *Waters of the State* as defined in Chapter 90.48 RCW which includes lakes, rivers, ponds, streams, inland waters, underground waters, salt waters, and all other surface waters and water courses within the jurisdiction of the State of Washington.

Waters of the United States refers to the definition in 40 CFR 122.2.

FACT SHEET

for the

PHASE I, WESTERN WASHINGTON PHASE II, AND EASTERN WASHINGTON PHASE II MUNICIPAL STORMWATER PERMITS

National Pollutant Discharge Elimination System and
State Waste Discharge General Permit
For discharges from
Small, Medium, and Large Municipal Separate Storm Sewer Systems
In Washington State

August 15, 2018

State of Washington
Department Of Ecology
Olympia, Washington 98504-7600

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1.0 Introduction

This Fact Sheet accompanies the final draft National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge Permits for Discharges from (Large, Medium, and Small) Municipal Separate Storm Sewers for Western and Eastern Washington (the Phase I, Western Washington, and Eastern Washington Phase II Permits). The Fact Sheet serves as the documentation of the legal, technical, and administrative decisions Ecology has made in the process of reissuing the Permits.

On August 1, 2012, Washington Department of Ecology (Ecology) issued the (current 2013/2014) Municipal Stormwater Permits. The table below provides the effective, expiration, and modification dates associated with each Permit.

Table 1: Important dates associated with each Municipal Stormwater Permit

	Effective Date	*Expiration Date*	*Modification Date*
Phase I Permit	August 1, 2013	July 31, 2018	January 16, 2015 August 16, 2016
Western WA Phase II Permit	August 1, 2013	July 31, 2018	January 16, 2015
Eastern WA Phase II Permit	August 1, 2014	July 31, 2019	

While the Phase I and Western Washington Phase II Permits were due to expire on August 1, 2018, Ecology administratively extended the Permits for one year. Ecology based this decision, in part, on the following considerations:

- The extension allowed the consideration of information from ongoing research on effectiveness of stormwater management actions and the review of submittals that are due late in the current Permit cycle.
- The extension allowed for more time to engage with the public and stakeholders during the process of Permit development.
- Extending the Permit cycle allows Ecology to reissue the Western and Eastern Municipal Stormwater Permits at the same time, ensuring an inclusive process for the whole state.

For context regarding the last bullet - Ecology issued (2) one-year, (1) two-year, and (3) five-year Permits in 2012. As required by RCW 90.48.260 through 2011 legislation, Ecology issued two Western Washington Phase II Permits by July 31, 2012. RCW 90.48.260 directed:

(1) By July 31, 2012, the department shall:

(a) Reissue without modification and for a term of one year any national pollutant discharge elimination system municipal storm water general permit first issued on January 17. 2007; and

(b) Issue an updated national pollutant discharge elimination system municipal storm water general permit for any permit first issued on January 17, 2007. An updated permit issued under this subsection shall become effective beginning August 1, 2013."

(2) By July 31, 2012, the department shall:

(a) Reissue without modification and for a term of two years any national pollutant discharge elimination system municipal stormwater general permit applicable to eastern Washington municipalities first issued on January 17, 2007; and

(b) Issue an updated national pollutant discharge elimination system municipal stormwater general permit for any permit first issued on January 17, 2007, applicable to eastern Washington municipalities. An updated permit issued under this subsection becomes effective August 1, 2014.

While not required to do so, Ecology followed a similar two-permit process for the Phase I Permit in order to issue both Permits in western Washington at the same time. The Western and Eastern Washington Phase II Permits' effective date for the five-year Permits were offset by a year, thereby creating staggered Permit expiration dates for western and eastern Washington.

As required by paragraph 402(p)(3) of the Clean Water Act, discharges covered under these Permits must effectively prohibit non-stormwater discharges into municipal separate storm sewer systems (MS4) that discharge to surface waters and must apply controls to reduce the discharge of pollutants to the Maximum Extent Practicable (MEP). As authorized by RCW 90.48.030 and RCW 90.48.162, Ecology also takes action through these Permits to control impacts of stormwater discharges to all waters of Washington State, including ground waters, unless the discharges are authorized by another regulatory program.

Discharges from agricultural runoff, irrigation return flows, process and non-process wastewaters from industrial activities, and stormwater runoff from areas served by combined sewer systems are not regulated directly by these Permits. These types of discharges may be regulated by local or other state requirements if they discharge to MS4s. These Permits authorize the MS4 to discharge stormwater that comes from construction sites or industrial activities under certain conditions.

This Fact Sheet addresses the revised and updated Phase I, Western and Eastern Washington Phase II Permits. You may download copies of the draft Permit documents at: https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Stormwater-general-permits/Municipal-stormwater-general-permits/Municipal-stormwater-permit-reissuance.

1.1 Municipal Stormwater General Permits in Washington State

Ecology issued the first Phase I Municipal Stormwater Permits in 1995 and reissued a general permit in 2007 and 2013 to cover the cities of Seattle and Tacoma, and Snohomish, King, Pierce, and Clark counties. The Phase I federal rule established the list of Phase I jurisdictions, and no new jurisdictions will be added to this list.

EPA issued the federal rule for Phase II of the stormwater permit program in 1999. In 2007, Ecology issued the first Phase II Municipal Stormwater General Permits. Ecology reissued the Phase II Municipal Stormwater Permit for Western Washington and Eastern Washington in 2013 and 2014, respectively.

A number of Phase II Permittees in western Washington are located in counties regulated by the Phase I Permit, or are adjacent to the cities of Seattle and Tacoma. Phase I and Phase II Permittees share basins, have interconnected conveyance systems, and discharge into many of the same water bodies. Phase I and Phase II communities cooperated in a number of permit programs and grant projects, and worked together through coordination groups.

In eastern Washington there are no Phase I Permittees, and thus no interconnected stormwater systems of Phase I and Phase II Permittees. A number of eastern and southwestern Washington Permittees, both Phase I and Phase II, discharge into the Columbia River. Permittees that discharge to tributaries of the Columbia coordinate within those smaller basins. Eastern Washington Permittees coordinate informally with Permittees in western Washington – and vice versa. During the current (2013/2014) Permit terms, Ecology funded several partnerships of eastern and western Washington Permittees to complete grant projects that benefit Permittees statewide.

Small MS4s may also be public stormwater systems similar to those in municipalities, such as systems at colleges and universities, state institutions, and special purpose districts. Ecology uses the term Secondary Permittees to refer to these entities. Special purposes districts may include ports, diking and drainage districts, school districts, park districts, irrigation districts, and state institutions. The MS4s of Secondary Permittees are publicly owned or operated and serve more than 1,000 people on an average day. For ports, schools, colleges, and universities the population figures include commuters as well as residents.

Wherever appropriate, Ecology coordinated the requirements of the Phase II Permits with the requirements of the Phase I Permit. All Permits include similar approaches to compliance with standards, TMDL implementation, and the use of a regional stormwater manual. Programs for illicit discharge detection and elimination and controlling stormwater from construction sites are also similar. In areas where conveyance systems are interconnected or discharges go to the same water body, successful implementation of stormwater management programs requires coordination between local jurisdictions. Ecology has established expectations for regional coordination in monitoring efforts and in proposed requirements for watershed-based stormwater planning for western Washington Permittees. Ecology expects to bring Phase I and Western Washington Phase II requirements for municipal stormwater management closer together in future permit cycles and has made progress toward that end in the current proposal. The proposed Western Washington Phase II Permit separates the mapping section from the IDDE section and includes a Source Control program like the Phase I Permit. The private facility operation and maintenance requirements were moved to the Phase II Operations and Maintenance section to align with the Phase I Permit structure.

2.0 Public Involvement Opportunities

2.1 Public Comment Period

Ecology invites public comments on the proposed draft Permits and Fact Sheet from August 15 until **11:59 PM on Wednesday, November 14, 2018**. Ecology welcomes all comments that address the Permit requirements in these formal draft documents.

Ecology will issue the final Permits after it considers all public comments and makes final changes to the draft Permits. Ecology will publish a *Response to Comments* document with the final Permits to address comments submitted during the public comment period.

2.2 Information to Include with Each Comment

In order for Ecology to adequately address comments, please include the following information with each comment:

- The Permit(s) subject to your comment.
- The specific Permit language used in the requirement subject to your comment. Include the page number(s), line numbers, and, where indicated, section reference (i.e., S8.D.2.b).
- A brief, concise comment including the basis for the comment, and in particular the legal, technical, administrative, or other basis for the concern.
- Suggested Permit language or a conceptual alternative to address your concern.

2.3 How to Submit a Comment

2.3.1 Written Permit Comments

Ecology will accept comments until 11:59 PM on Wednesday, November 14, 2018.

Send written comments regarding the Permits to Ecology by one of the methods below:

- **Preferred**: submit your comments electronically at:
  http://ws.ecology.commentinput.com/?id=JWY6h

- Send by mail to:

  Abbey Stockwell
  WA Department of Ecology
  Water Quality Program
  PO Box 47696
  Olympia, WA 98504-7696

2.3.2 Comments for the Stormwater Management Manual for Western Washington (SWMMWW)

Send written comments regarding the SWMMWW to Ecology electronically at:

- http://ws.ecology.commentinput.com/?id=YFRKA

2.3.3 Oral Comments

Submit oral comments by attending and testifying at the public hearings. (See Section *2.4 Public Hearing and Workshop Schedule* for more information).

2.4 Public Hearing and Workshop Schedule

The public hearings will provide an opportunity for the public to give formal comments on the draft Permit. Each hearing will immediately follow a short workshop with a question and answer session.

Before each public hearing, Ecology will host a general public workshop on the proposed changes in the draft Permits during the public comment period. In western Washington, the workshop will also include information regarding the draft SWMMWW.

The workshops provide Ecology an opportunity to explain the proposed changes to the Permits, and to answer questions. Ecology will not accept formal oral testimony or comments on the draft Permits or Fact Sheet during the public workshops, but will during the public hearings. Each workshop will address all the proposed Permit changes.

2.4.1 Eastern Washington Phase II workshops and hearings

Thursday, September 27, 2018, 9:30 AM
Moses Lake Civic Center
Council Chambers Room
401 S. Balsam
Moses Lake, WA 98837

Thursday, November 1, 2018, 10 AM
Webinar – Register for the Webinar

2.4.2 Phase I and Western Washington Phase II workshops and hearings

Tuesday, October 2, 2018, 10 AM
Skagit Transit Station
105 E. Kincaid
Mt. Vernon, WA 98773

Wednesday, October 10, 2018, 10 AM
South Seattle College – Georgetown Campus
Gene J. Colin Education Hall – Building C, Room C122
6737 Corson Avenue South
Seattle, WA 98108
Parking is $3.00/vehicle at this facility

Tuesday, October 30, 2018, 10 AM
DuPont City Hall
Council Chambers Room

1700 Civic Drive
DuPont, WA 98327

Tuesday, November 6, 2018, 1:30 PM
Webinar – Register for the Webinar

Wednesday, November 7, 2018, 10 AM
WA State School for the Blind
Fries Auditorium
2214 East 13th St
Vancouver, WA 98661

Please direct requests for printed copies of the Draft Permits and Fact Sheet to Dena Jaskar, at dena.jaskar@ecy.wa.gov or 360-407-6401.

Please direct questions about the public hearings/workshops, Notice of Intent, the Phase II Draft Permits, or Fact Sheet to Abbey Stockwell at abbey.stockwell@ecy.wa.gov or 360-407-7221.

Please direct questions about the Phase I Draft Permits, or Fact Sheet to Emma Trewhitt at emma.trewhitt@ecy.wa.gov or 360-407-7468.

2.5 Issuance of the Final Permits

Ecology will issue the final Permits after reviewing and considering all public comments. Ecology expects to issue the final Permits in July 2019. Ecology will send a copy of the Notice of Issuance to all persons who submitted written comment or gave public testimony at the public hearings.

Ecology will append the final Fact Sheet for the Permits with a summary of and response to comments. Parties submitting comments will receive a notice on how to obtain copies of the final Permits and Ecology's response to comments.

2.6 Public Involvement Opportunities Prior to August 1, 2018

Ecology conducted a number of public involvement processes in preparation for reissuance of the Municipal Stormwater General Permits.

2.6.1 "Ad-hoc" stakeholder early input for Western Washington

In 2016, Permittees, NGOs, and other interested parties organized a series of committee meetings with the purpose of developing recommendations for Permit revisions prior to Ecology starting the Permit writing process. The committees formed based on participants' interest in a topic related to Permit requirements (e.g. IDDE, mapping, source control, etc.). The result was a series of thoughtful recommendations for Permit language improvements or clarifications. These recommendation support some of the proposed changes prepared for the preliminary drafts and the final drafts Permits.

2.6.2 Listening Sessions

In February and March of 2018, Ecology hosted listening sessions in western Washington, and in April 2018 in eastern Washington, to announce the reissuance schedule and gather input for preparing to reissue the 2019 Permits. Ecology also presented the same information through an internet conferencing system, or webinar. More than 200 people attended the listening sessions statewide. We used the early input we received as the foundation to generate further discussion and receive broader input. Ecology shared their proposed priorities for revisions to the Permits. Listening sessions were held:

- February 23, 2017 -Lynnwood
- March 2, 2017 - Lacey Community Center (also held via webinar for western WA)
- March 14, 2017 - Vancouver
- April 5, 2018 - Moses Lake
- April 11, 2018 - Webinar for eastern WA

During the listening sessions, Ecology accepted email and online comments. Ecology posted the listening session notes on its website and considered these comments as it developed the Permit revisions. (See listening session materials at https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Stormwater-general-permits/Municipal-stormwater-general-permits/Municipal-stormwater-permit-reissuance)

2.6.3 Fall 2017 - Spring 2018 Western Washington Informal Public Comment Period

Ecology provided an additional public review opportunity for the Permit reissuance process in the fall of 2017. From October 3, 2017 to February 2, 2018 Ecology invited informal public comment on preliminary draft Permit language for the following topics:

- Phase I
  - S5.C.7 Structural Stormwater Control
- Phase I & Phase II
  - S5.C.10 / S5.C.2 Education and Outreach
  - S5.C.9/S5.C.5 IDDE tracking and reporting
  - S5.C.2/S5.C.4 Mapping
  - S5.C.5/S5.C.6 Controlling Runoff – site and subdivision scale
  - S8. Monitoring and Assessment
  - Long-term municipal stormwater planning concept paper
- Phase II
  - S5.C.8 Source Control Program for Existing Development

In addition, Ecology also accepted comments on proposed preliminary changes to the Stormwater Management Manual for Western Washington (SWMMWW). The preliminary draft package of the 2019 SWMMWW included:

- Full table of contents
- All of Volume II
- Select source control BMPs from Volume IV

The preliminary draft Permit language included explanatory notes documenting Ecology's rationale for the proposed draft requirements.

The preliminary draft documents generated a broad response. Ecology received comments from over 30 individuals or entities via email, letters, and an online comment form. This extra step in the public process provided valuable input from a wide range of interested parties. Ecology considered those comments as it developed these proposed draft Permit requirements. The preliminary draft language, explanatory notes, associated documents, and all the comments are available on Ecology's website at: https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Stormwater-general-permits/Municipal-stormwater-general-permits/Municipal-stormwater-permit-reissuance

3.0 Background

3.1 The Stormwater Problem

Stormwater runoff is a leading pollution threat to lakes, rivers, streams and marine water bodies in urbanized areas of Washington State. The stormwater problem was well defined decades ago, and we continue to learn about both the impacts of stormwater on receiving waters and biota across the State, as well as the effectiveness of stormwater management approaches to prevent, reduce, and correct these impacts.

Impacts from stormwater vary geographically due to differences in local land use conditions, hydrologic conditions, the type and condition of the stormwater infrastructure, and the type of receiving water. In typical undeveloped conditions, less than about ten percent of precipitation runs off the land as surface flow. In urban areas, the large amount of impervious surfaces interrupts infiltration and groundwater recharge, concentrates surface flows, and increases the frequency and quantity of runoff sent to receiving waters. As a result, more than 40% of precipitation exits urban areas rapidly through stormwater sewer systems[1]. This causes hydrologic impacts such as scoured streambed channels, excessive sediment transport, loss of habitat, and increased flooding.

Many pollution sources from common land use activities contaminate urban stormwater. Streams and storm outfalls monitoring studies have shown elevated concentrations of metals, nutrients, pesticides and organic compounds in relation to urban development. Contaminants in building materials, in illicit discharges and spills, from vehicular traffic, and atmospheric deposition are picked up by stormwater runoff and make their way to receiving waters if left untreated. Most of these pollution sources are not under the direct control of the Permittees that own or operate municipal storm sewer systems.

The following is a list of typical and potential impacts caused by stormwater discharges:

- **Human Health:** Untreated stormwater contains bacteria, trash, excessive nutrients, toxic metals, and harmful organic compounds. Untreated stormwater is not safe for people to drink and is not recommended for swimming or contact recreation.
- **Drinking Water:** In some areas of Washington, notably Spokane County and parts of Pierce and Clark Counties, gravelly soils allow rapid infiltration of stormwater. Untreated stormwater discharging to the ground could contaminate aquifers that are used for drinking water.
- **Shellfish:** Washington State's multimillion dollar shellfish industry is increasingly threatened by closures due to stormwater contamination.
- **Degraded Water Bodies:** In urban and urbanizing areas across Washington State, residential, commercial, and industrial land development continues to change land cover and drastically alter stream channels. Unmanaged stormwater from urban areas has severely degraded beneficial uses of Washington's waters.
    - A recent study described the "urban stream syndrome"[2] where development predictably and consistently results in degraded conditions of instream water quality and biota.
    - Other recent studies suggest that road density and traffic volumes are main stressors to benthos community health in urban streams indicating traffic associated pollutants in stormwater degraded receiving water bodies[3].
    - Studies in the 1990s found degraded stream benthos communities in watersheds with as little as 10% impervious surface[4]. Studies since then have found a continuum, with impacts detectable at lower levels of impervious surfaces.
    - Unmanaged stormwater has likely permanently destroyed stream habitat in some urban areas of Puget Sound. There are no known instances of recovering "poor" to "fair" or even "fair" to "poor" condition of stream benthos.
    - Recent modeling exercises have demonstrated that current site-by-site approaches to stormwater management approaches are insufficient to prevent continued degradation of receiving water quality (see section 3.2.1 below on "Phase I Counties' Watershed Modeling and Planning").
    - Elevated concentrations of pollutants in small Puget lowland streams in 2015 were significantly correlated with indicators of urbanization including impervious surfaces and watershed canopy[5]. This same study found significant differences between conditions of water quality and biota in streams inside and outside Urban Growth Areas (UGAs).
    - Bacteria is the most common cause of stormwater-related water quality impairment listings. Puget Sound nearshore monitoring programs that focus on

monitoring storm events or source identification tend to have higher bacteria levels than ambient programs[6].

- There are significantly more contaminants Puget Sound nearshore sediments in the incorporated UGAs than the unincorporated UGAs, and sites identified as depositional areas contained more chemicals than the high-energy drift cells (left, right, or divergent)[7] .
- Contaminant levels in mussels along Puget Sound UGA shorelines were correlated with impervious surfaces in the small watersheds adjacent to the shoreline[8].
- The common urban use pesticide bifenthrin was found in sediment samples from about ten percent of Puget lowland stream sites monitored in 2015[9].
- Numerous 303(d) listed water bodies across the State have been assigned stormwater waste load allocations.

- **Salmon Habitat:** Urban stormwater degrades salmon habitat in streams through effects on hydrologic flows and toxicity. Paved surfaces cause greater and more frequent winter stormwater flows that erode stream channels and damage spawning beds. Toxic chemicals in stormwater harm benthic insects, salmon embryos, immature fish, and adults returning to spawn. Several studies have identified concerns. Two important examples:
  - Surveys of spawning adult Coho salmon in Seattle in the early 2000s found that very high percentages of adult females (60-100 percent) were dying before they could spawn[10]. Scientists soon found that stormwater pollution is likely involved[11] and the problem is widespread throughout urban streams in Puget Sound. Untreated highway runoff is lethal, leading to 100% toxic response or death of adult salmon within 24 hours[12]. Active scientific investigation continues, and has made progress toward identifying the precise causes of these acute die-offs. Scientists are most recently honing in on chemicals associated with some tires[13].
  - Ecology and Pierce County conducted *in situ* trout toxicity testing studies in four urban streams in 2008. Pierce County found no significant toxicity[14]. However, Ecology identified the following chemical stressors that were capable of causing adverse effects that were detected on the native trout embryos and pre-swim-up fry: copper, lead, nickel, zinc, polycyclic aromatic hydrocarbons, and the agricultural fungicide Captan[15].
- **Pollution:** Urban stormwater is known to contain a fairly consistent suite of pollutants from common land use activities.

An evaluation of stormwater monitoring data from the National Stormwater Quality Database (NSQD)[16] compared the results for a range of pollutants in urban runoff from areas of different land uses. The NSQD contains a large data set from a representative number of Municipal Stormwater Permit holders. Much of the data may be used to characterize stormwater produced from specific land uses, such as industrial, commercial, low density residential, high density residential, and undeveloped open space. Preliminary statistical analysis of the NSQD found significant differences among land use categories for all pollutants, as shown in Table 2.

In the 2007 Permit, Phase I cities and counties and the ports of Tacoma and Seattle were required to conduct stormwater discharge characterization monitoring to improve our understanding of the amounts of a wider range of pollutants found in stormwater from various land uses. That monitoring and the findings are presented in section 3.2.8 below on "Phase I Permittees' Stormwater Discharge Characterization Monitoring."

Table 2: Event Mean Concentrations of Pollutants Discharged via Stormwater Compiled from the National Stormwater Quality Database, Version 1.0

Pollutant	**Units**	**Land Use**					**Overall**
		Resident-ial	Commer-cial	Industrial	Freeways	Open Space	
Ammonia	mg/L	0.31	0.5	0.5	1.07	0.3	0.44
Biochemical Oxygen Demand	mg/L	9	11.9	9	8	4.2	8.6
Cadmium, Total	ug/L	0.5	0.9	2	1	0.5	1
Cadmium, Filtered	ug/L	ND	0.3	0.6	0.68	ND	0.5
Chemical Oxygen Demand	mg/L	55	63	60	100	21	53
Copper, Total	ug/L	12	17	22	35	5.3	16
Copper, Filtered	ug/L	7	7.6	8	10.9	ND	8
Fecal Coliform	MPN/100 mL	7,750	4,500	2,500	1,700	3,100	5,081
Lead, Total	ug/L	12	18	25	25	5	16
Lead, Filtered	ug/L	3	5	5	1.8	ND	3
Nickel, Total	ug/L	5.4	7	16	9	ND	8
Nickel, Filtered	ug/L	2	3	5	4	ND	4
Nitrogen, NO_2+NO_3	mg/L	0.6	0.6	0.7	0.3	0.6	0.6
Nitrogen , Total Kjeldahl	mg/L	1.4	1.6	1.4	2	0.6	1.4

Pollutant	**Units**	**Land Use**					**Overall**
		Resident-ial	Commer-cial	Industrial	Freeways	Open Space	
Phosphorus, Total	mg/L	0.3	0.22	0.26	0.25	0.25	0.27
Phosphorus, Filtered	mg/L	0.17	0.11	0.11	0.2	0.08	0.12
Suspended Solids, Total	mg/L	48	43	77	99	51	58
Zinc, Total	ug/L	73	150	210	200	39	116
Zinc, Filtered	ug/L	33	59	112	51	ND	52

ND = Not detected, or insufficient data to determine a value
mg/L = Milligrams per liter
ug/L = Micrograms per liter
MPN = Most probable number

3.2 Previous and Ongoing Regional Efforts

Ecology and Permittees are investing in efforts to inform and improve our collective understanding of stormwater impacts and Permittees' implementation of the stormwater management programs and practices required in the Permits. The goals are to better understand the sources and pathways of pollutants, to measure our progress over time, and to continue to identify and target effective management approaches. In recent years, several regional efforts have significantly contributed to an understanding of stormwater impacts and management practices on the beneficial uses of Washington waters.

3.2.1 Phase I Counties' Watershed Modeling and Planning

The 2013 Permit required detailed modeling and planning by the four Phase I counties in western Washington. The purpose of the Permit requirement was to determine what stormwater management and other actions are necessary to meet water quality standards in developing areas. The counties invested considerable staff time and resources into this effort and learned some lessons that can be broadly applied.[17,18,19,20]

Each of the counties selected a medium sized (10-50 square miles) watershed located in an Urban Growth Area (UGA) designated pursuant to the State's Growth Management Act (GMA) and therefore known to be under pressure for development in the near future. The watersheds have unique characteristics, but all are already partially urbanized.

The counties created models to test a suite of supplemental strategies in various scenarios to see if water quality standards were, or could be, met. The modeling showed that current and future conditions in these watersheds are impacted in various ways, and that actions beyond site-by-site stormwater management will be needed to prevent degradation of the receiving waters and meet water quality standards. The models in all of the watersheds projected that riparian restoration and large amounts of additional stormwater detention are needed to improve conditions.

The anticipated costs to recover from these impairments is hundreds of thousands of dollars per acre of watershed. The costs per acre for these basins are somewhat lower for less developed basins, but they are still well beyond what might be affordable with current funding programs and approaches.

An important strategy that one of the four counties highlighted in their scenarios was changing the land use designation or zoning established as part of the growth management process. King County demonstrated that such changes will help protect water quality while substantially lowering the high capital project costs identified by the models. Ecology encourages stormwater managers to seriously consider pursuing this type of strategy in future planning to accommodate projected population increases.

3.2.2 Puget Sound Ecosystem Monitoring Program Stormwater Work Group (SWG)

The SWG developed recommendations for a comprehensive stormwater monitoring strategy focused on Puget Sound[21]. To develop the strategy, the SWG convened many of the region's stormwater experts to review previous work and evaluate the direct and indirect effects of stormwater on the Puget Sound ecosystem. The SWG also evaluated the various pathways by which those effects are transmitted and to develop the monitoring approach ultimately included in the 2013 Phase I and Western Washington Phase II Permits. In the process of reaching consensus from a broad range of expertise and technical backgrounds, the work group members formulated a conceptual model of the factors driving the stormwater-related impairment of water quality and habitat in the region. Figure 1 shows the types of stressors that should be considered, the pathways by which those stressors are transmitted, and how the outcomes of our management efforts should be assessed, using a Driver-Pressure-State Impact-Response (DPSIR) conceptual model approach[22].

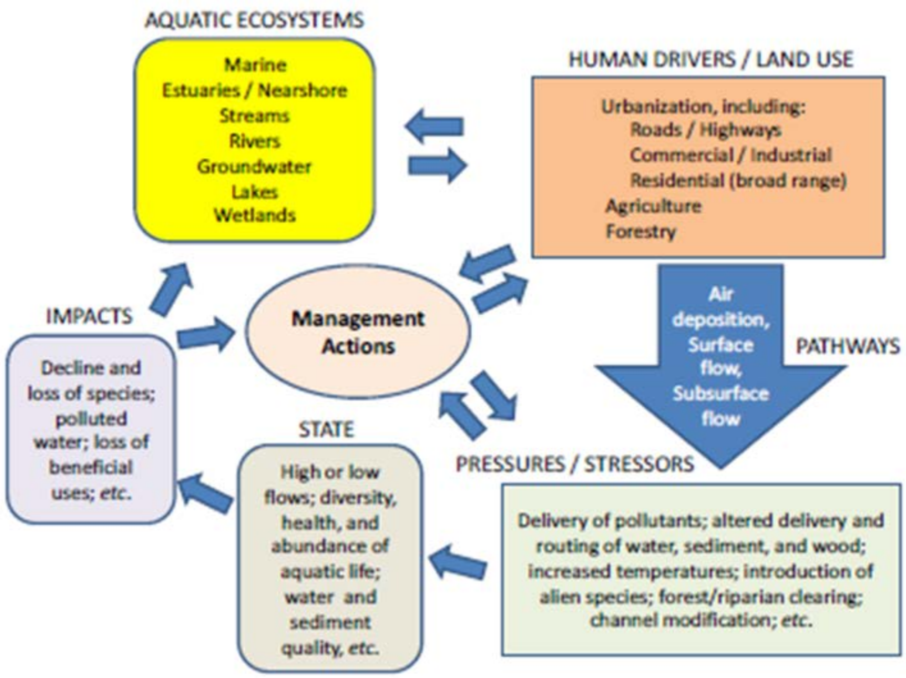

Figure 1: Stormwater Stressors and Pathways

The conceptual model identifies land use as the driver for impacts to aquatic ecosystems. Ecology is applying the DPSIR approach illustrated in this conceptual model to organize stormwater-related ecosystem recovery efforts and use monitoring information for adaptive management.

The SWG continues to discuss recent scientific finding and recommend priorities for the regional stormwater monitoring program.

3.2.3 Stormwater Action Monitoring (SAM)

SAM is the regional stormwater monitoring program which is primarily funded by Phase I and Phase II permittees in western Washington in the 2013 Permits through Special Condition S8. Monitoring and Assessment requirements. SAM was launched in 2014 and is implementing the SWG's strategy and recommendations. By the summer of 2018, 16 effectiveness, three source identification, and five receiving water studies were in various stages of completion, and two new studies were identified for contracting to begin before the end of the Permit extension year.

3.2.4 How has SAM resulted in changes to the Phase I and Phase II Western Washington Permits?

While findings and recommendations of SAM studies initiated during the 2013 permit were just beginning to come in as Ecology began the 2019 Permit reissuance process, some SAM results are already closely connected to various Permit requirements and compliance oversight.

- Ecology permit writers evaluated the "Business inspection source control"[23] SAM effectiveness study findings and recommendations in writing the 2019 Permit S8.C.5 IDDE program requirements for Phase II Permittees.
- Ecology engineers updated language in BMP T7.30 in the *Stormwater Management Manual for Western Washington* (SWMMWW) to emphasize proper design and sizing for curb cut inlets to match expected site conditions after Ecology reviewed the findings of the "Stormwater retrofit monitoring in the Echo Lake drainage basin"[24] SAM effectiveness study.
- The "Illicit Discharge Detection and Elimination Data (IDDE) evaluation for Western Washington"[25] SAM source identification study revealed that many Permittees were not keeping adequate records. These findings helped Ecology's permit managers provide technical assistance to improve record keeping practices. Ecology permit writers also clarified Permittees' IDDE reporting requirements to improve consistency and inform regional understanding and approaches for the most common IDDE problems.
- Ecology management supports the new comprehensive stormwater planning requirements in light of our understanding that the current Permit provisions are not sufficient to protect and restore water quality. Ecology looks to the SAM regional status and trends monitoring studies to assess whether the Permittees' SWMPs and additional strategic management actions can achieve the goals of minimizing and reversing harm caused by stormwater.
- Ecology's engineers kept the 60/40 mix as the default bioretention soil medium due in part to the "Bioretention reduction of toxicity to Coho salmon from urban stormwater"[26] SAM study that confirmed prevention of acute toxicity to Coho salmon. Performance of the 60/40 mix over time and lower phosphorus-exporting alternative mixtures are important anticipated results from ongoing SAM effectiveness studies.

3.2.5 Lower Columbia Urban Streams Status and Trends Monitoring

Led by the City of Longview, the Lower Columbia Fish Recovery Board, and the Pacific Northwest Aquatic Monitoring Partnership, stakeholders in the Lower Columbia Region developed an urban streams monitoring program that will be implemented in this 2019 Permit cycle.[27] The purpose of the monitoring is to answer the policy question: "Are regional conditions in receiving water quality and biota improving in concert with broad implementation of required stormwater management practices?"

3.2.6 Evaluation of Eastern Washington Receiving Water Data

In recognition of the differing hydrogeologic settings in eastern Washington, Ecology asked the U.S. Geological Survey to evaluate existing information about stormwater impacts to receiving waters in eastern Washington[28]. The review concluded that the receiving water monitoring approaches in Puget Sound and the Lower Columbia are not suitable for application in eastern Washington, and recommended instead focusing on effectiveness studies.

3.2.7 Eastern Washington Stormwater Management Effectiveness Studies

During the 2013 Permit, stormwater managers in eastern Washington engaged in a process to identify and prioritize effectiveness study questions and topics. By the summer of 2018, a total of eight studies were underway, each led by a Permittee. Results of these studies will be shared during the 2019 Permit cycle.

3.2.8 Toxic Loading Studies for Puget Sound

In 2010, Ecology and others[29] estimated toxic chemical loadings from surface runoff in the Puget Sound Basin. This was Phase 3 of a series of studies that began in 2006 and included a multi-partner steering committee of federal, state, and local government agencies, consultants, and reviewers.

As part of Phase 3 of its toxics loading study, Ecology collected water quality samples of surface runoff during eight storm or baseflow events from 16 distinct sub-basins, each representative of one of four land covers (Commercial/Industrial, Residential, Agricultural, and undeveloped Forest/Field/Other). Analyses of the samples employed much lower detection limits than typically used to produce pollutant concentration and loading data. No other study in Washington has quantified pollutant loads for so many constituents at this scale. Although this data represents surface runoff in the sampled sub-basins and is not directly representative of regulated stormwater discharges, some of the findings are generally in agreement with those from the 2005 analysis of the National Stormwater Quality Database. The pollutant loading estimates were based on data collected from small streams, where pollutant concentrations had likely been reduced by attenuation, degradation, deposition, and/or dilution. Therefore, the loading estimates might have been greater if they had been based on outfalls from stormwater conveyance systems.

The study found the following:

- Surface water runoff, particularly from commercial and industrial areas, did not meet water quality standards or human health criteria for the following parameters: dissolved copper, lead, and zinc; total mercury; total polychlorinated biphenyls (PCBs); several carcinogenic polycyclic aromatic hydrocarbons (PAHs); and DDT-related compounds.
- Organic pollutants and metals were generally detected more frequently and at greater concentrations in surface runoff from commercial and industrial areas than from other land uses. Runoff from residential and agricultural land had higher frequency of detection for most parameters than runoff from undeveloped/forested land, but generally less than runoff from commercial land. Greater detection frequencies occurred during storm events than during baseflow across all land cover types.
- During storm events, surface runoff from areas of forested and commercial land covers were chemically distinct from each other and from the other land cover types. Forested lands produced runoff with smaller concentrations of nitrate+nitrite nitrogen, total phosphorus, and total arsenic, copper, mercury, and suspended solids. Commercial land areas produced runoff with relatively greater concentrations of total lead, zinc, PBDEs, and PCBs.
- At the local scale, pollutant loading rates via small streams were substantially greater during storm events compared to baseflow. The rain-induced surface runoff during storm events caused higher streamflow rates. These higher flow rates coupled with increased pollutant concentrations to produce substantially greater loading rates for storm events

than for baseflow. This result suggested that the greatest opportunity for transport of toxic chemicals occurs during storm events.

3.2.9 Phase I Permittees' Stormwater Discharge Characterization Monitoring

In 2015, Ecology[30] summarized monitoring results from Phase I Municipal Stormwater Permittees, including Clark, King, Pierce, and Snohomish Counties, the Cities of Seattle and Tacoma, and the Ports of Seattle and Tacoma, and collected chemical monitoring data representing municipal stormwater discharge quality during 2007 Phase I Permit. Tacoma and Clark County continued this monitoring in the 2013 Permit.

The 2007 Permit required each city and county Permittee to conduct stormwater characterization monitoring at three (or, for each of the two Ports, one) municipal stormwater basins representing four land uses (industrial, commercial, low density residential, and high density residential). This monitoring represents flow-weighted composite samples from 11 storm events each water year, annual sediment sampling, and one-time toxicity testing of seasonal first-flush discharges.

No other stormwater monitoring effort in Washington – or in the nation – has generated comparable water quality data on municipal stormwater discharges for such a large parameter suite from these four typical land uses.

Generally, stormwater discharge concentrations were consistently lower than data in the National Stormwater Quality Dataset,[31] much lower the National Urban Runoff Program data,[32] but higher than the levels reported in the Toxics Loading Study for Puget Sound. These results were not surprising, the two national datasets likely contain data from denser cities and the toxics loading study sampled receiving waters, not stormwater discharges, during storm events. By in large, Ecology concluded that "typical" stormwater chemistry for a given land use remains an elusive definition. This compilation study also found the following:

- Approximately 600 storm events were sampled by the eight Phase I Permittees and Co-permittees. Hydrologically, the data set compared well to the precipitation record for the Puget Sound region and the samples covered 80-90% of the storm hydrograph in most cases.
- Efforts to assess toxicity of stormwater on trout embryos per Permit requirements were met with considerable logistical and bioassay complexity. Most bioassays had no adverse effects, and those with toxicity effects, samples from larger commercial areas, indicated the likely toxicants were zinc and copper.
- Fecal coliforms were a fairly ubiquitous contaminant, but were found at significantly lower concentrations from low density residential land uses. Seasonally, fecal counts were significantly higher in the dry season compared to the wet season.
- For nutrients, there does not appear to be any significant difference between land uses. Dissolved nutrients were higher from residential areas, but lower than the concentrations in the Toxics Loading Study, which suggests that piped stormwater systems in Phase I areas aren't a major source for dissolved nutrient loads to Puget Sound.
- Commercial and industrial areas discharged stormwater with the highest concentrations of metals, hydrocarbons, phthalates, total nutrients, and a few pesticides.

- Metals concentrations monitored during the dry season (May through September) were statistically higher than concentrations monitored during the wet season.
- Comparisons to water quality criteria were made for context in this report. Copper, zinc, and lead most frequently exceeded (did not meet) the water quality criteria for protection of aquatic life.
- PAHs, phthalates, PCBs, and the few detected pesticides did not exhibit a significant seasonal difference, suggesting these parameters were being discharged from a consistent source throughout the year. Bis(2-ethylhexyl) phthalate was frequently found in stormwater and stormwater sediment.
- Volatile organic chemistry parameters and multiple pesticides were infrequently detected or not detected at all in samples such as benzene, toluene, ethylbenzene, xylene, Malathion, prometon, chlorpyrifos, Diazinon, Triclopyr, mecoprop, and many phenolics.
- NWTPH-Dx compounds were persistent stormwater contaminants. Commercial and industrial areas discharged much higher concentrations and loads than did residential areas. When the motor oil fraction was considered separately, the highest load was from residential areas. However, NWTPH-Gx was poorly detected and, if present, was likely volatized before monitoring.
- Stormwater sediment samples (collected from catch basins or outfall locations) were infrequently collected but some of the parameters showed a similar contaminant level pattern to the stormwater samples across land uses. Concentrations for several phthalates, PAHs, phenols, copper and lead were often detected but generally lower than sediment cleanup objectives, except bis(2-ethylhexyl) phthalate which was often above. More data is needed to better characterize in-line stormwater solids both spatially and temporally.

3.2.10 Other Studies on Toxics Loading from Stormwater

Ecology monitored building materials and atmospheric deposition in areas of Lacey and Olympia, Washington, and found that high levels of copper and zinc are released each year from materials including streetlight poles, building roofing and siding materials, chain-link fencing, and roof gutters during rainfall events. The primary sources of copper were vehicle brake wear, building roofing and siding materials, treated lumber, and vehicle exhaust. The main sources of zinc were moss control products, building siding, vehicle tire wear, chain-link fence, roofing materials, and vehicle brake wear. New asphalt shingles with algae resistance were found to be particularly significant sources of both copper and zinc.[33,34]

3.2.11 Sediment Phthalates Work Group

The Sediment Phthalates Work Group was convened in 2006 to address the re-contamination of cleaned up sites in urban bays of Puget Sound. The Duwamish and Foss Waterways are Superfund sites in which sediment samples showed contamination by phthalates after costly sediment cleanups. Phthalates were not among the original contaminants of concern that led to the cleanup, and are pollutants of more contemporary origin than those addressed by the cleanup.

The work group was charged with identifying the sources and pathways for the phthalates and making recommendations regarding the newly contaminated sediments. This workgroup evaluated information to better understand how phthalates are reaching Puget Sound. The work group identified data gaps, made recommendations, and developed a comprehensive problem statement that included the following findings.[35]

- Billions of pounds of plasticized polyvinyl chloride (PVC) products are currently in use in urban environments, and these materials off-gas phthalates into the surrounding atmosphere for many years.
- Volatilized phthalates adhere to fine particulates in the air and eventually settle onto impervious surfaces and soil.
- Stormwater washes the phthalate-contaminated particulates into storm drains and subsequently into natural water bodies and sediments, where the concentrations and loadings of phthalates can build up over time.
- Although phthalates do not readily bioaccumulate, large amounts loaded into sediments are toxic to benthic organisms.

Phthalates are an example of a pollutant that exists throughout the urban environment. The work group report acknowledged that it may not be feasible to remove some pollutants such as phthalates from stormwater once they are in the environment. Source control solutions to reducing these pollutants may include finding alternatives to use in manufacturing the products that contain them. Their widespread uses make them somewhat ubiquitous in the contemporary urban setting. Phthalates and some other pollutants will require broader societal efforts to address the contaminants resulting from the manufacturing processes for many products widely used in contemporary society.

3.2.12 Climate Change

Ecology is funding a King County led study to determine the effects of climate change in the region. Working with University of Washington's Climate Impacts group, the study is looking to take larger scale global climate models and downscale them to align with the development regulations in the Phase I and Phase II Western Washington Permits. The study is ongoing and will not be complete until after the Permits are drafted. Ecology will analyze and disseminate the findings of the study within this Permit cycle and may use these findings as the basis for policies and regulations moving forward.

The continuous hydrologic modeling that is the foundation of the development regulation in Western Washington already considers climate change. Continuous modeling is based on the historic rainfall record. The rainfall record will be updated with this Permit cycle. Thus, the model adjusts to the extent that the most recent rainfall records reflect the changing climate.

Eastern Washington development regulations rely on single event modeling and climate that has not yet been analyzed. This modeling is based on widely accepted theoretical rainfall patterns not tied directly to local rainfall records. These theoretical rainfall events have not yet been adjusted to reflect the impacts of climate change.

3.3 Laws and Regulations

3.3.1 Federal Clean Water Act

These Permits implement sections of the Federal Clean Water Act (CWA), the U.S. Environmental Protection Agency rules, and the Washington State Water Pollution Control Act (RCW 90.48).

The Federal Clean Water Act (CWA, 1972, and later modifications in 1977, 1981, and 1987) established water quality goals for the surface waters of the United States. One of the mechanisms for achieving goals of the CWA is the National Pollutant Discharge Elimination System (NPDES) permitting program. In Washington State, Ecology has been delegated authority to administer the NPDES program for most dischargers, including most municipal stormwater dischargers. Chapter 90.48 RCW defines Ecology's authority and obligations in administering the NPDES permit program.

As part of the 1987 CWA amendments, Congress added section 402(p) to cover stormwater discharges to waters of the United States. Under the Federal Clean Water Act (33.U.S.C. Section 1342(p)(3)(B)), permit requirements for discharges from municipal separate storm sewer systems include:

> Municipal Discharge – Permits for discharges from municipal storm sewers:
>
> (i) May be issued on a system-or jurisdiction-wide basis;
>
> (ii) Shall include a requirement to effectively prohibit non-stormwater discharges into the storm sewers; and
>
> (iii) Shall require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques, and system design and engineering methods, and such other provisions as the Administrator or the State determines appropriate for the control of such pollutants.

Congress phased in NPDES requirements for municipal stormwater discharges in two phases. Phase I includes medium and large municipalities. Populations of over 250,000 are defined as "large," while those with populations between 100,000 and 250,000 are defined as "medium" municipalities.

In the 1987 CWA amendments, Congress directed EPA to study remaining sources of stormwater discharges and, based on the study, to propose regulations to designate and control other stormwater sources. These regulations, which are commonly known as the Phase II rules, were adopted by the EPA in December, 1999. The Phase II rules extend coverage of the (NPDES) program to certain "small" municipal separate storm sewer systems.

3.3.2 EPA Rules

U.S. EPA implementing regulations define the term "municipality" to mean incorporated cities and unincorporated counties that have sufficient population in a Census Bureau designated urbanized area to meet the population thresholds. In addition, the EPA rule requires permit coverage for other public entities (excluding incorporated cities), regardless of their size, that own and operate storm sewer systems located within the municipalities that meet the population thresholds. Examples of other publicly-owned storm sewer systems include state highways, ports, drainage districts, school districts, colleges and universities, and flood control districts located within permitted municipalities. Ecology uses the term "Secondary Permittees" for these Permittees in the Phase I and Phase II Permits.

Recognizing the complexity of controlling stormwater, Congress and EPA established a regulatory framework for municipal stormwater discharges that is different from traditional NPDES permit programs. Some of the key provisions of the stormwater rules that reflect these differences are:

- Permits require the implementation of stormwater management *programs* rather than establishing numeric effluent standards for stormwater discharges (40 CFR 122.26(d)(2)(iv)).
- Permits cover a large geographic area rather than individual "facilities." Within a permit coverage area there may be hundreds or thousands of individual outfalls discharging to surface water (40 CFR 122.26(a)(3)).
- Flexibility that allows Permittees to first focus their resources on the highest priority problems (40 CFR 122.26(d)(2)(iv)).
- Pollution prevention is emphasized with some provisions requiring eliminating or controlling pollutants at their source and by requiring Permittees to assess potential future impacts due to population growth and other factors (40 CFR 122.26(d)(2)(iv)(B) & (d)(1) (iii)).

EPA rules for discharges from large and medium MS4s did not establish actual permit requirements. EPA allowed the permitting authority flexibility to establish permit requirements that are appropriate for the local area under Phase I regulation.

The Phase II rules require the development, implementation, and enforcement of stormwater management programs designed to reduce the discharge of pollutants from MS4s to the maximum extent practicable (MEP), protect water quality, and satisfy the appropriate water quality requirements of the Clean Water Act.

The Phase II rules outline the minimum elements of a Stormwater Management Program (SWMP) which must include:

1. Public education and outreach on stormwater impacts
2. Public involvement and participation
3. Illicit discharge detection and elimination
4. Construction site stormwater runoff control
5. Post-construction stormwater management in new development and re-development
6. Pollution prevention and good housekeeping for municipal operations.

In addition to the above six minimum measures, the Phase II rules also require:

1. Compliance with approved total maximum daily load (TMDL, or water cleanup plan) or equivalent analysis, where appropriate, and
2. Evaluation and assessment of program compliance.

The Phase II rules require Ecology to "make available a menu of BMPs to assist regulated small MS4s in the design and implementation of the municipal storm water management programs to implement the minimum measures specified in (40 CFR) 122.34(b) of this chapter." The *Stormwater Management Manual for Eastern Washington* and the *Stormwater Management Manual for Western Washington* meet this requirement in regard to construction site stormwater control and post-construction stormwater management in new development and re-development.

On October 22, 2015, EPA published the final National Pollutant Discharge Elimination System (NPDES) Electronic Reporting Rule. This regulation requires the electronic reporting and sharing of Clean Water Act NPDES program information instead of the current paper-based reporting of this information.[36]

In 2016, EPA completed rulemaking known as the MS4 General Permit Remand Rule addressing a partial remand of the Phase II stormwater regulations by the U.S. Court of Appeals for the Ninth Circuit. The final MS4 General Permit Remand Rule establishes two alternative approaches an NPDES permitting authority can use to issue and administer small MS4 general permits:

1) Traditional General Permit Approach: the permitting authority establishes in the general permit the full set of requirements that are deemed necessary to meet the MS4 permit standard ("reduce pollutants to the maximum extent practicable, protect water quality and satisfy the appropriate water quality requirements of the Clean Water Act"), and the administrative record would include an explanation of the rationale for its determination.
2) Procedural Approach: the permitting authority would establish applicable permit requirements to meet the MS4 permit standard by going through a second permitting step following the issuance of the general permit (referred to as the "base general permit"), similar to the procedures used to issue individual NPDES permits. Eligible MS4 operators would be required to submit NOIs with the same information that has always been required under the Phase II regulations, that is, a description of the BMPs to be implemented by the MS4 operator during the permit term, and the measurable goals associated with each BMP. Following the receipt of the NOI, the permitting authority would review the NOI to assess whether the proposed BMPs and measurable goals meet the MS4 permit standard. If not, the permitting authority would request supplemental information or revisions as necessary to ensure that the submission satisfies the regulatory requirements. Once satisfied with the submission, the permitting authority would be required to propose incorporating the BMPs and measurable goals in the NOI as permit requirements and to provide public notice of the NOI and an opportunity to submit comments and to request a hearing in accordance with §§ 124.10 through 124.13. After consideration of comments received and a hearing, if held, the permitting authority would provide notice of its decision to authorize coverage under the general permit, along

with any MS4-specific requirements established during this second process. Upon completion of this process, the MS4 would be required to comply with the requirements set forth in the base general permit and the additional terms and conditions established through the second-step process[37].

EPA also allows a third option, known as “State’s Choice” which allows for a hybrid approach that incorporates elements from both processes described above. Ecology follows the traditional general permit approach to administer the Phase II Permits.

3.3.3 The State Water Pollution Control Act and Implementing Regulations

In addition to requirements in federal law, there are state law requirements for the control of pollution in Chapter 90.48 RCW, known as the Water Pollution Control Act. RCW 90.48.010 establishes that it is:

the public policy of the state of Washington to maintain the highest possible standards to insure the purity of all waters of the state consistent with public health and public enjoyment thereof, the propagation and protection of wild life, birds, game, fish and other aquatic life, and the industrial development of the state, and to that end require the use of all known available and reasonable methods by industries and others to prevent and control the pollution of the waters of the state of Washington.

The terms “pollution” and “waters of the state” are defined in RCW 90.48.020. Waters of the state “….shall be construed to include lakes, rivers, ponds, streams, inland waters, underground waters, salt waters and all other surface waters and watercourses within the jurisdiction of the state of Washington.” This definition differs from the federal definition of “waters of the United States” which is limited to surface waters. State law requires a permit to regulate discharge of pollutants or waste materials to waters of the state (RCW 90.48.162). In 1987 the State Legislature passed into law RCW 90.48.520. When issuing or renewing state and federal wastewater discharge permits, Ecology must review the applicant’s operations and incorporate permit conditions which require all known, available, and reasonable methods to control toxicants in the applicant’s wastewater. The law prohibits the discharge of toxicants which would violate any water quality standard, including toxicant standards, sediment criteria, and dilution zone criteria (RCW 90.48.520).

RCW 90.48.035 grants Ecology authority to adopt standards for the quality of waters of the state. Ecology has adopted the following standards:

- Chapter 173-200 WAC Ground Water Quality Standards;
- Chapter 173-201A WAC Water Quality Standards for Surface Waters; and
- Chapter 173-204 WAC Sediment Management Standards.

These standards generally require that permits that Ecology issues ensure that discharges will not violate standards, or that a compliance schedule be in place to bring discharges into compliance.

The Waste Discharge General Permit Program regulation, Chapter 173-226 WAC, establishes a general permit program for the discharge of pollutants, wastes, and other materials to waters of the state. One of the requirements (WAC 173-226-110) for issuing a general permit under the NPDES permit program is the preparation of a draft permit and an accompanying fact sheet.

4.0 Relationship to Other Stormwater Permits

EPA stormwater regulations establish NPDES permit requirements for stormwater discharges from industrial facilities, construction sites, large and medium municipal storm sewer systems (Phase I), and the Washington State Department of Transportation.

4.1 Industrial Stormwater General Permit

The federal stormwater regulations envision a cooperative relationship between industrial stormwater Permittees that discharge to municipal separate storm sewer systems (MS4s) and those municipal Permittees. In Washington State, a wide range of industrial facilities listed at 40 CFR 122.26(b)(14) must obtain coverage under Ecology's Industrial Stormwater General Permit, which authorizes discharges to surface waters or to MS4s that discharge to surface waters. Ecology has also issued several industry-specific permits that authorize stormwater discharges from those facilities, including the Sand and Gravel General Permit and the Boatyard General Permit.

4.2 Construction Stormwater General Permit

Under this permit, Permittees must adopt and implement measures to control discharges into the MS4 system from construction sites, including sites regulated by Ecology's Construction Stormwater General Permit. The Construction Stormwater General Permit is issued by Ecology to individual construction site operators for projects of one acre or more, or for projects of less than one acre that are part of a larger, common plan of development or sale. Construction site operators that are covered under and operating in compliance with the Construction Stormwater General Permit will be in compliance with the construction site runoff control requirements of the Municipal Stormwater Permit. Local jurisdictions may add additional requirements for construction site operators to address local conditions or concerns. Local jurisdictions also coordinate with and complement Ecology's regulation of construction sites to prevent pollutants from those sites from entering the MS4.

4.3 Washington Department of Transportation Municipal Stormwater General Permit

The Washington Department of Transportation (WSDOT) is a statewide agency that owns and operates municipal separate stormwater systems that carry discharges from highways, maintenance and storage facilities, ferry docks, and other WSDOT facilities. Discharges from WSDOT MS4s are authorized under a single statewide Permit for MS4s in Phase I and Phase II coverage areas, and in areas with applicable TMDLs. The WSDOT Municipal Stormwater Permit was first issued in 2009 and reissued in 2014.

The WSDOT Municipal Stormwater Permit includes requirements similar to the Municipal Stormwater General Permit to conduct public education and involvement, prevent and address polluting illicit discharges, and for operations and maintenance. Requirements for WSDOT construction sites and for managing stormwater discharges from new and re-development projects are consistent with the requirements in the Phase I Permit, except they are tailored to highway construction. WSDOT's Permit also includes a monitoring program to evaluate the effectiveness of its stormwater management program.

WSDOT stormwater conveyances frequently interconnect with MS4s covered under these Permits. This requires WSDOT and municipal Permittees to work together to control illicit discharges, respond to spills and dumping, and, where they discharge to shared water bodies, to implement TMDLs.

5.0 Antidegradation

5.1 Background

Federal regulations (40 CFR 131.12) and the Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A-300, 310, 320, 330) establish a water quality antidegradation program. The purpose of the antidegradation program is to:

- Restore and maintain the highest possible quality of the surface waters of Washington.
- Describe situations under which water quality may be lowered from its current condition.
- Apply to human activities that are likely to have an impact on the water quality of surface water.
- Ensure that all human activities likely to contribute to a lowering of water quality, at a minimum, apply all known, available, and reasonable methods of prevention, control, and treatment (AKART).
- Apply three Tiers of protection (described below) for surface waters of the state.

The federally mandated program establishes three tiers of protection for water quality. Tier I ensures the maintenance and protection of existing and designated uses. Tier I applies to all waters and all sources of pollution. Tier II prevents the degradation of waters that are of a higher quality than the criteria assigned, except where such lowering of water quality is shown to be necessary and in the overriding public interest. Tier II applies only to a specific list of polluting activities. Tier III prevents the degradation of waters formally listed as “outstanding resource waters,” and applies to all sources of pollution.

These Permits address antidegradation of Tier I and Tier II waters. Ecology has determined that there are no coverages under this Permit to Tier III waters.

5.2 Formal Adaptive Process to Comply with WAC 173-201A-320(6)

Washington’s Tier II requirements for general permits are outlined in WAC 173-201A-320(6):

a) Individual activities covered under these general permits or programs will not require a Tier II analysis.

b) The department will describe in writing how the general permit or control program meets the antidegradation requirements of this section.

c) The department recognizes that many water quality protection programs and their associated control technologies are in a continual state of improvement and development. As a result, information regarding the existence, effectiveness, or costs of control practices for reducing pollution and meeting the water quality standards may be incomplete. In these instances, the antidegradation requirements of this section can be considered met for general permits and programs that have a formal process to select, develop, adopt, and refine control practices for protecting water quality and meeting the intent of this section. This adaptive process must:

(i) Ensure that information is developed and used expeditiously to revise permit or program requirements;

(ii) Review and refine management and control programs in cycles not to exceed five years or the period of permit reissuance; and

(iii) Include a plan that describes how the information will be obtained and used to ensure full compliance with this chapter. The plan must be developed and documented in advance of the permit or program approved under this section.

d) All authorizations under this section must still comply with the provisions of Tier I (WAC 173-210A-310).

5.3 How the Municipal Stormwater Permits Meet the Antidegradation Requirement

Ecology's process for reissuance of the Municipal Stormwater General Permits includes a formal process to select, develop, adopt, and refine control practices for protecting water quality and meeting the intent of WAC 173-201A-310. All Permits are issued for a fixed terms of five years. Each time Ecology reissues the Municipal Stormwater General Permits, it evaluates the Permit conditions to determine if additional or more stringent requirements should be incorporated.

Ecology's evaluation of the Municipal Stormwater Permits includes an ongoing review of information on new pollution prevention and treatment practices for storm water discharges. Sources of such information include:

1. *Comments on draft Permits*. Ecology's public process for developing the 2019 proposed Permits includes the following:

    a. During the 2014 Permit modification to incorporate the results of Permit appeals, Ecology asked for input on opportunities to improve and simplify requirements without compromising environmental protection. Staff used comments from that process to revise and improve the Permits.

    b. A Permittee and Non-Governmental Organization (NGO) led process in 2016 generated substantive recommendations and comments ahead of listening sessions. Early input from eastern Washington in the winter of 2017 was also useful in determining needed Permit changes.

    c. In 2017-2018, Ecology staff held five listening sessions statewide and used the feedback to inform Permit revisions for all sections of the Permits.

    d. An Oct-Feb 2018 informal comment period for western Washington preliminary draft Permit language on education and outreach, IDDE reporting, Source Control for W. WA Phase II, Mapping, Structural Stormwater Controls (Phase I), Controlling runoff manual equivalency, and a framework for long-term municipal stormwater planning generated comments from over 27 entities or individuals.

e. Ecology will review and use public comment and testimony from public hearings during the public comment period on the draft Permits to develop the final Permits.

2. *Ecology's Stormwater Management Manuals*. Ecology periodically updates the stormwater management manuals based on new information and science. The update process includes a public involvement element. Since the Municipal Stormwater Permits require Permittees to select BMPs from the most recent edition of the stormwater manuals (or a program approved as functionally equivalent), the BMPs contained in updated stormwater manuals are adopted by Permittees. This improves the effectiveness of stormwater controls for protecting water quality and meeting the intent of the antidegradation provisions of the water quality standards. Ecology is providing an updated draft of the *Stormwater Management Manual for Western Washington*[38] for public comment concurrent with the draft Municipal Stormwater General Permits. The *Stormwater Management Manual for Eastern Washington*[39] will be updated at the end of 2018.

3. *Technology Assessment Protocol – Ecology (TAPE) process*. This formal process reviews and tests emerging treatment technologies for eventual adoption in Ecology's stormwater management manuals. The TAPE review process stimulates the development and use of innovative stormwater technologies used at construction sites and in new and redevelopment projects. There are more than ten Manufactured Treatment Devices (MTDs) with General Use Designations and many other MTDs going through their field monitoring in Washington State and at pre-approved TAPE monitoring sites across the U.S.

4. *Washington Stormwater Center research*. Ecology helped establish and fund the Stormwater Center and affiliated Low Impact Development research program to conduct stormwater technical research. The Center works in partnership with state academic institutions partners including Washington State University Puyallup Campus and the University of Washington Urban Waters Program in Tacoma. The Center disseminates information on current research and training opportunities to municipalities and businesses.

5. *Permittee compliance reports*. Each Permittee submits to Ecology an Annual Report, monitoring results, and special submittals by Permittees for alternative approaches to maintenance or detection of illicit discharges. Ecology staff review and act on Annual Reports to address compliance issues and provide technical assistance. A statewide Ecology Municipal Stormwater Permit Team produces written guidance and Permittee training opportunities to disseminate information on improved BMPs.

6. *Pilot Phase II audit program*. In 2015-2016, the Ecology Municipal Stormwater Permit Team audited specific programs being implemented by 1-2 Permittees in each region. The audits revealed where Permit language might need clarification or emphasis.

The low impact development requirements in the Municipal Stormwater Permits are part of the adaptive process to improve stormwater management and protect surface waters from degradation. Low impact development stormwater management for new and redevelopment projects is a nationally recognized innovative land use and stormwater management approach. Ecology's Permits require LID at levels appropriate to the experience and physical conditions in each region. Ecology funded an update to the Western Washington Hydrologic Model to address LID BMPs. Ecology continues to fund guidance and training on LID BMPs statewide. In Eastern Washington, where onsite retention is a common practice, but not necessarily through specific LID BMPs, Ecology proposes incremental steps toward eventual broad implementation of LID as appropriate to the climate, soils, and geology of that region. LID guidance specific to eastern Washington was developed during the 2014 Permit term, and is proposed to be incorporated in the updated SWMMEW. These statewide requirements support a fundamental shift to LID stormwater design and management in new and redevelopment that help meet the antidegradation requirements of WAC 172-203A-320(6).

The monitoring proposal in the draft Permits also help satisfy the anti-degradation requirements for adaptive management. The draft Permits requires monitoring studies to evaluate the effectiveness of individual BMPs and/or elements of stormwater programs, which will now include the repository of information for Source Identification and Diagnostic Monitoring for western Washington which still seeks to benefit Permittees statewide in improving programs to eliminate pollution sources. The proposal for monitoring status and trends in Puget Sound receiving waters would provide information to evaluate water quality changes in urban areas where programs are being implemented.

6.0 Explanation of Permit Revisions

The following section describes the rationale for proposed changes to the Permits. Unless specified otherwise, the explanations apply to all three of the Permits, i.e., the Phase I, W.WA Phase II, and E.WA Phase II Permits. The rationale for Permit-specific changes are clearly identified with sub-headings, (e.g., Proposed changes to Western Washington (WWA Phase II: S5.C.2; Phase I: S.5.C.11).

6.1.1 S1 – Permit Coverage and Permittees

This section defines the areas covered by the Permits, the entities that are to be covered under the Permits, and how to obtain Permit coverage.

No significant changes proposed.

6.1.2 S1.A Geographic Area of Permit Coverage

The areas covered by the permit include the entire incorporated area of a city, as described in Phase I S1.A and Western and Eastern Phase II S1.A.1. The Permittees covered under the Phase I Permit were determined by the 1990 census and therefore no new Permittees will be added to the Phase I Permit. No significant changes to S1 of the Phase I Permit are proposed (see discussion below under S1.D regarding proposed changes to the Notice of Intent).

6.1.3 This remaining section on S1 applies to Phase II Only:

To be regulated by the Phase II Permit, small MS4s must:

- Be located within, or partially within, a census-defined Urbanized Area or otherwise designated by Ecology;

- Discharge stormwater to a surface water of Washington State; and
- Not be eligible for a waiver or exemption.

Urbanized areas are population centers with greater than 50,000 people and densities of at least 1,000 people per square mile, with surrounding areas having densities of at least 500 people per square mile. The urbanized areas in this Permit are based on the 2010 population census and the most current Washington State Office of Financial Management population estimates[40].

For Phase I and Phase II counties, the Permits cover the urbanized area, or census-defined urban area, that extends outside the city. Ecology also includes the county unincorporated Urban Growth Areas (UGA) around Phase II cities where they extend outside of the census-defined urbanized areas, as described in the first part of S1.A.2. Ecology determined that this is appropriate in Washington State because the Permits are designed to address the urban impacts of stormwater, and Washington State has defined UGAs in 36.70A RCW, the Growth Management Act (GMA), as areas where jurisdictions must direct and concentrate urban growth.

Ecology may designate additional areas for coverage. For the 2019 permit cycle, Ecology evaluated the cities of: South Prairie, Shelton, Carnation, Yarrow Point, Woodway, Grandview, Moxee, Naches, Cheney, and College Place. Ecology also evaluated the unincorporated UGAs of: Clallam County, for Port Angeles UGA; Mason County, for Shelton; Island County, for Oak Harbor UGA; Kittitas County, for Ellensburg UGA; and Grant County, for Moses Lake UGA.

Of those evaluated, Ecology determined three jurisdictions warrant permit coverage under the Permits to be effective August 1, 2019: cities of Shelton and College Place, as well as Clallam County's unincorporated UGA for Port Angeles. Ecology lists those jurisdictions in the draft Permit for public review and comment. The second part of Western Washington Phase II S1.A.3 lists the county because it's not associated with census-defined urbanized areas.

6.1.4 S1.B. Regulated Small MS4s

This section defines the entities that must obtain coverage under the Phase II Permit. Ecology proposes only minor changes to this section to clarify or simplify language. No significant changes proposed.

6.1.5 S1.C. Exemptions and Waivers

This section describes the entities that do not need to obtain coverage under the Permits if the conditions in this section are met. EPA administers the Municipal Stormwater Permit program for federal facilities and most federally-recognized Indian Tribes. Proposed language changes to better align with phrasing from the federal regulations.

All MS4s of any size that are owned or operated by Washington State Department of Transportation (WSDOT) are not covered under these Permits because they are covered under a separate stormwater Permit. A copy of the WSDOT Permit is available at https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Stormwater-general-permits/Municipal-stormwater-general-permits/WA-Department-of-Transportation-Municipal-Stor-(1).

No significant changes proposed.

6.1.6 S1.D Obtaining Coverage and Entities Covered by the Permit

The Permittees listed in (S1.D.2.a) are continuing Permittees from the current Permit terms. In accordance with General Condition G18 of the current (2013/2014) Permits, all Permittees named in (S1.D.2.a) reapplied for Permit coverage by submitting a timely Permit reapplication (*Duty to Reapply – Notice of Intent (NOI))* prior to February 1, 2018 (W.WA) (or will need to submit by February 1, 2019 (E.WA)) and will have continuing coverage under these Permits.

Ecology includes a placeholder in (S1.D.2.b) for possible New Permittees that are brought under the final Permits if the evaluations Ecology is conducting demonstrate that a jurisdiction or area meets the criteria for coverage. Cities and county areas under evaluation for Permit coverage are listed in (S1.D.2.b.i) along with a footnote to clarify that coverage is proposed pending completion of the evaluations. If an evaluation determines that a jurisdiction meets the criteria for coverage, they may choose to submit a *Notice of Intent for Coverage under National Pollutant Discharge Elimination System Municipal Stormwater General Permit* (NOI) in advance of final Permits issuance. In this case, the jurisdiction would be listed in (S1.D.2.b) in the final Permits. If a jurisdiction chooses to wait, the draft language in (S1.D.2.b.i) requires the jurisdiction to submit a NOI to Ecology no later than 30 days after the Permit effective date of August 1, 2019.

Special condition S1.D.3 establishes an application process for New Secondary Permittees, or for Co-Permittees that are cities, towns and counties. Cities, towns, and counties that receive coverage after the Permits' issuance date may be brought under the Permit by petition, by expansion of federal census urban areas, or other designation under an administrative order.

The Notice of Intent (NOI) is the official Permit application to request coverage under these general Permits and is provided Ecology's website. Starting on December 21, 2020, Ecology must follow EPA's electronic reporting rule and accept electronic Permit applications in order to provide the required information to EPA. The paper application found in Appendix 5 of the 2013/2014 Permits will be converted to an electronic application, similar to the electronic annual report process.

6.2 S2 – Authorized Discharges

This section of the Permits authorizes the discharge of stormwater from MS4s owned or operated by the Permittees to waters of the State, subject to certain limitations. The Permits do not authorize discharges that are authorized under other permits or programs, such as the Underground Injection Control program.

No significant changes proposed.

6.3 S3 – Responsibilities of Permittees

Because not all parts of the Permits apply to all Permittees, S3 identifies the sections of the Permits that apply to each Permittee, and explains the responsibilities of each type of Permittee.

No significant changes proposed.

6.4 S4 – Compliance with Standards

This section establishes the standards that apply and includes a notification and response requirement under special condition S4 Compliance with Standards. Condition S4.F of the Permits address discharges from municipal separate stormwater sewer systems (MS4s) that are likely to contribute to or cause a water quality standards violation in a receiving water. This section of the Permits provide an adaptive management pathway for Permittees to address those discharges. Ecology prepared a publication to clarify the Permittee's procedural responsibilities under S4.F, as well as Ecology's response procedures.[41] Appendix 13 incorporates requirements in response to a significant long-term MS4 adaptive management response effort under Special Condition S4.F.3, which applies to the city of Seattle.

No significant changes proposed.

6.5 S5 – Stormwater Management Program for Cities and County Permittees

6.5.1 Requirements Applying to All S5 Components (S5.A)

Special condition S5.A of each Permit establishes the requirements for the cities and counties named in S1, as well as New Permittees as named in the final Permits, to implement the core components of a stormwater management program (SWMP).

The stormwater management components in S5 form the core requirements of the SWMP. The minimum requirements for each component are established in S5. This section of the Permits provide a complete written record of the local programs, planning documents, and ordinances or other regulatory documents that the Permittees will implement to meet these requirements.

No significant changes proposed.

6.5.2 New Permittee Requirements (Phase II only)

Ecology proposes language in this section for New Permittees as defined in (S1.D.1.b of the PH II Permits) to identify the requirements and implementation schedules they must meet during the Permit term. They must fully meet all the applicable requirements of S5, but for the requirements with footnotes, they must meet the requirements in accordance with the modified activity or implementation schedule. This will result in full implementation of the S5 requirements over the Permit term.

Ecology proposes to require an implementation schedule for New Permittees similar to the schedule met by continuing Permittees as they built their programs during the current (2013) permit term. After it issues the final Permits, Ecology will provide New Permittees with a guidance document that integrates the footnoted requirements into Permit language in order to facilitate planning and implementation.

The proposed language in this section referring to alternate schedules established as a condition of Permit coverage is intended to apply to New Permittees that may begin coverage after the issuance date of the Permit. This could occur, for example, as a result of petition.

No significant changes proposed.

6.5.3 Written Documentation of the SWMP (Phase I: S.5.A.1; PH II: S5.A.2; E.WA Phase II: S5.A.4)

Each Permittee must submit written documentation of their SWMP. The purpose of the SWMP is to provide a description of the activities and actions that the Permittee plans for the upcoming calendar year. Ecology requires Permittees to update their SWMP annually and to submit it with each Annual Report.

No significant changes proposed.

6.5.4 Program Tracking (Phase I: S.5.A.2-3; W.WA Phase II: S5.A.3; E.WA Phase II: S5.A.5)

Each Permittee is required to track the cost of development and implementation of the SWMP. The anticipated cost and resources available to implement the SWMP do not serve as the basis for deciding whether individual SWMPs meet the MEP standard for these Permits.

The requirement to track inspections, official enforcement actions and public education activities is based on EPA regulations in 40 CFR 122.42(c). Ecology proposes to retain language in this section to remind Permittees of this obligation.

No significant changes proposed.

6.5.5 Ongoing Implementation (Phase I: S5.B; W.WA Phase II: S5.A.4; E.WA Phase II: S5.A.3)

Permit language in this section calls for continued implementation of existing programs as Permittees phase in the requirements in their respective Permit, until proposed revisions are put into effect. Ecology includes requirements to retain regulatory mechanisms in local codes, including the illicit discharge prohibitions that cities and counties adopted under the current permit requirements. This language also requires New Permittees to retain existing programs and standards as they phase in the Permit requirements.

No significant changes proposed.

6.5.6 Coordination (Phase I: S.5.C.3; W.WA Phase II: S5.A.5, E.WA S5.A.6)

This requirement calls for establishment of coordination mechanisms both externally and internally to aid in the implementation of the SWMP.

In the requirement for external coordination, Ecology aligned the permit requirement to require coordination, where needed, when watershed, interconnected systems, or waterbodies are shared. Failure to effectively coordinate is not a permit violation provided the other entities, whose actions the Permittee has no or limited control over, refuses to cooperate. This recognizes the difficulty of defining shared water bodies and understands that such coordination may occur at a variety of scales appropriate to the activities being coordinated. Permittees in most parts of Washington worked together in a variety of formal and informal coordination groups during the current (2013/2014) Permit term.

No significant changes proposed.

6.5.7 Purpose of the SWMP (Phase I S5.B; W.WA PH II S5.B; E.WA S5.A.2)

This section is consistent with state and federal law and special condition S4 in requiring that the SWMP be designed to reduce the discharge of pollutants to the maximum extent practicable (MEP), and meet state AKART requirements.

No significant changes proposed.

6.5.8 Program Components. (Phase I: S5.C; W.WA Phase II S5.C; E.WA Phase II: S5.B)

This section of the Permits define the core components of the stormwater management program for cities and counties for the term of the Permits. Each component includes a description of requirements and minimum performance measures. Each component also includes administrative and legal elements that must be in place to ensure program implementation, as well as requirements which should directly affect reduction in pollutants and impacts.

No significant changes.

6.5.9 Legal Authority. Phase I Only (S5.C.1)

This section is directly from EPA regulations (40 CFR 122.26). No significant changes proposed.

6.5.10 Comprehensive Stormwater Planning. Western WA Only. (Phase I S.5.C.6; WWA Phase II: S5.C.1.)

This section is new to the western Washington Permits and contains requirements that apply a more holistic view to municipal stormwater management.

The 2008 Pollution Control Hearings Board (PCHB) Phase I ruling acknowledged the need for a watershed-scale approach to stormwater management based on the testimony of stormwater experts on all sides of the appeal. Scientists and policy-makers recognize that it is not possible to maintain water quality and aquatic habitat in lowland streams in Washington State without considering land use and how the landscape is developed. This must occur at a scale that is broader than individual site and subdivision projects.

The PCHB directed Ecology to require the "permittees to identify, prior to the next permit cycle or renewal, areas for potential basin or watershed planning that can incorporate development strategies as a water quality management tool to protect aquatic resources.[42,43]" This proposal continues the effort to meet the PCHB's direction.

6.5.11 Background and need

Urbanization of stream basins in western Washington has almost without exception been accompanied by a significant degradation or loss of the stream-related beneficial uses; in particular, the anadromous fish resources. There are multiple causes for the loss and those include: degradation of chemical and physical water quality; high flow-related stream channel alterations; loss of base flows; significant alteration of hydrologic patterns; and loss of critical riparian area functions.

Various forms of basin planning took place in the past. Those planning efforts traditionally suggested managing urban stormwater from planned new development and redevelopment by using the latest practices recommended by Ecology. Most of those practices are of limited effectiveness because they are applied at the end-of-pipe and/or only partially address the water quality and hydrologic changes of new development. They cannot address the full range of impacts caused by land development. Because the controls recommended by Ecology did not fully address the water quality, nor hydrologic impacts caused by urbanization, those plans have fallen short of protecting the aquatic resources.

Further, addressing stormwater impacts from new development and redevelopment at the site and subdivision scale will not adequately address legacy impacts from previous development patterns and practices, nor will it serve to protect areas providing ecological services for stormwater management. It is clear that we cannot protect the state’s waters without also addressing degradation caused by stormwater discharges from existing developed sites. For that reason stormwater programs must include planning and developing policies that address receiving water needs, including development of policy and regulations, and retrofit provisions.

A broader view of planning and implementation is needed in order to support and further habitat restoration needs. Policies that promote compact development, with a smaller footprint, reduced impervious surfaces, natural areas within the urban core, and improved water detention can help local communities meet the Growth Management Act's goals of accommodating growth while protecting the environment[44]. Moreover, research indicates that most stream restoration projects that actively stabilize eroding channels should not be implemented until after hydrologic retrofits have been completed that restore the hydrologic regime, not concurrently with the implementation of the retrofits[45].

Finally, as mentioned above, the PCHB directed Ecology to use Permit requirements to include watershed-scale planning as a water quality management tool to meet MEP and AKART.[46]

6.5.12 The 2013 Permit requirements

The “Watershed-scale stormwater planning” requirement in the 2013 western Washington Permits (Phase I: S5.C.5.c; W. WA Phase II: S5.C.4.g) is Permit language that must be modified for the 2019 Permit cycle as it was an effort that was not intended to be replicated each Permit cycle, it was expected that this requirement would evolve overtime based on the information gleaned and the lessons learned.

We learned from the “Watershed-scale Stormwater Plans” that the calibrated model for each of the selected basins showed that current and future conditions in these watersheds do not meet water quality standards, and that actions beyond site and subdivision scale of stormwater management will be needed to prevent degradation of the receiving waters.

The models in all of the watersheds projected that riparian restoration (for temperature) and large amounts of additional stormwater detention and infiltration (for flow control, for Benthic Index of Biotic Integrity (B-IBI) scores, and for bacteria) are needed to improve receiving water conditions.

The anticipated costs to restore these watersheds is tens of thousands of dollars per acre of watershed in Snohomish and Clark Counties. The costs per acre for these typical Puget lowland and lower Columbia developing watersheds are significantly lower than for more developed basins (the Juanita Creek Study estimated costs were approximately $300,000 per acre).[47] While this demonstrates that current Permit requirements are having a significant impact, the modeled additional effort to recover the beneficial uses are still well beyond current funding programs and approaches.

One important strategy that only one of the four counties highlighted in their scenarios was changing the land use designation or zoning established as part of the growth management process. King County demonstrated that such changes will help protect water quality while substantially lowering the high capital project costs identified by the models.

Comprehensive planning, and stormwater management are regulated under different laws and overseen by different state and local departments with separate administrative and public processes. However, coordination and long-range planning is needed. The consideration of stormwater impacts from development is critical during the planning phases of development. This not only includes planning on the site-level, but also with respect to discharges from the MS4 on a watershed level. To the extent possible, stormwater management must be an integral part of long-range planning documents that determine where and how development that will result in stormwater discharges to the MS4 should occur since these decisions affect water quality. Using land efficiently can result in better stormwater management by putting development where it is most appropriate.

It is possible and reasonable to significantly improve water quality in many urban receiving waters. This requires more than just a new development and redeveloped sites program, however, which at best can only hold the line. To actually improve the quality of receiving waters, it is necessary to develop and implement land use and development strategies that keep in mind the needs of receiving water health, and mitigate discharges from existing developed sites. This can be done in a variety of ways, through public projects, or creative public-private partnerships, or voluntary/incentive programs that encourage property owners to retain discharge onsite. Municipal projects, such as traffic calming sites could also include stormwater retrofit components, such as curb bump outs that include bioretention features or other treatment approaches.

6.5.13 What is proposed?

Local jurisdictions take different approaches to long-range municipal stormwater management planning. Some Permittees have advanced watershed plans, that take into account receiving water health and the need to improve or develop additional stormwater management controls, where some others have only a few policies and have only implemented what has been required by the Municipal Stormwater Permits. Some municipal stormwater programs work well with their long-range planning staff and are successful in influencing policies designed and intended to improve receiving water health and municipal stormwater management; others do not.

This proposed new Phase I and W.WA Phase II Permit section includes three planning elements that address long-term and short-term stormwater management needs.

The first element, coordination with long-range plan updates, works toward a better understanding of local long-range planning processes and how policies, strategies, codes and other measures do, or do not, address probable impacts of increased future stormwater discharges on receiving water health and include additional stormwater management activities needed to meet the goals of protecting and restoring beneficial and designated uses.

The second element, low impact development code-related requirements, brings forward the requirement in the 2013 Permits' "Controlling Runoff" section (Phase I S5.C.5.b; W.WA Phase II S5.C.4.f), which requires local development-related codes or enforceable standards to require LID in order to make it the preferred and commonly used approach. This element also includes a provision for New Permittees to follow.

The third element, stormwater management action planning (SMAP), applies differently for Phase I and W.WA Phase II Permittees. For the Phase II Permit, the SMAP element begins with a receiving water assessment – to ensure that Permittees compile and review existing data and information on their receiving waters and contributing area conditions, so that they can identify and develop a plan to fill any significant gaps in knowledge. The Permit enables Permittees to complete this element individually or as part of a regional/interlocal effort. Permittees must then develop a receiving water prioritization method and process to rank high priority areas where stormwater retrofits and other management actions would provide a water quality benefit to receiving waters. Permittees must use the prioritized ranking as the basis for creating a plan for one priority area that takes into account tailored stormwater management strategies, including identification of the potential need for stormwater treatment or flow control BMPs to address existing or planned development.

Instead of the receiving water prioritization method and process that Phase II Permittees use, Phase I Permittees have a requirement in (S5.C.7) Structural stormwater controls, which requires Permittees to plan structural stormwater control projects based on a locally developed program that includes a process to prioritize and implement projects. Additionally, the third element applies to Phase I Counties which asks to explain how the watershed-scale stormwater plans (developed in the 2013-2018 permit cycle) informs the prioritization or selection of projects (or both). The requirement helps to refine the watershed-scale plans to highlight implementation actions for a catchment within, by providing a submittal that explains what actions, if any, resulting from the watershed-scale stormwater plans will move forward as short-term or long-term projects and the anticipated implementation schedule.

Overall, the proposal intends to drive a process that incorporates stormwater policies and infrastructure as a need that must be accommodated early in land use planning, capital facilities planning, and regulations.

6.5.14 Purpose of proposed Permit requirements

1. Maintain or develop an interdisciplinary team(s) that can support and coordinate the elements of the requirement.
2. To gain an understanding of how Permittees are currently addressing stormwater needs and receiving water health through various types of comprehensive planning being conducted at the local level.

3. To continue to make LID the preferred and commonly used approach.
4. For Phase I Counties, understand how the watershed-scale stormwater plans are informing and influencing planned stormwater management actions.
5. For WWA Phase II Permittees, to prioritize and plan municipal stormwater retrofits and enhanced SWMP implementation to address impacts from existing or planned development on priority receiving waters.

6.5.15 Internal Coordination

Convene an interdisciplinary team to conduct and coordinate the comprehensive planning program effort. Team make-up should include representatives from the jurisdiction’s stormwater program, long-term planning, transportation, parks and recreation, and scientific and technical experts.

For Phase II, this team could be used to coordinate the planning effort across various departments, compile existing information, refine initial prioritization results, prepare plan, and evaluate the process and implementation of the plan as an ongoing task (if applicable).

6.5.16 Coordination with long-range plan updates.

This section requires the analysis and reporting of how stormwater infrastructure and receiving water health needs are informing the planning update processes, and influencing policies and implementation strategies during existing planning update or development processes. This section does not intend to create a parallel planning process to ongoing long-range planning or Comprehensive Plan updates – rather, the reporting will describe how those processes take into account, consider, and evaluate information related to receiving water health and stormwater infrastructure needs while determining how to accommodate projected growth, or provide adequate services to the existing population served by the MS4.

Permittees will develop a submittal that describes how, or if, stormwater-related water quality and watershed protection are being addressed in revisions to your Comprehensive Plan (or equivalent process) as well as how water quality and watershed protection are being addressed in revisions to other locally-initiated, state-mandated long-range land use, transportation plans, or other plans used to prepare and accommodate population needs.

As described above, stormwater management needs must be taken into consideration early in the planning process, including while determining land capacity for accommodating growth. Ecology intends to learn how Permittees are addressing this need in existing planning updates.

6.5.17 Low impact development code-related requirements

Maintaining the intent of the 2013 Permits, this requires that as jurisdiction’s development-related regulations and standards are being developed or updated, LID must continue to be required in order to maintain and, where needed, make continued progress toward making LID the preferred and commonly used approach.

This section was moved from the “Controlling runoff from new development and redevelopment…” section as it fits in with the roles and responsibility with long-range planning staff typically assigned to updating development codes. The requirement to look at the broader suite of development-related codes, not just stormwater code that follows Appendix 1 and which applies at the site and subdivision scale, was a point of confusion. Further, it may also be helpful to use the same interdisciplinary team that was developed to complete the first full code-review required by the 2013 Permits to continue to inform this process and the other elements of the Comprehensive stormwater program (i.e. coordinating with long-range plans and stormwater management action planning).

LID requirements for Western Washington Permittees stem from appeals of the 2007 Permit. The Pollution Controls Hearing Board (PCHB) issued a ruling on August 7, 2008 for the Phase I Municipal Stormwater Permit (Phase I permit) for local governments covered under the Phase I permit, including King, Snohomish, Pierce, and Clark counties and the cities of Seattle and Tacoma. The *Findings of Fact, Conclusions of Law, and Order* for the Phase I permit stated that Ecology must "……require non-structural preventive actions and source reduction approaches including Low Impact Development techniques (LID), to minimize the creation of impervious surfaces, and measures to minimize the disturbance of soils and vegetation where feasible..."

On February 3, 2009 the PCHB issued a *Findings of Fact, Conclusions of Law, and Order* for the WWA Phase II Permit that recognized the wide range of capacity and expertise among Phase II jurisdictions for implementing low impact development requirements.

LID design is not limited to specific stormwater best management practices (BMPs) such as bioretention, permeable pavement, and vegetated roofs. LID also requires an approach to site assessment and project design to conserve vegetation, minimize soil disturbance, and minimize and disconnect impervious surfaces. In order to clarify that implementation of LID includes these elements, Ecology distinguishes between *LID BMPs* and *LID principles* in Permit language, as follows:

- **LID Best Management Practices:** Distributed stormwater management practices, integrated into a project design, that emphasize pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration. LID BMPs include, but are not limited to, bioretention/rain gardens, permeable pavements, roof downspout controls, dispersion, soil quality and depth, vegetated roofs, minimum excavation foundations, and water re-use.
- **LID principles:** Land use management strategies that emphasize conservation, use of on-site natural features, and site planning to minimize impervious surfaces, soil disturbance, native vegetation loss, and stormwater runoff.

By including both terms in the LID requirement, Ecology intends that Permittees will amend or develop stormwater and land use codes, rules, standards, and other enforceable documents as necessary to apply both LID BMPs and LID principles. For continuing Permittees, this applies to the development of new codes/documents, or whenever existing relevant codes/documents are revised. This is not proposed or intended as a repeat of the 2007-2013 Permit requirements, but rather a continuation, so as new codes are being developed or revised, they should not create barriers to LID implementation. In addition, as new codes and administrative practices are being implemented as a result of the updated local programs, any newly found barriers should be reported and corrected.

New Permittees are required to follow the process as was required under the 2013 Permits. See the November 4, 2011 Fact Sheet for discussion on this requirement, available here: https://ecology.wa.gov/Asset-Collections/Doc-Assets/Water-quality/Water-Quality-Permits/MS4-permits/WWA-PhII/WWAPhaseIIFactSheetFINAL.

The requirements entail annually reporting a summary of:

1. Any newly identified administrative or regulatory barriers to implementation of LID principles or LID BMPs and measures to address the barriers since local codes were updated in accordance with the 2013-2018 Permits.
2. Any mechanisms adopted to encourage or require implementation of LID principles or LID BMPs. This may include incentive programs, adopted code, or similar efforts.

New Permittees will submit a list of the participants (job title, brief job description, and department represented), the codes, rules, standards, and other enforceable documents reviewed, and the revisions made to those documents which incorporate and require LID principles and LID BMPs. The summary is to include existing requirements for LID principles and LID BMPs in development-related codes and organized by:

- Measures to minimize impervious surfaces.
- Measures to minimize loss of native vegetation.
- Other measures to minimize stormwater runoff.

New Permittees have an additional year after the requirements to adopt of Appendix 1 to complete the broader suite of code review. Ecology has developed an optional reporting template that may be used to help meet this requirement. It is found in municipal Permittee guidance on Ecology's website.

6.5.18 Stormwater Management Action Planning

Phase I Permittees have a requirement in Structural Stormwater Controls (S5.C.7.b.ii (a)) which requires Permittees to develop a prioritization process and criteria to select projects to address impacts caused by the MS4 from areas of existing development. (See discussion above regarding Phase I County's proposed requirement.) This type of planning requirement is new for W.WA Phase II Permit. The following describes how the requirement is structured for Phase II Permittees. See also draft guidance document, Stormwater Management Action Planning Guidance (Ecology 2018).[48]

Basic receiving water inventory and assessment

Permittees will document and assess existing information related to local receiving waters and contributing area conditions to identify receiving waters that will benefit from stormwater management planning. The Permit enables Permittees to complete this element individually or as part of a regional/interlocal effort.

Permittees will prepare an inventory of local receiving waters to which the MS4 discharges and document information about the contributing watershed areas. The inventory shall include currently available basic water quality assessment information.

Where data is lacking, the Permittee should develop a plan and protocol to improve the state of knowledge.

Prioritization of basins for tailored management actions

Informed by the inventory and assessment of receiving waters, Permittees conduct a prioritization process to identify the contributing watershed areas are where implementation of stormwater retrofit projects (i.e., new or upgraded stormwater facilities to reduce pollutant loading and address hydrologic impacts from existing and/or new development in the basin), and/or other tailored management strategies and actions will provide the greatest to benefit to the receiving waters. This process should include a feedback loop designed to adaptively manage the process and outcomes based on lessons learned.

The Annual Report submittal will describe the well-documented approach the Permittee used to identify high priority areas for retrofits and other tailored management actions based on (1) conditions in the receiving waters, and (2) an assessment or understanding of influence of stormwater management strategies and actions to reduce impacts to the receiving waters.

The Annual Report submittal will describe how the prioritization effort identified and ranked watershed sub-basins or catchment areas where the receiving waters will receive a benefit from implementation of stormwater facility retrofits. The submittal also describes how the prioritization process was used to better inform the implementation of stormwater management actions related to Permit sections within S5.C: IDDE field screening, prioritizations of Source Control inspections, O&M inspections or enhanced maintenance, or Public Education and Outreach behavior change programs.

The Annual Report submittal will document the process and schedule to provide future assessment and feedback to improve the planning and implementation of the proposed projects and actions.

Permittees may reference existing or previous local watershed management planning process(es) as source(s) of information or as the basis or rationale for the prioritization.

Stormwater Management Action Plan

Develop a Stormwater Management Action Plan (SMAP) for at least one high priority area that identifies tailored stormwater management actions, including: stormwater facility retrofits (new facilities or upgrades to existing facilities), a proposed implementation schedule, and budget sources. The plan must identify (1) short-term actions (i.e., actions to be accomplished within six years), (2) long-term actions (i.e., actions to be accomplished within seven to 20 years), and (3) a process to adaptively manage the plan. The SMAP 6-year planning period is based upon GMA/Comprehensive Plan-related capital facilities planning (CFP) requirements, which also aligns with transportation grants which typically require a 6-year plan. The SMAP 20-year planning period is based on the Washington State Department of Commerce recommendation that CFPs also cover a 20-year planning horizon because capital project financing often requires multi-year commitments of financial resources.

The Annual Report submittal will describe the high priority basin area, the proposed short-term and long-term actions, a funding mechanism, and a description of the adaptive management process. The actions proposed should go beyond existing site and subdivision scale stormwater management requirements. Permittees may reference existing plans, or modifications to those plans, that address these requirements.

6.5.19 Public Education and Outreach (Phase I: S5.C.11; W.WA Phase II: S5.C.2; E.WA Phase II: S5.B.1)

6.5.20 Proposed changes to all three Permits:

- Format changes for structure and clarity.
- Revisions to clarify target audiences and subject areas and the level of effort needed to comply with this requirement.
- The specific inclusion of "overburdened communities" as a target audience that should be considered. This term is from the US EPA Environmental Justice guidance,[49] see definitions section of this document for further discussion. Several early commenters recommended greater emphasis on inclusion of all our Washington communities in the education and outreach program.
- To further address and include our diverse communities, another consideration added is the need to prepare material in alternative languages when the target audience speaks a language other than English.

6.5.21 Proposed changes to Eastern Washington

The proposed revisions focus on providing clarity to the public education and outreach section.

One of the target audiences was narrowed to focus on businesses and subject areas that prevent pollution from reaching the MS4. This promotes an education and outreach focus on source control at existing businesses. Ecology is not proposing a Source Control business inspection program for eastern Washington. This is in part based on comments and recommendations received from eastern Washington Permittees. This initial approach focuses on education and outreach, and when needed the authority to require source control BMPs to prevent illicit discharges (see IDDE section for additional discussion).

In order to determine whether a promoted message is reaching a target audience, an evaluation of the program is proposed and the results are to be used to direct the future efforts of the program.

6.5.22 Proposed changes to Western Washington

Ecology received input from Permittees, the regional education and outreach group- STORM, and environmental groups, which recommend changes to the education and outreach program. Significant issues raised include:

- The need to focus the program on known local water quality problems,

- Refine the Phase I behavior change section – specifically because this section of the Permit requires significant time and resources to create and implement behavior change campaigns for each of the target audiences and best management practices (BMPs). The requirement to address the full list was diluting the effectiveness of the program overall.

After considering the comments, existing Permit language, as well as Permit submittals related the to the education and outreach programs, Ecology finds it important to align the Phase I and Phase II Permit requirements so that partnerships between Phase I and Phase II Permittees can continue to leverage resources, as well as provide consistent programs to the regions. The proposed Permit language clarifies that the selection of the target audiences and topics be based on local water quality issues. In order to instill consistency in the process for implementing a behavior change campaign, community-based social marketing, a best management practice for establishing behavior change, is called out specifically as a process to follow.

The proposed revisions focus on providing clarity to the components that make up the public education and outreach program:

1. general awareness,
2. behavior change, and
3. stewardship opportunities

The general awareness and stewardship sections stay largely the same as in the 2013 Permit, with language added to help clarify how many audiences and BMPs must be targeted and how to create stewardship opportunities.

Ecology encourages Permittees to cooperate in regional public education efforts. During the past and current Permit terms, Ecology funded efforts such as the Puget Sound Stormwater Outreach for Regional Municipalities (STORM) program and awarded other grants to groups of Permittees for regional or statewide public education activities. Some Permittees requested that Ecology clarify that they may meet Permit requirements through a regional effort, and Ecology added such language to this section of the draft Permit. Jurisdictions using a regional approach should contribute a meaningful level of effort, ensure that the education approach is implemented in their jurisdiction, and ensure that the regional education activities are applicable to audiences and issues in those communities. Cooperative regional efforts are often more effective in disseminating a coordinated message across a region and are generally more cost effective for Permittees.

Language was also added to emphasize the need to consider high priority water quality issues when developing the education and outreach program. The Comprehensive Stormwater Planning receiving water health assessment requirements may be helpful for informing education and outreach program development.

Revisions to clarify target audiences and subject areas:

- Subject areas or revised categories of BMPs are proposed to be refined when the listing was redundant, or could be combined or clarified.

- Subject area: *impacts of illicit discharges and how to report them* was removed because this topic is a requirement of the IDDE section.
- Under the behavior change program, general public is removed as a target audience as this category is too broad of an audience on which to focus a behavior change program. Behavior change programs should target a more specific audience so that it is easier to discern barriers and opportunities for the desired behavior. Target audiences were combined in this section for clarity. Source control BMPs are added to BMPs to promote for a specific target audience.

Revisions to behavior change program section:

- The behavior change section is revised and clarified to set specific expectations for the process to be followed in order to encourage changes in behavior.
- To maintain effectiveness, the behavior change program is based on evaluation of ongoing efforts and how successful the program is at reaching the target audience. The 2013 Permits required an evaluation of the program (due no later than 2/2/2016. See Phase I: S5.C.10.c; W.WA Phase II: S5.C.1.c). The results of that evaluation were required to be used to direct future efforts. In year 2020, a new evaluation of the behavior change program is required. Permittees shall document lessons learned and recommendations for next steps with the program.
    - Recent evaluations of the existing, ongoing behavior change program may count to meet this requirements. To be clear, the original evaluation required under the 2013 Permit (Phase I: S5.C.10.c; W.WA Phase II: S5.C.1.c) would not count toward this proposed requirement.
- Using the new evaluation, Permittees will design the next iteration of the program using community-based social marketing methods to develop a strategy and schedule. Three different options to proceed are offered:
    1. Develop a strategy and schedule to more effectively implement the existing program.

This option is to refine the existing, ongoing, behavior change program with the *inclusion* of community based social marketing methods. This includes, if not part of the program already, a plan to evaluate the effectiveness of the program going forward.

2. Develop a strategy and schedule to expand the existing program to a new target audience or BMPs.

This option is to expand the existing, ongoing behavior change program to a new audience with the same BMP, or same audience but a new BMP may be a better fit or more effective at achieving the desired behavior change.

3. Develop a strategy and schedule for a new target audience and BMP behavior change campaign.

This option is to develop a new approach for the behavior change program, focusing on a new audience and BMP than the existing program.

Solely relying on providing information is not adequate to changing the behavior of individuals. Community-based social marketing is a Best Management Practice to promote and achieve behavior change. Community-based social marketing uses tools and findings from social psychology to discover the perceived barriers to behavior change and ways of overcoming these barriers[50]. Community-based social marketing is pragmatic and generally involves:

- identifying the barriers for a specific demographic (target audience) to a desired behavior,
- developing and piloting a program to overcome these barriers,
- implementing the program across a community, and
- evaluating the effectiveness of the program.

The date by which the strategy developed must begin to be implemented does not necessarily mean when a new or refined program must roll out to the target audience, but may include the start of a survey or focus groups of the target audience or other early tasks that inform the behavior change program.

A report on the effectiveness of the strategy and any potential changes to improve effectiveness of the behavior change program will be required with the Annual Report in year 2024. This provision provides time for the program to develop and be implemented, with time to evaluate and report on the effectiveness of the behavior change program – or whether the target audience received the message and changed their behavior to the desired actions.

6.5.23 Public Involvement and Participation (Phase I: S5.C.4; W.WA Phase II: S5.C.3; E.WA Phase II: S5.B.2)

This section requires each Permittee to make the SWMP and Annual Report available electronically either on the local webpage or through Ecology's webpage by May 31 each year to ensure timely posting after the March 31 deadline for submittal to Ecology. Ecology believes this is a reasonable requirement given the common use of the internet for public information. Permittees should make other submittals related to the Municipal Stormwater General Permits available to the public upon request.

The intent is to create an environment where the public can have an active role in shaping the local stormwater program. Because Washington State has strong requirements for public participation in local government decision-making processes, a number of SWMP activities such as code revisions already require public involvement under other state and local laws.

No significant changes proposed.

6.5.24 MS4 Mapping and Documentation (Phase I: S5.C.2; W.WA Phase II: S5.C.4; E.WA Phase II: S5.B.3.a)

Many of the changes are proposed to bring statewide consistency to the mapping requirements. The MS4 mapping requirements in the W.WA Phase II Permit are now found in this section –

which is new to the W.WA Phase II Permit. This section was taken from the Illicit Discharge Detection and Elimination (IDDE) Program in order to follow the Permit structure of the Phase I Permit. The mapping requirements for eastern Washington are still found in the IDDE section, but are discussed here.

As stated in previous permit cycles, Ecology proposes the minimum mapping standards in order to know the MS4 system and thus, to be responsive to spills and perform the IDDE and Operation and Maintenance (O&M) requirements (at a minimum).

Although the requirements are not explicit, Ecology expects that Permittees will also map structures such as catch basins and inlets to support their IDDE activities when they map tributary conveyances. This information would be particularly important for purposes of tracing illicit discharges and preventing harm from spills.

Ecology also expects Permittees to map the MS4 in greater detail in areas with land uses that involve storage, transfer, or use of materials where the risk of harm is greater because of factors such as the frequency of transfer or use, the potentially severe or irreversible environmental impacts associated with the illicit discharge or release of such materials, or the nature of the downstream resources at risk. Ecology intends for Permittees to apply local knowledge of land uses to map the MS4 more completely in these areas to meet the intent of the illicit discharge program.

In spring of 2017, Ecology announced in western Washington that we were considering adding an outfall reporting standard requirement to the Permits. We proposed some minimum data attribute information and stated that Ecology would upload the information received into Ecology's Water Quality Atlas. Based on comments received and Ecology's own internal procedures, we are proposing a more step-wise approach to addressing outfall mapping and reporting by requiring the collection of more specific information (i.e. outfall size and material).

Ecology commits to working with Permittees to voluntarily associate outfall data with NHD reach and measure and load it into the Water Quality Atlas during the 2019-2024 permit cycle.

6.5.25 Proposed changes to all three Permits:

- Ecology reformatted the mapping requirements for clarity. Ecology intends for Permittees to update the map of the MS4 on a regular basis to keep them current for intended uses. Draft requirements for New Permittees to map their systems reflect the same expectations and deadlines that applied to continuing Permittees in the current (2013/2014) Permit term.
- All known outfalls have been required to be mapped since the Municipal Stormwater Permits were first issued. In addition to location, Ecology proposes that, at a minimum, the size and material of the outfall, where known, be collected and reported.

As outfall records are updated or added, additional information describing the size of the outfall and the material that it is made out of must be added. This does not mean that Permittees must re-survey all known MS4 outfalls by the date included in the proposed Permit language. Rather, as this information becomes available to the Permittee, through inspections, maintenance, project approvals etc., this attribute information would be added to the outfall records.

- A proposed new feature is the mapping of all known connections from the MS4 to a privately owned stormwater system.

Authorized connections to the MS4 have been required to be mapped under previous Permit cycles. The proposal to map connections from the MS4 to private stormwater systems is to ensure that it is understood where MS4 discharges are leaving the public system. This information, at minimum, could be used to better respond to spills and to be able to complete field screening accurately.

Within the Draft Mapping Guidance that was released with the Western Washington preliminary draft for mapping, the location where the MS4 discharges to a private stormwater system was noted as an outfall location. That guidance is consistent with past guidance from Ecology, as well as with other municipal stormwater permits in the U.S. However, based on comments received, this location is commonly mapped and labeled as a connection point. Ecology prefers to see consistent mapping and following the commonly used terminology meets the intent, as long as these locations are mapped.

6.5.26 Proposed changes to Eastern and Western WA Phase II

- Make electronic format with fully described mapping standards required (electronic format is currently preferred) with a phase-in period for compliance.

This proposed change makes the mapping format consistent across the state. For guidance, Ecology provides an example of mapping standards on its website at: https://ecology.wa.gov/Research-Data/Data-resources/Geographic-Information-Systems-GIS/Standards.

6.5.27 Proposed changes to Eastern Washington

The following additions are proposed to make Phase II mapping requirements more consistent and to improve effectiveness of stormwater management programs.

- The mapping of known discharge points is a new feature to include on the MS4 maps (see Definitions). This term is added for consistency as this term was added to the western Washington Permits with the 2014 Permit modification. It further helps to distinguish when a discharge leaves the MS4 and infiltrates through the Permittees' MS4 facilities designed to infiltrate or the discharge goes to a surface water (see revised definition for outfall). Discharge points do not include UIC facilities, as these facilities are not authorized the Municipal Stormwater Permits, although Ecology sees the benefit in mapping UIC facilities.
- Permanent stormwater facilities owned or operated by the Permittee are added because flow control and treatment BMPs owned or operated by the Permittee are required to be inspected and maintained to ensure proper function and water quality protection.
- Mapping of the connections listed below, assists with operations, maintenance, and IDDE program activities, such as source identification as well as tracking and preventing harm from spills or other illicit discharges.

  - All known and new connections to the MS4 authorized or approved by the Permittee.
  - Connections between the MS4 owned and operated by the Permittee and other municipalities or public entities.

6.5.28 Proposed changes to WWA Phase II:

Mapping requirements were clarified into sections that call out the ongoing mapping requirements, and the proposed new mapping requirements that need to be added to the MS4 maps to follow the Phase I Permit structure.

6.5.29 Proposed changes to Phase I:

Proposed requirements include the start of mapping the tributary conveyances to outfalls (with a size of 24" or greater) for 50% of the areas of the county not previously mapped in the previous Permit cycles. Previous Permit requirements required the mapping of these features in the urban/higher density rural sub-basins. This proposal continues to update the MS4 map to include these tributary conveyances not previously mapped.

6.5.30 Illicit Discharge Detection and Elimination (Phase I: S5.C.9; W.WA Phase II: S5.C.5; E.WA Phase II: S5.B.3)

Permittees used the illicit discharge detection and elimination (IDDE) program during the current Permit cycle to eliminate many pollution problems.

6.5.31 Proposed changes to all three Permits:

- For this Permit cycle, Ecology proposes to collect this information consistently through an application in the Water Quality WebPortal - WQWebIDDE. However, if this application is not developed in time to be used, a new Appendix is included to provide the information and format to submit with the Annual Report.

An IDDE incident tracking and reporting Annual Report question is in the current Permits. Permittees are required to track and maintain records of the activities conducted to meet the requirements of the IDDE section. In the Annual Report, each Permittee submits data for all of the illicit discharges, including spills and illicit connections reported to, or investigated by the Permittee during the previous calendar year, regardless of whether G3 notification was required, whether an illicit discharge was confirmed, or whether follow-up action was required by the Permittee.

Ecology issued guidance for Permittees in western Washington to meet this reporting requirement during the 2013 Permit cycle, but it was used by only a few. A compilation and review of the data Permittees submitted for the 2014 calendar year found that the variation in reporting limited the analysis and interpretation of the information for adaptive management purposes. Ecology wants the requirement to be meaningful and useful. The Stormwater Work Group stakeholder committee involved Permittees in providing helpful definition and clarity to the expected reporting requirements. Ecology's IT department is developing a form in the Water Quality WebPortal, WQWebIDDE that is primarily intended for use by Permittees with smaller numbers of incidents to report. Each Permittee may either use their own system or the form in

WQWebIDDE for recording this data. If using your own tracking system, Ecology prefers that all Permittees' submittals be zipped xml files that are compatible with and follow the data schema described in WQWebIDDE, available in the WQWebPortal. As an alternative to WQWebIDDE, should it not be available, the Annual Report submittal must include all of the information specified in the new IDDE reporting Appendix (appendix 7 for E.WA, 12 for WWA Phase II, and 14 for Phase I).

Other changes:

- For the ongoing program designed to address illicit discharges, clarification was added as to whom should be notified.
- For the ongoing program designed to detect and identify illicit discharges and illicit connections into the Permittee's MS4, Permittees are to track their total percentage of the MS4 that has been field screened (or assessed).

6.5.32 Proposed changes to Eastern Washington

- See MS4 mapping and documentation (above) for discussion on S5.B.3.a.
- The subsection that provides legal authority to prohibit non-stormwater discharges into the MS4 proposes an update to the compliance strategy.

The strategy "shall" include the use of operational and/or structural source control BMPs, and the ability to require maintenance of existing private stormwater facilities that discharge into the MS4. Under the 2014 Permit, this strategy was suggested but not mandatory, so Permittees may already have this as part of their program. Permittees may use these steps before, or as part of formal enforcement. Ecology intends that this will provide additional tools to local governments when the IDDE program identifies illicit discharges that are caused by lack of operational or structural BMPs, or the lack of stormwater system maintenance. Ecology does not intend this as a requirement for pro-active business inspections, but to establish the local authority to effectively minimize illicit discharges to the MS4. In a broader context, this enhancement of the Permit-required SWMP provides an additional tool to local governments to address specific pollution problems identified in receiving waters, such as in many types of S4.F notification situations.

This requirement to have the authority to require operational or source control BMPs is also proposed in the W.WA Phase II Permit, but is included in the *Source Control Program for Existing Development* and therefore not discussed in this section.

6.5.33 Proposed changes to Western Washington (Phase I and Phase II)

- For the ongoing program designed to detect and identify non-stormwater discharges and illicit connections into the Permittee's MS4, the source control inspection program may be leveraged if IDDE inspection needs are incorporated into the inspection.

The guidance provided for this section and for field screening has been updated to reference a locally developed manual, the 2013 *Illicit Connection and Illicit Discharge Field Screening and Source Tracing Guidance Manual*– available on the Washington Stormwater Center's website.[51] Ecology provides flexibility in the procedures for conducting field screening, and for each

Permittee to develop the method or methods that are most effective and efficient for their MS4. A jurisdiction may employ a method that works best in one part of the system and another method in other parts of the system.

6.5.34 Proposed changes to Western Washington Phase II

- See MS4 mapping and documentation (above) for discussion on mapping requirements.
- Language added to match Phase I Permit language regarding the overall approach for the program. This language does not increase or change Permit obligations relative to the 2013 Permit.
- Since the reference to IDDE awareness was removed from the education and outreach program, this provision was moved up in the list of requirements in this section.

The requirement in to inform public employees, businesses, and the general public about the hazards of illicit discharges is an important part of the program to find illicit discharges. Ecology does not propose to move this requirement to the public education and outreach program. By retaining it in the IDDE section, the requirement applies to all Permittees, rather than being one of several possible topics of public education. Disseminating public information on this topic, combined with a publicized hotline number, will continue to raise public awareness and lead to more public hotline reports of potential illicit discharges.

6.5.35 Proposed changes to Phase I

No additional significant changes proposed.

6.5.36 Controlling Runoff from New Development, Redevelopment and Construction Sites (Phase I: S5.C.5; W.WA Phase II: S5.C.6; E.WA Phase II: S5.B.4&5)

This program prevents and controls the impacts of runoff from new development, redevelopment, and construction activities. The Eastern Washington Permit maintains two sections: 1) construction site stormwater runoff control, and 2) post-construction stormwater management for new development and redevelopment. Proposed changes to both of those sections are discussed here.

6.5.37 Proposed changes to all three Permits

- Requirements for ongoing program implementation by continuing Permittees and footnotes for New Permittees indicating where some requirements are modified and establishing an implementation schedule.

The draft Permits require Permittees to continue to implement the ongoing programs established during the current (2013/14) Permit term. Permittees would be required to modify the program by the deadline proposed for adoption and implementation of the draft revisions to Appendix 1. The implementation schedule Ecology proposes for New Permittees is similar to the timelines applied to Permittees during the current (2013) Permit term (E.WA did not have any new Permittees in the 2014 Permit). An additional year is proposed for New Permittees in western Washington to review and revise LID-related development codes.

The proposed language carries forward the timeframe provided for projects to start construction which were approved under previously adopted local standards. If construction is not started by the date specified in the Permits, then the currently adopted local standards must be applied to the proposed project. The Washington State Supreme Court upheld this Permit language in December of 2016.[52] Applications submitted after codes were updated and adopted, as required under the 2013/2014 Permits, do not have a date by which construction must start before the 2019 Permit standards must apply; the proposed changes to Appendix 1 and the SWMMWW/SWMMEW are not significant enough to require the administrative tracking and review of projects submitted and reviewed under updated 2013/2014 programs.

6.5.38 Proposed changes to Eastern Washington

- Permit language is reorganized, however it should be noted that the "track changes" version unfortunately shows Permit language that was moved (from one sub-section to another) as redlined so that it appears more language is added than was moved. However, in most cases language was moved intact instead of added.

S5.B.4: Construction Activities proposed changes

- Permit language was moved to clarify the need for Permittees to investigate complaints about sites that apply the Erosivity Waiver in the same manner as one will investigate complaints about sites that have submitted Construction SWPPPs for review and don't receive a waiver.
- Construction activity requirements are enhanced as follows. These proposed changes will promote the proper planning, preparing, and installation of BMPs and applies more consistent requirements across the state.
  - Review of plans and a site inspection prior to clearing for construction (at sites with high potential for sediment transport).
  - An inspection during construction to ensure proper installation of BMPs is proposed.
- Recordkeeping and training requirements were consolidated in both construction and post-construction sections, rather than distributed throughout different subsections.

S5.B.5: Post-construction proposed changes

- See above – changes to all three Permits. Ecology does not propose significant changes to this section of the Permit. All the changes are either to simplify language and clarify the requirements for continuing Permittees and New Permittees. Permittees must update programs to include the changes proposed in Appendix 1 and adopt the 2019 Stormwater Management Manual for Eastern Washington. The regional technical manuals approved by Ecology may continue to be relied upon for the 2019 permit cycle. Ecology recommends that those relying on an Ecology-approved manual begin to plan the needed updates to align with the 2019 SWWMMEW.
- Maintains the requirement that Permittees allow low impact development. See the Fact Sheet for the E.WA Phase II Permit (November 4, 2011): available here:

https://ecology.wa.gov/Asset-Collections/Doc-Assets/Water-quality/Water-Quality-Permits/MS4-permits/EWA-PhII/EWAPhaseIIFactSheet.

6.5.39 Proposed changes to Western Washington

- A date is provided by which code updates related to Appendix 1 and site and subdivision scale requirements must be completed and applied to submitted Permits.

The significant revisions to Appendix 1 are provided in Appendix 10. Appendix 10 lists the minimum changes a Permittee must make to its local program adopted as required by the 2013 Permits. Phase I Permittees will be required to submit their local programs for approval by Ecology. Following past processes, Phase II Permittees do not need to submit their local programs for approval. See additional discussion on the Phase I Permit local program review and approval process under 'proposed changes to Phase I', below.

- Clarify definition and therefore requirements related to *stormwater treatment and flow control BMPs/facilities*.

In the 2013 Permits, Ecology introduced a new term *stormwater treatment and flow control BMPs/facilities.* This term has been developed in part to clarify the extent to which LID is included in various SWMP minimum performance measures. See the 'definitions' section of this document for additional discussion. Proposed revisions are shown as underlined text:

Stormwater treatment and flow control BMPs/facilities means detention facilities, ***permanent*** treatment BMPs/facilities; ***and*** bioretention, vegetated roofs, and permeable pavements that help meet treatment and flow control requirements.

The term clarifies that long-term maintenance and inspection requirements would not apply to smaller project sites.

- Ecology maintained the 80% inspection rate.

The 80% rate was put in place for the Permit in 2009 to recognize the impacts of the economic downturn on local governments. Ecology proposes to retain this inspection rate in the 2019 Permit for WWA Permittees. The long-term inspections and maintenance requirements applies to BMPs and facilities in project areas that had to meet treatment and flow control requirements. Maintaining this level of effort may help to addresses some of the concerns raised in informal comments regarding additional workload on local government staff. This requirement is consistent with existing requirements for long-term inspections and maintenance.

- The requirements related to the updates to broader development codes (i.e. broader than site and subdivision scale requirements found in Appendix 1) requiring low impact development (LID) to be the preferred and commonly used approach, and the section on watershed-scale stormwater planning, have evolved for continuing and new Permittees.

These requirements are now found in the Comprehensive Stormwater Planning section of the Permits.

6.5.40 Proposed changes to Western Washington Phase II

- The program to verify adequate long-term operation and maintenance (O&M) of privately owned stormwater treatment and flow control BMPs/facilities that are permitted and constructed pursuant to S5.C.6 is now found in the Operation and Maintenance Permit section (S5.C.7.b.i) (formerly *Municipal* Operations and Maintenance).

This follows the Phase I Permit structure. All long-term O&M requirements will be found in the same section. This proposed change meets Ecology's goal of aligning the Permit structures of the western Washington Permits.

6.5.41 Proposed changes to Phase I

- Requirements to apply updated programs to projects that have not started construction by specified dates.

The 2013 Phase I Permit required Permittees to submit their updated local programs to Ecology for review and approval. The programs were reviewed for equivalency with Appendix 1 and the SWMMWW (as amended in 2014). The deadline for the local adoption of these programs was based on a date in the Permit, which could be extended by the amount of time exceeded due to Ecology's review of the programs which was exercised, therefore each Permittee had a different adoption date. The proposed date to start construction follows the 2013 permit structure of providing five-years after the program adoption date. Each schedule is listed individually. We considered retaining the June 30, 2020 start of construction date, as listed in the 2013 Permit, as well as relying on the latest date listed in the schedule (e.g. March, 2021) to give all Permittees the same date. The preliminary determination is to follow the 2013 permit structure, but to provide each Permittee with its own schedule. Ecology invites comments on this proposal.

- Ecology proposes to require that Phase I Permittees submit draft revised codes, rules, standards, and other enforceable documents prepared to comply with S5.C.5.b to Ecology for review and approval.

Based on experience from the previous Permit cycles, Ecology retains Ecology's review time period of 90 days to accommodate any iterative review and revision process with Permittees to finalize approved language. The specific required revisions and format are found in Appendix 10. Ecology expects a streamlined review process. Ecology proposes that the Permittee prepare the submittal for review in a specified format that directly calls out where the revisions were made. Ecology will limit its review to those required sections, unless a Permittee requests review of other sections. A request for review must be complete, all needed information must be submitted with the request or it will be rejected and not part of Ecology's review and approval.

Once approved, Ecology will list the approved manuals and codes in Appendix 10 of a modified Phase I Permit. This list of approved manuals and codes can be used by Phase II Permittees who choose to adopt a Phase I program that Ecology deems to provide a functionally equal or similar level of protection to the minimum requirements, thresholds, and definitions in Appendix 1.

Between July 1, 2020, which is the deadline for submitting the amendment package, and the July 1, 2021 adoption deadline, Permittees would be responsible for the following:

- Responding to Ecology's comments. Based on previous experience, several iterations may be necessary before all comments are resolved. However, Ecology intends to bring structure to this review process so that it does not result in an extension beyond July 1, 2021.
- Finalizing documents that reflect the resolution of Ecology's comments.
- Conducting the public process for adoption.
- If necessary following public processes, making changes and coordinating such changes with Ecology to ensure approvability.
- Adoption by elected officials.
- Make program effective.

6.5.42 Coordinating with Updates of Stormwater Manuals, Guidance, and the Hydrology Model

Ecology is updating the stormwater manuals which provide guidance to local governments and developers on how to design projects to meet the requirements of these Permits.

Stormwater Management Manual for Eastern Washington, Department of Ecology (expected publication*:* December 2018 or January 2019).

- Ecology released a draft SWMMEW for public comment May 25-July 25, 2018. Proposed edits were based on early comments received and needed updates to better integrate UIC and LID BMP guidance.

Stormwater Management Manual for Western Washington, Department of Ecology (expected publication: July 2019)

- Ecology released the proposed edits of the SWMMWW for public review on July 13, 2018, a month earlier than the public comment period of the formal draft Western Washington Permits. Ecology heard the request to from Permittees and others to have additional time to review the proposed SWMMWW changes ahead and separate from the proposed Permit changes. The close of the comment period for the SWMMWW coincides with the comment period for the Permits.

See Appendix 1 section of this Fact Sheet for related information.

6.5.43 Operations and Maintenance Program (Phase I: S5.C.10; W.WA Phase II: S5.C.7; E.WA Phase II: S5.B.6)

The changes proposed for this section requires continuing implementation of the operation and maintenance programs developed during the current (2013/14) Permit term. Proposed changes are for clarity and streamlining Permit language where appropriate. In eastern Washington, this program still only applies to *municipal* O&M but is discussed here.

6.5.44 Proposed changes to all three Permits

- Maintenance Standards – In this section Ecology sets a deadline for cities and counties to update maintenance standards to be consistent with those in the SWMMWW/SWMMEW.

The proposed deadline is the same as the schedule for adoption of proposed site and subdivision requirements in the Controlling Runoff sections of the relative Permits.

- SWPPP Requirement – Ecology proposes to clarify what should be included in a proper SWPPP as well as include relevant SWPPP to the required training for this program.
- Permit language is clarified to include connections to public or private storm systems when conducting catch basin inspections for maintenance needs. This phrasing is used to ensure that the contributing area to where a discharge leaves the MS4 are included and not left out of the inspection area.

6.5.45 Proposed changes to Eastern Washington Phase II

- Format changes for structure and clarity.
- Discharge point is added.
- Street cleaning is added as a municipal activity required to be addressed.

These proposed additions promotes statewide consistency among the Municipal Stormwater Permits. Permittees in western and eastern Washington are engaged in or starting effectiveness studies related to municipal street sweeping programs; results may inform future Permit requirements.

6.5.46 Proposed changes to western Washington Phase II

- Long-term O&M requirements of stormwater treatment and flow control BMPs/facilities that are permitted and constructed pursuant to S.5.C.6. are now found in the "*Operations and Maintenance*" section for the Phase II Permit.

This follows the Phase I Permit structure and creates one section for all of these related O&M requirements.

6.5.47 Source Control Program for Existing Development. Western WA Only - (Phase I S5.C.8; W.WA Phase II S5.C.8)

This provision is based upon EPA rules at 40 CFR 122.26(d)(2)(iv)(A) which call for a stormwater management program that includes, among other things, source control measures.

Ecology is proposing to add the Source Control Program to the W.WA Phase II Permit, the proposed Permit language is modeled from the Phase I Permit language.

The Source Control Program for Existing Development is a proactive, preventative, inspection-based program that is focused on addressing pollution from existing land use and activities that have the potential to release pollutants to the MS4. This program relies on local authority to inspect businesses and properties, and if necessary requires operation or structural source control BMPs in order to prevent pollution from entering the MS4.

6.5.48 Proposed changes for Western Washington Phase II

Ecology received input in the fall of 2016 from a group of Permittees that recommended adding this program to the WWA Phase II Permit. At Ecology-held listening sessions on Permit reissuance (in spring 2017), Ecology proposed adding this program to the Permit. Ecology has considered the comments and proposed Permit language in the WWA Phase II Permit that addresses comments received.

Preventing pollutants from coming into contact with stormwater and entering the MS4 is the best way to reduce impacts of municipal stormwater and thus protect receiving waters. This program has been effective within the Phase I Permit coverage areas, as well as within Phase II communities implementing similar programs voluntarily. Ecology expects better protection of receiving waters by expanding this program to all western Washington Permittees. The compliance strategy should include technical assistance and education and outreach as the first approach to gain compliance. Enforcement actions are only needed when other approaches are found to be ineffective. While each Permittee will need to have local authority to require the use of BMPs, Permittees may work together or form regional partnerships as a means to implement the inspection program locally.

The proposed Permit requirement provides a transition period to develop the program and begin inspections. This allows time to form regional partnerships to help meet this requirement. As proposed, the requirements provide:

- Three years to adopt any necessary ordinances and develop the inventory of businesses.
- Three and a half years to begin inspections.

These timeframes are based on the input Ecology received at the listening sessions. Permittees requested additional time in order to conduct outreach to the existing business community ahead of ordinance adoption. This thoughtful and planned approach to develop the program may gain local support for the program, creating a better adoption process. Additional time allows planning for the needed resources for implementation.

The Permit requires a program to identify potentially pollutant generating sites. The categories of land uses and businesses listed in Appendix 8 are based on the Stormwater Management Manual for Western Washington. Unlike cities, counties do not have local business license programs. Permittees may use other records, such as land use maps and parcel information to generate the inventory provided the inventory represents and encompasses the business types listed in Appendix 8. The inventory must be created once during the permit cycle, and will follow the practice of being updated once every five years as called for in the Phase I Permit. A complaint-based response program is also required; this can be combined with the requirement for a citizen complaints/reports telephone number for the illicit discharge detection and elimination program.

The number of annual inspections is equal to 20% of the businesses or properties on the inventory list.

The Permit requires an inspection and enforcement program for identified sites. Note that while the Permits call for inspecting 20% of the identified sites each year, Ecology does not expect inspection of 100% of the sites over the 5 year term of the Permit. Follow-up inspections count towards the annual inspection rate. Permittees may prioritize sites, categories of land use, or geographic areas. If a jurisdiction knows that a health district or industrial stormwater inspector will inspect a particular business/property for stormwater management needs, the Permittee may choose to prioritize other businesses/properties to inspect. Those sites where the property owner denies entry and there is no legal authority to inspect the site may be excluded from the onsite inspection, however, the Permittee is still responsible for enforcement of applicable local laws related to pollution or evidence of an illicit or contaminated discharge can be documented without entering the property.

The Permit requires implementation of a progressive enforcement policy to assure compliance with stormwater requirements within a reasonable time period. The reason for this requirement is to ensure Permittees' implement the legal authority required in the EPA rules and in S5.C.

Training for the source control program may be combined with training for the illicit discharge detection and elimination program and operation and maintenance programs.

6.5.49 Proposed changes to Phase I

Ecology clarifies that the Source Control Program applies to public and private properties that meet the criteria of the program. No significant changes proposed.

6.5.50 Structural Stormwater Controls. Phase I Only - (S5.C.7)

Phase I Permittees are required to implement a program for Structural Stormwater Controls (SSC) as part of their Stormwater Management Program (SWMP). Ecology aims this program toward retrofitting existing developed areas; and promotes planning and prioritization of these projects to reduce impacts to watershed hydrology and pollutant discharges from MS4s. Qualifying projects reduce or prevent negative water quality impacts from MS4s. This program also addresses regional stormwater facilities and stormwater impacts inadequately controlled by other Permit requirements.

6.5.51 Proposed Retrofit Incentive Point Requirement

Ecology proposes a defined level of effort for the SSC Program. The level of effort is counted in "retrofit incentive points," which is an accounting system created to standardize quantification of project benefits for a wide range of qualifying project types that are implemented to varying degrees of effectiveness across a multitude of landscapes, land uses, and scales. Ecology is proposing a minimum SSC point requirement of 300 incentive points.

Including a minimum point requirement in the Phase I Permit means there needs to be a deadline for conducting the compliance tally, clarity on project status that qualifies for tallying, and a target number of retrofit incentive points to achieve over the course of the tallying period.

- Ecology proposes December 31, 2022 as the cut-off date for calculating points toward the required minimum. This allows for reporting by March 31, 2023 in advance of the Permit expiration date. This equates to a tallying period of 3.5 years.

- The projects that qualify for tallying must be at defined project stage(s) or frequencies. This Permit cycle's minimum point requirement is intended to allow for a "ramp up" adjustment to reflect program planning, and therefore includes a level of effort for design-stage incentive points as well as complete/maintenance-stage incentive points. Complete/maintenance-stage incentive points may substitute for design-stage incentive points, however a minimum of complete/maintenance-stage incentive points must be achieved by the date proposed. Qualifying maintenance projects which sum annual activities are to be reported and tallied individually per year (e.g., separate line items in Appendix 12 reporting).
- Points to be achieved must be both goal-oriented and reasonable. Ecology proposes the following defined level of effort for the 2019-2024 Permit cycle:
  - 225 design-stage retrofit incentive points, and
  - 75 complete/maintenance-stage incentive points.

This level of effort was based on Ecology's analysis of data from the 2013-2018 Phase I Appendix 11 submittals, Permittee provided point estimations of projects completed during the 2013-2019 Permit cycle; and best professional judgement. Permittees' reported funding of these projects from a mix of local, state, and federal funds. The minimum level of effort proposed therefore reflects some inclusion of these funding sources. The proposed Permit requirement to demonstrate a minimum level of effort will not make projects ineligible for state grant and loan funding. While water quality funding sources and levels have remained relatively stable over the years, Ecology makes no assumptions that that will be the case in the future. Grant and loan sources will remain competitive with no guarantee of securing funding for individual projects that may contribute to SSC incentive points.

Ecology's proposed calculation of a project's retrofit incentive is intended to reflect MS4 retrofit priorities as well as receiving water conditions and project effectiveness. This Permit cycle's minimum point requirement is intended to allow for a "ramp up" adjustment to reflect program planning, and therefore includes a level of effort for design-stage incentive points as well as complete/maintenance-stage incentive points.

Points are assigned differently to each qualifying project type. The scaling basis of point assignments is relative and is used solely for calculating compliance with the retrofit incentive point requirements of the SSC Program. Many point assignments are based on an "equivalent area" calculation. Ecology bases the equivalent area calculation on a scale that compares the amount of runoff treatment or hydrologic control achieved through the proposed project to the amount achieved if you designed the project to meet the new and redevelopment criteria for the area draining to the new BMP(s).

Equivalent area is then used for LID (MR #5), runoff treatment (MR #6), or flow control (MR #7) benefit standardization, reflected as a ratio. Because hydrologic and treatment benefits from stormwater facilities vary, Ecology has divided each into different levels of project achievement. Each level is given a retrofit incentive point multiplier that reflects a point system that is used to define the required SSC Program level of effort.

When creating the point system, Ecology placed particular emphasis on:

- Reducing negative water quality impacts from existing MS4 discharges;
- Project effectiveness (as compared to minimum technical requirements for new/redevelopment projects);
- Addressing receiving water quality impairments (i.e., 303(d) listings); and
- Preventing future negative water quality impacts from the creation of MS4s (i.e., permanent protection from development) and MS4-related discharges.

The point system is intended to accommodate:

- Separate Incentive points for Design and Construction of a single project to provide credit for taking a project beyond the 60% design level.
- Diverse qualifying project types – For example, projects that involve habitat protection or reforestation are difficult to quantify in terms of a hydrologic and/or runoff treatment benefit. Thus, Ecology based the retrofit incentive points on the land area protected or restored.
- Different MS4 service area scales, landscapes and land uses – Cities and counties have distinctly different landscapes in their MS4 service areas, and thus present different opportunities for SSC project types.

In general, the proposed Retrofit Incentive Point structure is intended to result in:

- More incentive points for projects that improve water quality discharges to a water body with known water quality problems (such as 303(d) listing or contaminated sediment cleanup site).
- More incentive points for projects that treat greater volumes of stormwater runoff (using a metric based on the 91% volume required for new and redevelopment projects) than projects with runoff treatment facilities that treat lesser volumes of water.
- More incentive points for projects that provide greater "large storm" (MR #7) hydrologic benefit as compared to the standard flow control requirement
- More incentive points for projects that provide greater "small storm" (LID, MR # 5) hydrologic benefit as compared to the LID Performance Standard.
- More incentive points for runoff treatment projects that quantifiably address targeted pollutants, such as dissolved metals, phosphorus or other chemicals of concern.
- Modest incentive points for property acquisition or other permanent protection of forest cover and riparian habitat.
- Fewer incentive points for expensive capital maintenance projects and for enhanced maintenance activities that provide variable or conditional outcomes.
- Fewer incentive points for projects that restore riparian buffer because this project type can be construed to, at least in part, mitigate for prior negative impacts from MS4 discharges, hydromodification, or land disturbing activities. Due to its likely direct

improvement to surface water quality via shade and vegetative cover, riparian restoration is assigned slightly more points than forest restoration.

Projects that restore forest cover and reconnect floodplains receive the least amount of incentive points because these project types can be construed to, at least in part, mitigate for prior negative impacts from land disturbing activities.

6.5.52 S5.C.7.a Project Types for Consideration

Ecology proposes the following changes for qualifying project types:

- Ecology proposes to remove ‘riparian habitat acquisition’ as its own project type, as this project would qualify under ‘property acquisition for water quality and/or flow control facilities.
- The addition of ‘permanent removal of impervious surfaces’ as a project type. Doing so changes the Project Type Numbers that were used during the 2013-2018 Permit cycle.
- Ecology proposes the LID BMP project type as separate from the flow control facility (after having combined them as a result of public comments on the 2013-2018 Permit). This enables LID BMPs to receive independent credit for achieving the LID Performance Standard. Doing so changes the Project Type Numbers that were used during the 2013-2018 Permit cycle.
- Ecology proposes to include modest additional credit for qualifying projects related to the MS4 which implement an Ecology-approved basin plan (refer to Permit Appendix 1, Section 7), a watershed-scale stormwater plan from the 2013-2018 Permit’s Special Condition S5.C.5.c, a TMDL (refer to Appendix 2), or an Ecology-approved adaptive management plan (refer to Permit’s Special Condition S4F.3 and Appendix 13). The 2013-2018 Permit included, as a distinct qualifying project type, “capital projects related to the MS4 which implement an Ecology-approved basin or watershed plan.” Ecology proposes to remove this as an independent qualifying project type because qualifying projects are included in other Project Type categories. Instead, such projects are given additional retrofit incentive points. Ecology proposes the addition of 0.10 to the applicable multiplier. Ecology proposes to limit this addition to capital projects and explicitly exclude maintenance actions under Project Type #10.

The following information describes and provides clarifying information for each project type that must be considered in Permittees’ SSC programs:

(1) New flow control facilities (S5.C.7.a.i(a))—Flow control facilities need not be regional. These facilities do not have to meet the “standard flow control requirement” (refer to Permit Appendix 1 Section 4.7) but they shall be new facilities designed to control stormwater flow from existing development. Project proponents that don’t follow design criteria from the SWMMWW, or equivalent manual, should be prepared to provide additional project details at Ecology’s request to support calculations for equivalent area, water quality benefits, and retrofit incentive points. Qualifying projects in this category will be compared against the Flow Control Standard for retrofit incentive point calculations.

(2) New runoff treatment facilities (S5.C.7.a.i(b))—Runoff treatment facilities include facilities that provide oil control, phosphorus treatment, enhanced (dissolved metals) treatment, and basic treatment. Facilities in this category do not have to meet runoff treatment requirements (e.g. treat 91% of the average annual runoff) but they shall be new facilities that provide a treatment benefit for existing development. Project proponents that don't follow design criteria from the SWMMWW, or equivalent manual, should be prepared to provide additional project details at Ecology's request to support calculations for equivalent area, water quality benefits, and retrofit incentive points. Maintenance activities are <u>not</u> classified under this project type. Qualifying projects in this category will be compared against the Runoff Treatment Standard for retrofit incentive point calculations.

(3) New LID BMPs (S5.C.7.a.i.(a)-(b))**—**These facilities are consistent with the lists of On-Site Stormwater Management BMPs of Minimum Requirement 5 and reduce the volume of runoff by infiltrating runoff from the small, more frequent storms. Qualifying new LID BMP projects result in the reduction or prevention of hydrologic changes through use of on-site (e.g., infiltration, dispersion, evapotranspiration, rainwater harvesting) stormwater management BMPs. LID principles reflected in site design techniques do ***not*** qualify because projects that apply LID principles in a retrofit setting should be accommodated in other qualifying project types (such as property acquisition and restoration of forest cover). Qualifying projects in this category will be compared against the LID Performance Standard for retrofit incentive point calculations.

(4) Retrofitting of existing stormwater facilities (S5.C.7.a.i(c))**—**Retrofitting is expected to occur on previously constructed stormwater facilities that, if modified, would provide additional hydrologic or runoff treatment benefits. For example, Ecology considers the retrofit of a stormwater pond to provide a settling area and more storage a retrofit to a stormwater facility. Maintenance activities such as removing sediment to re-establish wet pool volume but not increasing volume beyond the initial design are <u>not</u> classified under this project type.

(5) Property acquisition to provide additional runoff treatment and/or flow control benefits (S5.C.7.a.i(d)) — This category excludes the purchase of property for the siting of a stormwater facility. Instead, purchase of a likely development site to permanently prevent it from being developed would qualify under this category. This category includes forest protection and conservation easements. Riparian habitat acquisition qualifies under this project type. Property used for dispersion does not qualify under this project type; it is considered a new LID BMP (Project Type 3).

(6) Maintenance with capital construction costs ≥ $25,000 (S5.C.7.a.i(e)) — This project type applies to repair projects that improve the hydrologic or treatment performance of stormwater facilities. This project type is directly related to Operations and Maintenance Program requirements at S5.C.9.a.ii which reflects that maintenance projects, including repairs, which require capital construction ≥ $25,000 are not subject to the required 2-year window for completing the maintenance. These projects typically compete with the other types of retrofit projects for limited capital construction funding. Ecology intends that these projects be reflected in the SSC program in order to provide a comprehensive view of MS4 maintenance activities and requirements. Permittees may develop criteria for identifying maintenance projects that reach the capital construction cost threshold on an area-wide or system-wide basis per the requirement in S5.C.7.b.ii (g). A maintenance project that removes sediment from an existing pond to re-establish the original design volume, will qualify under this project type.

(7) Restoration of riparian buffers (S5.C.7.a.ii(a)) — This project type is retained from the 2007 Permit, this project type is not directly related to stormwater (i.e. not driven by stormwater capital planning) but provides stormwater benefits.

(8) Restoration of forest cover (S5.C.7.a.ii(b)) — This project type is retained from the 2007 Permit, however this project type is not directly related to stormwater (i.e. not driven by stormwater capital planning) but provides stormwater benefits.

(9) Floodplain reconnection projects on water bodies that are not flow control exempt per Appendix 1 (S5.C.7.a.ii(c)) – Qualifying floodplain reconnection projects will have an MS4 nexus and provide flow reduction and runoff treatment benefits. Ecology added this project type in response to comments on the 2013-2018 Permit.

(10) Permanent removal of impervious surfaces- (S5.C.7.a.ii(d)) Permanent removal of impervious surfaces and replacement with pervious vegetated surfaces meeting BMP T5.13 or trees that promote infiltration, dispersion, and uptake by plants or reduce the amount of pollution generating impervious surfaces qualify under this project type.

(11) Other actions to address stormwater runoff into or from the MS4 not otherwise required in S5.C (S5.C.7.a.ii(e)) —Ecology included this project type in the SSC Program to allow Permittees to count the runoff treatment (pollutant removal) and/or hydrologic benefits of maintenance actions that address existing stormwater runoff into or from the MS4 not otherwise required in the Stormwater Management Program requirements of S5.C. Ecology intends this category to encompass "enhanced maintenance" projects, such as high efficiency street sweeping and line cleaning not otherwise used to comply with S5.C.10 (i.e., catch basin inspection alternatives). In order for any action to receive credit under the SSC Program, it must have a quantifiable hydrologic or runoff treatment/pollutant removal benefit and sufficient recordkeeping to verify implementation and benefits. While this project type will generally consist of "activities," Ecology considers them "projects" due to the data collection and analysis that are necessary to support assignment of retrofit incentive points.

6.5.53 S5.C.7.b SWMP requirements for the SSC Program

The required written documentation of the Permittee's SSC program is substantially unchanged.

6.5.54 S5.C.7.c Structural Stormwater Control Reporting

The reporting of planned projects over the Permit term is substantially unchanged.

6.6 S6 - Stormwater Management Program for Secondary Permittees

Secondary Permittees are public entities such as ports, park districts, school districts, colleges and universities, state institution campuses, state military campuses, irrigation districts, and diking and drainage districts that are located in a Phase I and Phase II coverage areas and own or operate a regulated MS4. This section of the Permit describes the requirements that apply to Secondary Permittees and makes up the core elements of their Stormwater Management Program.

The SWMP for Secondary Permittees is intended to apply to a wide variety of Secondary Permittees. The requirements of Special Condition S6 will apply differently depending on the type and function of the public entity, the size and nature of the coverage area, and the specifics of the entity's MS4. For example, ports covered by the Permit may lease property to other entities that manage stormwater on the leased property, and in some cases that property may be covered by the *Industrial Stormwater General Permit* or another NPDES stormwater permit. Alternatively, many colleges and universities have resident and commuter student populations. Diking and drainage districts may serve more than 1,000 residents because their service areas are now partially in urbanized areas, but they have little or no authority over activities on those properties. Some Permittees may rely on the local jurisdiction to regulate discharges into their MS4s, others may rely on another NPDES permit for such discharges, while others such as school districts may rely on internal policies that control operations on all the lands served by their MS4.

Ecology's is not proposing any significant changes to the Secondary program. For purposes of this Fact Sheet, a description of the program is provided.

6.6.1 S6.A New Secondary Permittees

Secondary Permittees may begin Permit coverage at any time during the Permit term, and the implementation schedule may extend from one Permit term to the next. Secondary Permittee implementation schedules are calculated based on the date of Permit coverage. As New Secondary Permittees begin Permit coverage and fully implement their requirements, they will be subject in future Permit terms to deadlines for the "initial" date of Permit coverage. Ecology uses this approach to direct continuing Secondary Permittees to continue implementing their programs according to their individual schedules, and to direct New Secondary Permittees to phase in their programs according to individual schedules over a four and one-half year period. Once the SWMP is fully implemented, Ecology expects all Secondary Permittees to continue full program implementation.

6.6.2 S6.D Stormwater Management Program

The purpose of the SWMP is revised to include descriptions of the planned program activities for the upcoming year. This could be relatively short, and could include a brief description of planned activities for public education and outreach, field screening, or stormwater system maintenance.

No significant changes proposed.

6.6.3 S6.D.1 Public Education and Outreach

No significant changes proposed.

6.6.4 S6.D.2 Public Involvement and Participation

No significant changes proposed.

6.6.5 S6.D.3 Illicit Discharge Detection and Elimination

No significant changes proposed.

6.6.6 S6.D.4 - Construction Site Stormwater Runoff Control

No significant changes proposed.

6.6.7 S6.D.5 - Post-construction Stormwater Management in New Development and Redevelopment

Secondary Permittees do not have land use authority under state law, and the requirements of this and the previous section refer to the obligation to comply with local ordinances governing these activities. Where the MS4 is interconnected with the local jurisdiction MS4, Secondary Permittees must coordinate to assist the local jurisdiction in achieving compliance with local codes. This might occur if the local jurisdiction needed assistance in addressing a discharge from a Secondary Permittee's MS4 that originated from a tenant's discharge into the MS4 of the Secondary Permittee.

6.6.8 S6.D.6 - Pollution Prevention and Good Housekeeping for Municipal Operations

The draft Permits require that operation and maintenance of the Secondary Permittee's MS4 must include standards consistent with or more protective than those in Ecology's updated *SWMMWW or SWMMEW.* The updated Ecology manuals may include new standards relevant to the Secondary Permittee's MS4.

Ecology proposes language to require Secondary Permittees to review maintenance standards to ensure they are consistent with any updates in local or Ecology standards. Secondary Permittees would update their maintenance standards to be consistent with the 2018/2019 manual updates.

6.6.9 Phase I Only - S6.E Stormwater Management Program for the Port of Seattle and Port of Tacoma

No significant changes proposed.

6.7 S7 - Compliance with Total Maximum Daily Load Requirements

Under some circumstances, when the water quality of a water body is impaired, the federal Clean Water Act requires States to set limits on the amount of pollutants that the water body receives from all sources. States may also set limits on pollutant loads when water bodies are threatened. These limits are known as Total Maximum Daily Loads (TMDLs). A TMDL is developed through a defined process to identify the maximum amount of a pollutant that may be discharged from all sources to a water body without causing violations of water quality standards. Pollutant control strategies are developed in a TMDL to keep the pollutant loading below that level. TMDLs include an assignment of Waste Load Allocations (WLAs) to NPDES permitted dischargers and Load Allocations to control the load from non-point pollution sources.

Stormwater dischargers authorized by these Permits are required to implement actions necessary to achieve the reduction in pollution called for in applicable TMDLs. Applicable TMDLs are TMDLs which EPA has approved prior to the date the final Permit is issued, or prior to the date that Ecology issues coverage under these Permits, whichever is later. Information on Ecology's

TMDL program is available on Ecology's website at: https://ecology.wa.gov/Water-Shorelines/Water-quality/Water-improvement/Total-Maximum-Daily-Load-process

Ecology incorporates these required actions in the Permits through Special Condition 7. In some cases, actions are included in Appendix 2 as requirements for individual Permittees. Appendix 2 lists the actions by TMDL and by Permittee. The proposed Appendix 2 includes both updated actions from the current (2013/2014) Permit term and new actions proposed for TMDLs approved since the 2013/2014 Permits were issued.

The stormwater management program required by these Permits can help make progress in preventing pollution and cleaning up water bodies impaired in part by stormwater discharges. These two related Clean Water Act programs are integrated through Appendix 2 actions. Ecology expects the addition of TMDL actions to focus resources where Ecology and local communities identified the most severe problems and the actions needed to correct them in the TMDL process. Ecology encourages Permittees to participate in the TMDLs that are currently being developed within their jurisdiction, and to begin implementation where appropriate.

Ecology reviews EPA-approved TMDLs to identify those that assign a Waste Load Allocation to one or more municipal stormwater Permittees. Ecology then identifies the actions for Permittees and compares them to existing Permit requirements. There are three types of TMDL actions:

1. Actions already addressed by regular stormwater program implementation, such as a public education program or ongoing maintenance of the MS4. Ecology does not include these actions in Appendix 2. Special condition S7 states that for TMDLs not listed in Appendix 2, compliance with the Permit constitutes compliance with those TMDLs.

2. Actions that require a Permittee to target a SWMP requirement to a specific area or activity, such as focusing the illicit discharge screening program in the area draining to the impaired water or conducting a public education program that includes pet waste education. Appendix 2 lists these actions with a reference to the related program, and identifies the specific area, BMP, or timeline.

3. Actions in addition to the current SWMP that are not necessarily reflected in the existing program requirements, but are relevant to the MS4 and its contribution of pollutants to the impaired water body. This could include special monitoring requirements or a specific stormwater facility retrofit.

Where monitoring is required, Appendix 2 requires that it be conducted according to an Ecology-approved Quality Assurance Project Plan (QAPP).

The proposed Appendix 2 actions link to and address the potential MS4 contribution to the impairment. If the list for one Permittee is long, Ecology proposes priorities and schedules. In some cases, the draft actions for one permit term may include requirements to collect and evaluate monitoring data, then use the analysis to develop an action plan, and finally to begin implementing the action plan. This supports an adaptive management approach, to avoid requiring Permittees to monitor a site for the entire Permit term before acting on the information.

The focus is on achieving the TMDL objective, which is to meet the WLA for the MS4 contribution, and ultimately to improve or restore water quality in the receiving water.

The proposed Permits also includes updated actions for TMDLs that are listed in the current (2013/2014) permit's Appendix 2. Updates may include removing actions now completed, moving to the next logical action, or incorporating new actions based on lessons from the current Permit term.

Before releasing the draft Permits, Ecology informed affected Permittees of the range and scope of actions it expected to propose in the draft Appendix 2. In some cases, Ecology staff met with affected Permittees to review proposed language and ask for feedback. This "no surprises" approach reflects Ecology's recognition of Permittees' local knowledge in ground-level efforts to clean up impaired waters.

6.8 S8 - Monitoring and Assessment

6.8.1 New Permittees

Because new permittees are just starting their programs, Ecology is not requiring them to participate in regional monitoring studies or conduct monitoring during the 2019 Permit term. New permittees should plan to either participate in regional monitoring studies or conduct individual monitoring in future Permits. See respective Permits for description of program and options available.

6.8.2 Proposed changes to Eastern Washington Phase II

Permit condition S8.A of the 2014 Permit has been removed. Ecology reviewed the information provided by Permittees in their Annual Reports and found the submittals to be redundant with other Permit conditions including S4.F (Compliance with Water Quality Standards); S7 and Appendix 2 (Total Maximum Daily Loads); S5.C.3 (Illicit Discharge Detection and Elimination); and S8.B (Stormwater Management Program Effectiveness Studies).

During the 2014 Permit, all eastern Washington city and county Permittees participated in a robust and extensive process to identify, prioritize, and select stormwater management program effectiveness study topics and questions. Before the end of the Permit cycle, eight studies were chosen, and Quality Assurance Project Plans (QAPPs) were approved by Ecology for each study.

During the 2019 Permit, the eight studies identified in the 2014 Permit cycle will be completed, and new studies will be identified. There are ten designated Urban Areas in eastern Washington: Wenatchee, Ellensburg, Yakima, Sunnyside, Tri-Cities, Moses Lake, Walla Walla, Clarkston, Pullman, and Spokane. Ecology expects the Permittees associated with each Urban Area to collaborate to prioritize, plan, and begin implementation of a new study. Any number of Urban Areas may work together on a single new study (*i.e.*, all of the cities and counties in Yakima, Sunnyside, and Tri-Cities Urban Areas – or all Eastern Washington Permittees – can propose a single study as a regional group). This will result in up to, but no more than, ten new studies beginning by the end of the 2019-2024 Permit.

For a new study, Ecology encourages Permittees to utilize the list of study topics and questions submitted per S8.B.3 of the 2014 Permit. For a new study, Permittees may decide to conduct a second or follow-up phase of one of the eight studies begun under the 2014 Permit. The new study answer may address questions that remained unanswered in the first study, provide deeper research, or be otherwise closely tied to the original study. Studies do not need to be completed within the 2019-2024 Permit cycle, but the QAPPs must include complete project timelines.

Study design proposals and QAPPs must follow the format and instructions in the three QAPP templates produced during the 2014 Permit cycle for studies of structural BMPs, operational BMPs, and education and outreach BMPs[53]. The QAPP templates are available on Ecology's website.

Effectiveness studies of retrofit projects will use the QAPP template for structural BMP studies, but TAP-E requirements do not need to be met for these studies. Grant-funded capital projects provide good opportunities for collecting high quality data to document water quality benefits of retrofit and redevelopment stormwater projects. Permittees may submit proposals for monitoring these types of projects as effectiveness studies. Such a proposal must complement the grant-funding process and take into account the uncertainty of capital project funding.

Ecology expects every Permittee to participate in one or more of the following ways:

1. Actively leading a study: serving as Lead Entity and providing project management oversight of the study from QAPP completion through implementation and completion.
2. Providing staff or in-kind services: participating in the project's Technical Advisory Committee, reviewing draft study documents, arranging field sampling locations, lending equipment, conducting field work.
3. Contributing funds through an interagency agreement or other arrangement with the Lead Entity or directly via a contract with a study sub-contractor.

These studies are associated with the Permittees' Stormwater Management Programs, and should be included therein. All Permittees are expected to keep track of their assigned duties and record their participation in meetings, proposal development, project reviews, and study implementation. A summary of these activities will be included in each Permittee's Annual Report.

6.8.3 Proposed changes to Western Washington (Phase I and Western Washington Phase II)

This section defines adaptive management monitoring requirements for Permittees in western Washington. The 2019 Permits continue the collaborative regional stormwater monitoring program (RSMP) approach that began in the 2013 Permits. The RSMP is now called Stormwater Action Monitoring (SAM). SAM's primary audience is stormwater managers, and a SAM communication strategy was developed and implemented in 2017.

Ecology accepted the Stormwater Work Group stakeholder group's 2010 recommendations describing a comprehensive framework with status and trends monitoring in receiving waters, effectiveness studies, and source identification. Because the Permits do not include compliance monitoring, and very few Permittees have continued stormwater discharge characterization monitoring, Ecology needs the receiving water monitoring to evaluate and continue to adapt the Permits over time. The effectiveness studies provide more regionally applicable and robust findings than would be produced by requirements for each individual Permittee conducting their own studies.

Permittees choose to collaborate with each other, and other stakeholders, by funding SAM through their S8 requirements. Making contributions to SAM cost-share accounts relieves Permittees of the duty to conduct individual adaptive management monitoring projects. SAM conducts regionally relevant projects that provide adaptive management feedback information to improve Permittees' stormwater management program implementation and to inform Ecology's Permit requirements. SAM projects are prioritized and approved by a formal stakeholder group. SAM projects include: receiving water monitoring, effectiveness studies, and source identification.

Permittees make annual contributions to SAM cost-share accounts that are managed by Ecology and overseen by the formal stakeholder group. The Permits provide the option of either paying into the SAM accounts or conducting stormwater discharge monitoring as was required in the 2007 Phase I Permit and for Clark County in the 2013 Phase I Permit, and was provided as an alternative to participating in the effectiveness studies component of SAM in the 2013 Phase I and Phase II Permits. Phase I Permittees also have the option of conducting an effectiveness study in lieu of paying half of the annual cost-share account contribution for effectiveness studies.

SAM was launched in 2014. By the summer of 2018, five Puget Sound receiving water studies were completed, and fourteen effectiveness studies and three source identification projects – all relevant to Permittees across western Washington – were in various stages of completion; and four more SAM projects were in development. The 2019 Permits introduce a new regional urban streams monitoring program in geographic areas of the Lower Columbia (LC) River basin covered by the Permits.

Background

Ecology's Permits have never included compliance monitoring, but instead have required stormwater discharge characterization and effectiveness studies by Phase I Permittees. The earlier Permits' Phase I monitoring requirements provided useful information, but at significant cost and effort. In 2005 a group of Phase I and Phase II Permittees formally asked Ecology to consider a different approach to MS4 permit monitoring. The Puget Sound Monitoring Consortium (PSMC) was funded by the state legislature in 2007 at the request of local jurisdictions and other stakeholders.

The 2007 Phase I Permit required each individual Permittee city, county, and port to conduct stormwater discharge monitoring, stormwater treatment and flow control facility evaluation monitoring, and targeted program effectiveness monitoring. The 2007 Phase II Permit did not include monitoring requirements; it required each Permittee to submit an effectiveness study proposal in their Annual Report in 2011. The lack of Permit monitoring requirements in the 2007 Phase II Permits was challenged, and the Pollution Control Hearing Board (1) concluded that Ecology should require monitoring in subsequent Phase II Permits and (2) endorsed the PSMC process for framing a collaborative regional monitoring program.

In 2008 the PSMC convened the Stormwater Work Group (SWG), with Ecology providing staff support. The SWG is a formal stakeholder group with a charter and bylaws; the SWG updates its biennial work plan each year. SWG members are designated as official representatives by the caucuses of federal and state agencies; by a local jurisdiction caucus; and by environmental and business groups. Additional seats at the table are designated for tribes, ports, and agriculture. In 30-plus meetings from 2008-2010, the SWG deliberated and reached consensus agreement on nearly all of the 88 stakeholder recommendations the group submitted to Ecology for a comprehensive scientific framework, implementation plan, and Permit monitoring requirements. Ecology then wrote the 2013 Permit monitoring requirements to implement the SWG's recommendations.

The collective S8 requirements in both of the 2013 Phase I and Phase II Permits – S8.B status and trends monitoring, S8.C stormwater management program effectiveness studies, and S8.D source identification and diagnostic monitoring – replaced the individual monitoring requirements in the 2007 Phase I Permit that otherwise would be continued into future Phase I and Phase II Permits.

Process for selecting SAM studies

The SWG selects and approves all activities funded by the SAM cost-share accounts. The SWG gathers stakeholder input and sets priorities for each of the three strategic categories where SAM activities are targeted to answer stormwater management questions: receiving water monitoring, effectiveness studies, and source identification.

SAM projects provide regionally applicable information to improve how stormwater is managed either by informing Permittees' or developers' implementation of BMPs or by improving Ecology's permits, guidance documents, or BMPs in the *Stormwater Management Manual for Western Washington*. SAM studies work together to provide information about how our overall approach to stormwater management is working: Are conditions in receiving waters improving? Do BMPs function as intended? What are the sources of pollution and how can we find and reduce them?

Topics for study under SAM are developed in stages, and continue to evolve reflecting the needs for feedback information from stormwater managers. For Puget Sound receiving waters, the scientific framework completed in 2010 included the scientific approach and study design for the studies which were first conducted in 2015-2016. In 2013, the SWG recommended a list of six priority topics for the first two solicitation rounds for SAM effectiveness studies. In 2012-2013, an EPA-funded literature review and scoping paper described the need for a Source Identification Information Repository with two components: Results and Findings, and Methods and Approaches.

The SWG conducted solicitation rounds in 2014 and 2017 to identify and select SAM effectiveness studies. The solicitation process included technical reviews by Ecology's engineers and the SWG's effectiveness subgroup (of Permittees, consultants, and state and federal agency scientists) and Permittee voting to rank the proposals. Another SWG subgroup (of mostly IDDE field practitioners) recommended the first four SAM source identification projects for SWG approval. Permittees will continue to vote on individual effectiveness studies and source identification project proposals prior to SWG approval for SAM funding. A third solicitation round is planned for fall 2019; it will solicit studies and projects in both effectiveness and source identification categories. In 2018, the SWG began a year-long process to adjust the study design approach and priorities for future status and trends monitoring, effectiveness studies, and source identification projects. A workshop is planned to gather feedback on the proposed priorities for the 2019 solicitation round.

Communicating and applying findings from SAM studies

Each contracted SAM project is described on the web pages at ecology.wa.gov/SAM where Permittees and stakeholders can follow project development and findings. A two-page fact sheet is posted at the main SAM web page for each completed SAM project. The fact sheet includes details about the stormwater management problem addressed by the project, study findings, and recommendations. The fact sheets also include sections titled “Why does this study matter?” and “What should we do with this information?” and “What will Ecology do with this information?” Permittees should read through the fact sheets and apply the findings to their stormwater management programs as applicable. Stormwater managers may also read the full reports posted on the SAM web pages.

Oversight of SAM contracting decisions and expenditures

Ecology agreed to manage the SAM program, per the SWG’s 2010 recommendations, with the condition that the SWG oversee and make decisions for funding projects with the SAM cost-share accounts. The SWG’s Pooled Resources Oversight Committee (PRO-C) provides this oversight, with a focus on projects’ scopes, schedules, and budgets. Ecology’s roles are to collect, administer, and manage the SAM cost-share accounts and contracts. Ecology contracts with local governments and others to conduct the SAM studies that have been approved by the SWG. Each spring, Ecology outlines the progress SAM made during the prior calendar year in an Annual Report to Permittees. Ecology also delivers regular budget and progress reports to the PRO-C and SWG as part of the SAM oversight process. These reports, and SAM project deliverables, are posted on the SAM web pages.

The PRO-C ensures transparency, efficiency, and accountability in Ecology’s SAM contracting decisions and cost-share account expenditures. The PRO-C has a charter and bylaws, and the seven PRO-C members formally represent Permittees and other stakeholders. The PRO-C meets regularly for detailed program management discussions with Ecology’s SAM Coordinator. The PRO-C and SWG provide feedback to Ecology on SAM implementation.

Cost allocation approach

A table listing each Permittee’s cost shares for S8.A Regional status and trends monitoring and S8.B effectiveness studies and source identification is provided in new Appendix 11. The costs were allocated by population using the same approach as for the 2013 Permit with updated data from OFM that was available in April 2018. The regional population covered by the Phase I and Phase II Permits increased by 14.2% but the annual cost-share amount for nearly every Permittee is lower than in the 2013 Permits.

New Permittees in the 2013 Phase II Permit were not included in the cost allocations for the 2013 Permits but are included in the cost allocations for the 2019 Permit for both S8.A.2 and S8.B.2. New Permittees in the 2019 Phase II Permit are not included in the cost allocations.

The Ports of Seattle and Tacoma do not have residential populations but they participate in SAM and are included in the cost allocations. The assigned population for the Ports' 2013 Permit cost allocations was increased by 10% for the 2019 Permit cost allocations.

The Washington State Department of Transportation (WSDOT) is covered by a separate MS4 Permit. WSDOT participates in the SAM regional receiving water monitoring in Puget Sound and the Lower Columbia and conducts effectiveness studies per the requirements of their separate Permit. WSDOT was not included in the cost allocations for the 2013 Permits but WSDOT is included in the cost allocations for regional receiving water monitoring in the 2019 Permits. As agreed by stakeholders for the Puget Sound and Lower Columbia receiving water monitoring programs, WSDOT's cost allocation is set equivalent to the City of Kent for Puget Sound and to the City of Longview for the Lower Columbia region.

Future annexations could potentially affect the proportional allocation of cost shares determined by this approach. Because Permittees' cost shares will not be amended during the 2019-2024 Permit term, Ecology encourages local jurisdictions to consider addressing their financial commitments to SAM in future annexation agreements.

Proposed Changes from the 2013 Permit

The 2013 Permit condition S8.A is removed from the 2019 Permits. The condition required Permittees to provide summaries of other stormwater-related monitoring information provided to them during each reporting year. In 2017, Ecology reviewed all of the reports submitted in the Annual Reports for the 2013 Permits and found the information to be redundant to other parts of the Permits, especially Special Conditions S4 Compliance with Standards (and particularly S4.F), S5 IDDE program requirements, S7 and Appendix 2 TMDL requirements, and S8 Monitoring and Assessment regional stormwater monitoring program activities.

New 2019 Permit conditions S8.A.1 and S8.B.1 require SAM contributions in the first year of the 2019 Permit by all Permittees who participated in those SAM components in the 2013 Permit. S8.A.1 and S.8.B.1 support the business practice of spreading SAM contributions over five years, lowering Permittees' annual contributions and helping the SAM Coordinator and PRO-C efficiently manage income and expenditures. This approach was presented in the informal draft Permit language that Ecology released for public comment in fall 2017; Ecology received no negative comments about this proposed payment or its timing. Permittees will be invoiced for this payment soon after the Permits are issued.

2019 Permit condition S8.A.2 is similar to the 2013 Permit condition S8.B.1 but adds new Permittees that became covered in the 2013 Permit, one Phase I Permittee and seven Phase II Permittees in Clark and Cowlitz Counties. Together they fund a Lower Columbia (LC) Urban Streams regional monitoring study that was developed during the 2013 Permit cycle and recommended by the LC stakeholders and Permittees, including WSDOT.

The 2013 Phase I Permit condition S8.B.2 is removed from the 2019 Permit. Clark County will be conducting the LC Urban Streams monitoring study in the 2019 Permit cycle. Stakeholders in the LC region came to agreement on a study design and implementation plan during the 2013 Permit. On March 30, 2018 Clark County sent a letter to Ecology expressing their intent to enter into a contract to conduct LC Urban Streams monitoring as a SAM project. Clark County's contracted work will begin in August 2020. New 2019 Permit conditions for Clark County include completing the "Quality Assurance Project Plan for Status and Trends Monitoring of Urban Streams in Clark and Cowlitz Counties in the Lower Columbia River Region – Template for Clark County, Lead Entity," including two interim submittals for specific QAPP sections, during the first year of the 2019 Permit and then, in the second and following years of the Permit, contributing to the cost-share account for LC Urban Streams, along with the seven Phase II LC Permittees. In the first year of the 2013 Permit, Phase I city and county Permittees in Puget Sound were required to contribute $15,000 each toward status and trends monitoring startup costs including QAPP writing as a transition from their stormwater discharge monitoring Permit requirements to the regional receiving water monitoring. The QAPP template for LC Urban Streams monitoring was largely completed during the 2013 Permit cycle with grant funding from Ecology, so completing the QAPP is expected to be a small (less than $15,000) effort. The QAPP template includes an approach for adaptively managing the study design as information is analyzed.

New 2019 Permit condition S8.B combines 2013 Permit conditions S8.C and S8.D. This approach was presented in the informal draft Permit language that Ecology released for public comment in fall 2017; the comments Ecology received were supportive of this approach.

As indicated above, the cost allocations for each Permittee have changed. In the 2013 Permit cycle the total cost-share amounts contributed annually by all participating Permittees (including WSDOT) was $892,176 for status and trends and $1,744,122 for effectiveness studies and source identification. The intent expressed in the informal draft Permit language Ecology shared in 2017 was to spread costs over five years rather than four, reducing the per-capita cost allocation. However, due to regional population increases, this approach represented a net increase in SAM funding over a five-year period. The SWG's and others' comments on the 2017 informal draft Permit language recommended keeping total SAM funding for the 2019 Permit cycle approximately the same as for 2013 Permit cycle.

After consideration of the comments on the 2017 informal draft language, the Ecology determined that an annual funding level of $750,000 ($0.1654 per person in Puget Sound) will adequately fund future rounds of SAM's Puget Sound receiving water monitoring and analyses; and that an annual funding level of twice that, or $1,500,000 ($0.3023 per person in western Washington permitted areas), for SAM's regional effectiveness studies and source identification will support approximately five new projects per year – a project management load that can be supported with the current SAM staffing levels. The LC Urban Streams cost allocation was set during the stakeholder process at $0.2442 per person (equal to the 2013 Permit per-capita cost allocation amount for the first round of Puget Sound receiving water studies), resulting in $136,466 per year for that study.

New Phase I Permit condition S8.B.2.c.ii is similar to 2013 condition S8.C.3 in the 2013 Permit. Phase I Permittees choosing this condition must submit a detailed proposal following the template provided by Ecology. The "SWMP Effectiveness Study Proposal and QAPP Template" includes specific instructions for the information and organization required to meet both S8.B.2.c.ii.(a) and S8.B.2.c.ii.(b). This template was adapted from a document developed under an Ecology Grant of Regional or Statewide Significance for selecting and finalizing the Eastern Washington effectiveness studies during the 2014 Permit. Ecology believes the use and application of this template will improve study designs and ultimately broaden the applicability of study findings to other Permittees.

New 2019 Permit condition S8.C requires Permittees who choose not to participate in SAM, via either or both S8.A and/or S8.B, to conduct stormwater discharge monitoring. S8.C replaces 2013 Phase I Permit condition S8.B.1.b and Phase II Permit condition S8.B.2 and 2013 Phase I and Phase II Permit condition S8.C.2. S8.C is similar to 2007 Phase I Permit condition S8.D and 2013 Phase I and Phase II Permit condition S8.C.2. The SWG's 2010 recommendation was that all Permittees be required to participate, but Ecology decided that the Permits should include an alternative option. In the 2013 Permit, one Phase I Permittee chose condition S8.C.2, one Phase I Permittee chose condition S8.B.1.b, and one Phase II Permittee chose condition S8.B.2. The 2013 Phase I and II Permits' alternative to participation in regional status and trends monitoring of receiving waters has been removed and replaced with this new condition. Implementation of 2013 Phase I Permit S8.B.1.b and Phase II Permit S8.B.2 was challenging for Permittees and required substantial additional project management by Ecology staff. Many of the streams sites were nested and therefore duplicative, and the sites provided a relatively insignificant contribution to the regional findings. Ecology decided that Permittees' local receiving water monitoring should be targeted to meet individual jurisdictions' needs and not diverted to geographically limited replications of the regional monitoring.

Compliance with monitoring requirements

Permittees who participated in SAM in the 2013 Permit and Permittees who choose to participate in SAM in the 2019 Permit must submit required payments to Ecology by the indicated due dates. Ecology will invoice Permittees three months in advance of each SAM payment due date. Receipts for each Permittee's annual payments into the SAM cost-share accounts are entered into PARIS by Ecology staff.

All Permittees must inform Ecology before the December 1, 2019 as to which option under each section S8.A and S8.B the Permittee chooses to implement for the remainder of the Permit. Each Permittee must choose only one option for the duration of the 2019 Permit. Timely annual payments into the SAM cost-share account(s) fully satisfy a Phase I or Phase II Permittee's obligations under S8.A.2.a and/or S8.B.2.a; and partially satisfies a Phase I Permittee's obligations under S8.B.2.c.

Ecology will administer the cost-share accounts and execute contracts to implement SAM projects under the oversight of the SWG and PRO-C. The status of SAM project implementation and production of monitoring data, related information, and other contract deliverables shall have no effect on any Permittee's compliance with this Permit.

Permittees who choose not to participate in SAM must fulfill the requirements of S8.C and Appendix 9. Phase I Permittees who choose S8.B.2.c must fulfill the additional requirements in S8.B.2.c.ii.

Other monitoring

Ecology believes that the responsibility for stormwater-related monitoring is shared among Permittees, the State, and the federal government. SAM does not, nor is it intended to, represent the total effort to collect meaningful information about stormwater impacts on receiving waters and effectiveness of stormwater management practices. Other local, State, and federal monitoring programs provide additional data, meaning, and context for SAM findings.

Participation in SAM does not fulfill a Permittee's requirement to conduct monitoring that may be required to implement the requirements of other sections of the Permits. SAM is not designed or intended to address locally-specific monitoring driven by illicit discharges, TMDLs, and other needs and priorities. Ecology recognizes that many individual jurisdictions invest a significant level of resources in these other types of monitoring both to implement these Permit-required activities and to otherwise inform their efforts to protect local water bodies.

The provisions of this Permit section meet Ecology's needs for adaptive management information and should be considered part of Permittees' stormwater management programs, as opposed to their monitoring programs. Some Permittees have asked Ecology to provide "credit" for their local monitoring activities in lieu of contributing funds for SAM receiving water monitoring, but the study designs and approaches to answer different questions at different scales are not scientifically compatible. To the extent that comparable methods are used for parameters common to SAM and local monitoring programs, the efforts can learn from – but not replace – each other.

Ecology has embraced the SWG formal stakeholder group recommendations for SAM's, collaborative regional approach to Permit-required monitoring to minimize the diversion of resources away from local monitoring efforts and to provide meaningful information as a benefit to all Permittees.

6.9 S9 - Reporting Requirements

Ecology proposes to retain the same timing for Annual Reports for the 2019-2024 Permit term, which is a report for the previous calendar year to be submitted by March 31. The first year Annual Report due by March 31, 2020 will cover the period from January 1, 2019, through December 31, 2019. Permittees will report on implementation of the continuing programs required by the 2013/2014 Permits and any new requirements due or implemented as required by the 2019 Permits.

6.9.1 Annual Report Appendices

Ecology applies the following list of objectives when developing the draft Annual Report appendices:

1. Track the compliance status of Permittees.
2. Gather information to improve Permits.

3. Identify needs for technical assistance.
4. Identify successful outcomes of program for the public.
5. Help Permittees coordinate internally.
6. Gather meaningful quantitative information statewide.

Because of the variation in requirements and implementation schedules, Ecology provides separate Annual Reports for cities, towns and counties that are continuing Permittees (Appendix 3) and those that are New Permittees (Phase II only, Appendix 5). The Annual Report for Secondary Permittees (Appendix 4) is intended both for continuing Secondary Permittees and for New Secondary Permittees, as the deadlines are tied to the initial Permit coverage date. The Phase I Permit also has an Annual Report for the Ports (Appendix 5).

The draft appendices include questions that Ecology intends to address using the six objectives listed above. The number of questions with numerical answers is reduced, although some remain as indicators of compliance and for reporting statewide outcomes. There are a few more questions requesting summaries of activities intended to provide information on meaningful successes and outcomes, needs for technical assistance, and opportunities to improve the Permits.

6.10 General Conditions

Ecology has revised General Condition G3 Notification of Discharge, Including Spills. This condition requires Permittees to notify the proper entities when there is knowledge of a discharge, including spills, into or from a MS4 which could constitute a threat to human health, welfare, or the environment. The revision proposed for G3 prepares for alternative reporting methods currently under development.

Follow-up actions responsive to a G3 report should be tracked by the Permittee and reported in the Annual Report per the requirements of Phase I: S5.C.9; W.WA Phase II: S5.C.5; and E.WA Phase II: S5.B.3.

6.11 Definitions and Acronyms

Ecology's revisions to the Definitions section of the Permits reflect objectives of improving consistency across the Municipal Stormwater General Permits, simplifying and clarifying language, and improving the accuracy of definitions of the terms as used in the Permits. Specific edits proposed to Definitions include the following types of changes:

1. Addition of terms and definitions new to the Permits.
2. Correction of a previous definition to match the use of the term in the Permits.
3. Edits for consistency with other NPDES stormwater general permits, or for consistency across all three Permits.

Ecology lists the proposed revised terms below according to the type of change.

6.11.1 Addition of terms and definitions new to the Permits.

6.11.2 Proposed changes to all three Permits

Overburdened Communities (added to all three Permits). Proposed definition:

Overburdened Communities means Minority, low-income, tribal, or indigenous populations or geographic locations in the United States that potentially experience disproportionate environmental harms and risks. This disproportionality can be as a result of greater vulnerability to environmental hazards, lack of opportunity for public participation, or other factors. Increased vulnerability may be attributable to an accumulation of negative or lack of positive environmental, health, economic, or social conditions within these populations or places. The term describes situations where multiple factors, including both environmental and socio-economic stressors, may act cumulatively to affect health and the environment and contribute to persistent environmental health disparities.

See Education and Outreach section for additional discussion. This term is from the USEPA Environmental Justice guidance[54]. Several early commenters recommended greater emphasis on inclusion of all our Washington communities in the education and outreach program.

6.11.3 Proposed changes to Eastern Washington

The proposed revisions to the following definitions bring consistency to all of the Municipal Stormwater Permits.

Conveyance system. Proposed definition:

Conveyance system means that portion of the municipal separate storm sewer system designed or used for conveying stormwater.

This proposal brings consistency to the definitions across all three Permits.

Discharge point. Proposed definition:

Discharge point means the location where a discharge leaves the Permittee's MS4 through the Permittee's MS4 facilities/BMPs designed to infiltrate.

This definition pertains specifically to facilities/BMPs designed to infiltrate that are owned or operated by the Permittee. Locations that inadvertently infiltrate are not included in this definition. In locations where Discharge Points overlap with other features that are required to be mapped (such as stormwater treatment and flow control BMPs/facilities) both features should be mapped and distinguishable - as Permit requirements relate to the features differently. For example, Discharge Point would be used for an infiltration BMP designed as a retrofit project, whereas a stormwater treatment and flow control BMP/facility is used to meet Minimum Requirements in Appendix 1 and has specific inspection and maintenance requirements contained elsewhere in the Permit. As a result, it will be important for O&M section compliance purposes to know where these latter features are located.

Receiving Waterbody or receiving waters. Proposed definition:

Receiving waterbody or *receiving waters* means naturally and/or reconstructed naturally occurring surface water bodies, such as creeks, streams, rivers, lakes, wetlands, estuaries, and marine waters, or ground water, to which a MS4 discharges.
Receiving waters is intended as a sub-set of waters of the state, no expansion of permit terms are created nor intended.

6.11.4 Correction of a previous definition to match the use of the term in the Permits.

6.11.5 Proposed changes to Western Washington

Stormwater treatment and flow control BMPs/ facilities. Proposed revised definition:

Stormwater Treatment and Flow Control BMPs/Facilities means detention facilities, **permanent** treatment BMPs/facilities; ***and*** bioretention, vegetated roofs, and permeable pavements that help meet minimum requirement #6 (treatment), #7 (flow control), or both.

The term *stormwater treatment and flow control BMPs/facilities* was added to the 2013 Permits' *Definitions* section. The 2007 Permits applied various terms to refer to stormwater facilities and BMPs, such as stormwater controls, structural BMPs, stormwater post-construction BMPs, and permanent stormwater treatment and flow control facilities. There was concern that the definition limited the mapping and O&M requirements for BMPs put in place that do not help to meet MR 6, or 7, or both which were required to be mapped and inspected/maintained under the 2007 Permit requirements. The proposed revision is intended to restore mapping and O&M requirements as detention and facilities and permanent treatment BMPs/facilities that were included under the 2007 Permit. The intent to limit the mapping and O&M requirements of permeable pavement, bioretention, and vegetated roofs to those that help to meet MR #6 and 7, or both, is maintained. From the 2011 Fact Sheet, which supports the 2013 Permits:

Although it applies to a broader set of BMPs and facilities, Ecology developed this term in part to clarify the extent to which low impact development (LID) is included in various SWMP minimum performance measures, including mapping. Ecology uses the term to distinguish certain low impact development (LID) BMPs and facilities that have been constructed to help meet treatment and flow control requirements in Appendix 1from those that do not. The draft Permit requires that the BMPs and facilities that help meet the treatment and flow control requirements must be mapped for maintenance purposes.

This term applies to requirements under mapping (PH I S5.C.2/ WWA PH II S5.C.4), and maintenance of post-construction runoff controls in (PH I S5.C.5/WWA PH II S5.C.6) as well as operations and maintenance in (PH I S5.C.10/WWA PH II S5.C.7).

Stormwater Action Monitoring (SAM). Proposed revised definition:

Stormwater Action Monitoring is the regional stormwater monitoring program for western Washington. This means, for all of western Washington, a stormwater-focused monitoring and assessment program consisting of: status and trends monitoring in small streams and marine nearshore areas, stormwater management program effectiveness studies, and source identification projects. The priorities and scope for SAM are set by a formal stakeholder group that selects the studies and oversees the program's administration.

Minor revisions to the definition used for Regional Stormwater Monitoring Program (RSMP) – RSMP was renamed to SAM in 2017.

6.11.6 Edits for consistency with other NPDES stormwater general permits, or for consistency across all three Permits.

6.11.7 Proposed changes to Eastern Washington

The proposed revisions bring more consistency to the terms used in all of the Municipal Stormwater Permits. Consistency in terms promotes better understanding when all share the same language.

Outfall — The proposed definition describes a discharge to surface waters only, instead of waters of the state. Proposed revised definition:

Outfall means a point source as defined by 40 CFR 122.2 at the point where a discharge leaves the Permittee's MS4 and enters a surface receiving waterbody or surface receiving waters. Outfall does not include pipes, tunnels, or other conveyances which connect segments of the same stream or other surface waters and are used to convey primarily surface waters (i.e., culverts).

New development. This proposal matches the SWMMEW and brings consistency to all three Permits. Proposed revised definition:

New development means land disturbing activities, including Class IV general forest practices that are conversions from timber land to other uses; structural development, including construction or installation of a building or other structure; creation of impervious surfaces; and subdivision, short subdivision and binding site plans, as defined and applied in Chapter 58.17 RCW. Projects meeting the definition of redevelopment shall not be considered new development

Redevelopment. This proposal matches the SWMMEW and brings consistency to all three Permits. Proposed revised definition:

Redevelopment means on a site that is already substantially developed, the replacement or improvement of impervious surfaces, including buildings and other structures, and replacement or improvement of impervious parking and road surfaces that is not part of a routine maintenance activity. (Any new impervious surfaces created by a redevelopment project are subject to the requirements for new development.)

6.12 Appendices

The appendices - where the content is similar or matches - are reordered for consistency across all three Permits. For examples, in the 2013/2014 Permits, all have an Annual Report for cities and counties, but in Phase I, this was appendix 12, in both the Phase II Permits it was appendix 3. Now the Annual Report for cities and counties is in all three Permits is appendix 3.

Table 3: Proposed order of Appendixes for 2019 Permits

	Phase I	W.WA Phase II	E.WA Phase II
APPENDIX 1.	Minimum Technical Requirements for New Development and Redevelopment		
APPENDIX 2.	Total Maximum Daily Load Requirements		
APPENDIX 3.	Annual Report Questions for Cities and Counties		
APPENDIX 4.	Annual Report Questions for Secondary Permittees		
APPENDIX 5	Annual Report Questions for the Port of Seattle and the Port of Tacoma	Annual Report Questions for New Permittees	
APPENDIX 6.	Street Waste Disposal		
APPENDIX 7.	Determining Construction Site Sediment Damage Potential		IDDE Reporting Data and Format
APPENDIX 8.	Businesses and Activities that are Potential Sources of Pollutants		
APPENDIX 9.	Stormwater Discharge Monitoring		
APPENDIX 10.	Equivalent Programs for Runoff Controls for New and Redevelopment and Construction Sites		
APPENDIX 11.	Annual contribution amounts for regional monitoring		
APPENDIX 12.	Structural Stormwater Controls Project List	IDDE Reporting Data and Format	
APPENDIX 13.	Adaptive Management Requirements		
APPENDIX 14	IDDE Reporting Data and Format		

6.12.1 Appendix 1 – Minimum Technical Requirements for New Development and Redevelopment

See additional discussion in section *Controlling Runoff from New Development, Redevelopment and Construction Sites*.

Appendix 1 is the same in the Western Washington Permits. Eastern Washington's minimum technical requirements are different from western Washington due to geographic and climatic differences in the regions.

6.12.2 Proposed changes to Eastern Washington Appendix 1

Ecology's general approach to changes for Appendix 1 is to simplify where appropriate, and to clarify and improve consistency with the Municipal Stormwater Permits, Construction Stormwater General Permit, and changes proposed in the Draft Stormwater Management Manual for Eastern Washington (released for public comment May 25, 2018-July 25, 2018). Several changes are proposed in the following sections.

Exemptions: Clarifications to Permit language is proposed. Including minor updates to clarify the commercial agriculture exemption and road and parking area preservation/ maintenance exemptions.

Core Element #2: The proposed language is updated to align with the 13 Elements as described in the current Construction Stormwater General Permit (CSWGP). The current CSWGP went into effect May 5, 2017.

No significant changes proposed.

6.12.3 Proposed changes to Western Washington Appendix 1

See additional discussion in section Controlling Runoff from New Development, Redevelopment and Construction Sites (PH I: S5.C.5; PH II: S5.C.6) of this Fact Sheet.

Proposed language for Appendix 1 includes those requirements, definitions, and thresholds that Ecology intends the Permittees to adopt into local codes or other enforceable documents and apply to new and redevelopment projects. Most of the proposed changes in Appendix 1 are to clarify the intent of the existing requirements. Ecology's goal for the updated language is improved implementation of the existing Permit requirements.

Text edits were made to refer to BMPs by the specific name and number within the SWMMWW, rather than by referring readers to sections within the SWMMWW. This is a more precise reference style.

While implementing these changes, Ecology also identified the following changes that must be made in order to continue to provide the best environmental protection available:

- **Continuous Simulation Modeling:** The proposed language is updated to be consistent with the latest and most accurate modeling available (e.g. using the 15-minute time step instead of the 1-hour time step).

- **Minimum Requirement (MR) 2:** The proposed language is updated to align with the 13 Elements as described in the current Construction Stormwater General Permit (CSWGP). The current CSWGP went into effect May 5, 2017.
- **MR 5:** The proposed language requires BMP T5.13 (Soil Quality and Depth) when choosing to use the LID Performance Standard to meet MR 5 for MR 1-5 projects. The 2014 SWMMWW text only required BMP T5.13 with the LID performance standard for MR 1-9 projects. Ecology considers this an important BMP essential to providing environmental protection and is proposing this revision to correct this oversight with this update.
- **MR 7:** The proposed language is updated to ensure that a TDA discharging to a marine waterbody meets all exemption requirements before it can be determined to be Flow Control exempt. This will ensure the same protection of waterways between the TDA discharge point and the marine waterbody as is provided with other types of exempt waterbodies.

Section 1: Exemptions

Minor changes to clarify the language.

Specifically, in the “Pavement Maintenance” subheading, edits were made to simply define the type of surface, and then direct readers to the thresholds in Section 3. Ecology found through user feedback that the previous text, which stated which MRs applied for those surfaces, was not as clear.

Section 2: Definitions

Minor changes for consistency with the SWMMWW.

The following definitions were updated by more than minor text edits:

New impervious surface (new definition)

A surface that is:

- changed from a pervious surface to an impervious surface (e.g. resurfacing by upgrading from dirt to gravel, asphalt, or concrete), or
- upgraded from gravel to asphalt or concrete, or
- upgraded from a bituminous surface treatment (“chip seal”) to asphalt or concrete.

This definition already existed in the “Pavement Maintenance” subheading from Section 1. Ecology found through user feedback that this term is often misunderstood, and has added it to the glossary to aid in finding this definition.

Threshold Discharge Area (figure updated)

Ecology has updated the figure that accompanies this unchanged definition. The updated figure adds clarity for TDA delineation on roadway or other long linear projects.

Vehicular Use (updated)

Ecology updated this definition to state that “sidewalks not subject to drainage from roads for motor vehicles” are not subject to vehicular use.

Section 3: Applicability of the Minimum Requirements

Subheading 3.5 was determined to be redundant and removed. After detailed review, Ecology concluded that the information provided in subheading 3.5 was repetitive to the information provided more prominently in Section 7. The information was consolidated into Section 7.

Additional changes for clarity include:

- Subheading updated from “Thresholds” to “Minimum Requirement Thresholds”.
- Subheadings 3.2 and 3.3 were updated to clarify that they are discussing PROJECT Thresholds, as opposed to the TDA thresholds that are discussed in MRs 6 and 7.
- In subheading 3.3, the text was revised text from “project limits” to “same site” to use a term that is defined and has the same meaning.
- In subheading 3.4, the text was updated to refer to the “Site”. The definition of “Site” already matches what was described in the text.

Section 4: Minimum Requirements

Minimum Requirement #1

No changes.

Minimum Requirement #2

The proposed language is updated to align with the 13 Elements as described in the current Construction Stormwater General Permit (CSWGP). The current CSWGP went into effect May 5, 2017.

Text in Element 6 and Element 8 was revised to reflect modeling using the latest continuous simulation modeling software, specifically the use of 15 minute time steps rather than the results from a one hour time step increased by a factor of 1.6.

Additional specific edits for clarity include:

- Revised text to use the full/correct name of the CSWGP.
- Revised subheading as “Project” Thresholds to clarify that these are thresholds determined at the project level, not at the TDA level like MRs 6 and 7.
- Revised text to consistently refer to “Construction SWPPP” and “Construction SWPPP Elements.”
- Element 9d: removed "such as a closed loop recirculation or upland application." Neither of these are an on-site treatment system, which is referenced in the first half of the sentence.

- Element 9f: identified recycled concrete stockpiles as a source of contamination by pH modifying sources.
- Element 9i: added food grade vinegar as an option to adjust pH.
- Element 13a: updated to clarify that the element applies to all LID BMPs, not just bioretention and rain gardens.
- Element 13b: updated to apply to all LID BMPs that infiltrate.

Minimum Requirement #3

No changes.

Minimum Requirement #4

No changes.

Minimum Requirement #5

The proposed language requires BMP T5.13 (Soil Quality and Depth) when choosing to use the LID Performance Standard to meet MR 5 for MR 1-5 projects. The 2014 SWMMWW text only required BMP T5.13 with the LID performance standard for MR1-9 projects. BMP T5.13 may be feasible for projects applying MR 1-5 and must be considered. Ecology is proposing to correct this oversight with this update.

Additional specific edits for clarity include:

- Removed subheading title "Applicability" while maintaining the content of that section. MRs 5, 7, and 8 were the only ones with this subheading, although all the MRs had similar text.
- Removed "on-site" in the introduction– if using the LID performance standard, BMPs may not be "on site" (LID) BMPs.
- Removed "project" in the introduction – text revised to the more general term "thresholds" since the thresholds, as explained further in the text, relate to multiple things (project, parcel, etc.). This changes makes the introductory text more consistent between MRs 5, 6, 7, and 8.
- Proposed text clarifies what Ecology means by a Flow Control exempt project, as opposed to a Flow Control exempt TDA described in MR 7.
- Ecology revised the structure of this MR for clarity. Revisions include clear subheading titles, three project types (MR1-5, MR1-9, and Flow Control Exempt), new subheadings for the two compliance methods (the List Approach and the LID Performance Standard), and a List #3 for Flow Control exempt projects. List 3 is not new, it was previously descried within the text of MR 5 and has been restructured to be included as a list. The lists are now presented in a table format.

Minimum Requirement #6

Specific edits for clarity include:

- Added an introduction statement for consistency in layout with the other MRs.
- Revised the subheading from "Project Thresholds" to "TDA Thresholds" to be more precise with the Threshold language within this MR. The MR had relied on TDA Thresholds in the last permit cycle, but the title did not reflect that. Further, this seeks to eliminate confusion with the "Project Thresholds" identified in Section 3.
- Added introduction text within the TDA Thresholds subheading to clarify the steps needed to determine the requirements for each TDA. This text matches text from MRs 7 and 8.
- Updated the existing text within the TDA Thresholds subheading for clarity.
- Revised subheading to "Runoff Treatment Performance Goal Thresholds" for consistency with terms.
- Updated the Runoff Treatment Performance Goal Thresholds text for consistency with the SWMMWW. This text was created based on existing text from 2 places in the manual and the Permit. The language was merged so that it is consistent in both documents.
- Runoff Treatment Performance Goal Thresholds: Basic Treatment – removed text saying that basic treatment is not needed if infiltrating through soils that meet the soil suitability for infiltration treatment, because infiltrating through appropriate soil and subsurface conditions meet Basic Treatment.
- Runoff Treatment BMP Sizing – subheading name updated for consistency in terms.
- Runoff Treatment BMP Sizing –paragraph added to introduce the concept that Runoff Treatment BMPs are sized by either a volume or flow rate, depending on the BMP.
- Term changed from "water quality design storm volume" to "water quality design volume". The volume is not tied to a specific storm, but ensuring that a percentage of the runoff file gets treatment. This better matches the term "water quality design flow rate."
- The Water Quality Design Volume language was updated to more clearly define the two ways Ecology allows the volume to be calculated.
- The Water Quality Design Flow Rate text was updated for consistency in terms and clarity.
- Additional Requirements – removed second half of sentence saying that untreated stormwater may be infiltrated through soils that meet the soil suitability for infiltration treatment. As noted above, this is a circular statement, because by infiltrating through soils that meet the soil suitability for infiltration treatment, you are getting Runoff Treatment.

Minimum Requirement #7

The proposed language is updated to ensure that a TDA discharging to a marine waterbody meets all exemption requirements before it can be determined to be Flow Control exempt. This will ensure the same protection of waterways between the TDA discharge point and the marine water body as is provided with other types of exempt waterbodies.

The proposed language is updated to require the approved continuous runoff model for the 2019-2024 Permit cycle. Specifically, text in the TDA Thresholds subheading was revised to eliminate the option of using a threshold of a 0.10 cfs increase using a one hour time step. The approved continuous runoff model uses the other existing threshold that allows a 0.15 cfs increase with 15 minute time steps.

Additional specific edits for clarity include:

- Removed “Applicability” subheading for consistency with other MRs. Updated intro text for consistency with other MRs.
- Added subheading for TDA Exemption. Minor revisions to TDA exemptions text for clarity.
- Removed text “If the discharge is to a stream that leads to a wetland, or to a wetland that has an outflow to a stream, both this minimum requirement (Minimum Requirement #7) and Minimum Requirement #8 apply.” This text was in the exemption subheading, and it is not an exemption. Also, it is giving direction for MR8, which is not appropriate in MR7.
- Changed subheading “thresholds” to “TDA Thresholds” to eliminate confusion with the “Project Thresholds” identified in Section 3.
- Added introduction text within the TDA Thresholds subheading to clarify the steps needed to determine the requirements for each TDA. This text matches text from MRs 6 and 8.
- Updated existing TDA Thresholds text for clarity.
- Removed text from footer and added it to main text, stating that the 0.15 cfs increase should be from existing condition, not historic/forested. Many users missed this text when it was in the footer.
- Updated heading to “Flow Control Performance Standard” – this creates consistent style with MR5’s “LID Performance Standard”.
- Changed “available” to “provided” – the project proponent must provide the info described.
- Changed “WWHM” to “approved continuous simulation model” – Ecology does not want to name specific models. Ecology will name the specific approved models within the SWMMWW.
- Removed text saying the performance standard is waived for sites that infiltrate all runoff – it is circular. The requirement isn’t waived, it is met.

Subheading updated to “Alternative Flow Control Performance Standard” for consistency in terms.

Minimum Requirement #8

Specific edits for clarity include:

- Removed “Applicability” subheading, while maintaining the content. Updated intro text for consistency with other MRs.
- Revised the subheading from “Project Thresholds” to “TDA Thresholds” to eliminate confusion with the “Project Thresholds” identified in Section 3.

Minimum Requirement #9

No changes.

Sections 5: Adjustments

No changes.

Sections 6: Exceptions/Variances

No changes.

Section 7 – Altering the Minimum Requirements with Basin Plans

Specific edits for clarity include:

- Revising the section title from “Basin/Watershed Planning” to “Altering the Minimum Requirements with Basin Plans.” This was done while consolidating the information from Section 3.5 into this Section 7.
- Text edits for clarity and consolidation with Section 3.5 from the previous Permit.

6.12.4 Appendix 2 – Total Maximum Daily Load Requirements

See discussion of Special Condition S7 *Total Maximum Daily Load Requirements*.

6.12.5 Appendix 3 – Annual Report Questions for County, Town and City Permittees

See discussion of Special Condition S9 *Reporting Requirements*. Annual Report questions for cities and counties was Appendix 12 in the 2013 Phase I Permit.

6.12.6 Appendix 4 – Phase II Only - Annual Report Questions for Secondary Permittees

See discussion of Special Condition S9 Reporting Requirements.

6.12.7 Appendix 5 - Phase II Annual Report Form for New Permittees (Eastern and Western Washington)

This Annual Report form was Appendix 8 in the 2013 W.WA Phase II Permit. This is new for the E.WA Phase II Permit. See discussion of Special Condition S9 Reporting Requirements.

Appendix 5 used to hold the Notice of Intent form. This form will be available online at Ecology's website. Starting on December 21, 2020, Ecology must follow EPA's electronic reporting rule and accept electronic Permit applications in order to provide the required reports to EPA. The paper application found in Appendix 5 of the 2013/2014 Permits will be converted to an electronic application, similar to the electronic Annual Report process.

6.12.8 Appendix 5 - Phase I Only – Annual Report Questions the Port of Seattle and the Port of Tacoma

This was Appendix 3 of the 2013 Phase I Permit. See discussion of Special Condition **Error! Reference source not found.**.

6.12.9 Appendix 6– Street Waste Disposal

No changes proposed for Appendix 6.

6.12.10 Appendix 7 – E.WA Phase II only - IDDE Reporting Data and Format

This appendix is provided in all three Permits, but with different appendix numbers. Ecology may remove this appendix when the WQWebIDDE is completed, prior to issuance of the Permits. It is included to document the information required to submit as well as the format for the Annual Report submittal, as described in the IDDE section.

6.12.11 Appendix 7 – Western Washington only - Determining Construction Site Sediment Damage Potential

No changes proposed for Appendix 7.

6.12.12 Appendix 8 – Western Washington only - Businesses and Activities that are Potential Sources of Pollutants

This appendix has been updated to reference NAICs industry supersector codes. The crossover from the '87 SIC major group numbers to the 2017 NAICs supersector group numbers isn't exact, however Ecology is only using these groups as a general description of the types of businesses that should be inspected under S.5.C.8 in both the Phase I and Phase II Permits. Group descriptions have also been updated to more closely align with NAICs industry supersector groups listed on the Bureau of Labor Statistics website[55]. It is a new appendix for the W.WA Phase II Permit.

6.12.13 Appendix 9 - Western Washington only – Stormwater Discharge Monitoring

This section in both the Phase I and Phase II Permits defines the approach for meeting individual stormwater discharge monitoring requirements for Permittees in western Washington who choose not to participate in SAM, the regional stormwater monitoring program. See fact sheet language for S8. Monitoring and Assessment for more information.

Changes from the 2013 Permits:

This appendix was updated to reflect changes in laboratory methods and to cite the updated references for the standard protocols that were developed in 2009 to ensure consistent and quality implementation of the monitoring. Based on lessons learned during prior monitoring, flexibility was granted for each Permittee to identify the appropriate antecedent dry period condition for their local conditions.

Based on Ecology's analysis of the Phase I discharge monitoring data collected for the 2007 Permit, these poorly performing and/or very rarely detected parameters have been removed from the required stormwater sample collection and analyses: mercury, toxicity (WET), 2,4-D, carbaryl, chlorpyrifos, NWTPH gas-fraction, and BTEX (benzene, toluene, ethyl-benzene, and xylene).

Ecology has continued to review scientific study findings and has determined that the following new parameters should be added to the in-line stormwater solids screening: dichlobenil, phenolics, phthalates, polybrominated diphenyl ethers (PBDEs), and a lower resolution method for PCBs.

6.12.14 Appendix 10 – Western Washington only - Equivalent Programs for Runoff Controls for New and Redevelopment and Construction Sites

The draft Permits require Permittees to continue to implement the ongoing programs established during the current (2013) Permit term. Permittees would be required to modify the local program by the deadline proposed for adoption and implementation of the draft revisions to Appendix 1. Appendix 10 describes the needed changes to a local program adopted under the 2013 Permits. Appendix 10 is new for WWA Phase II and lists the significant changes to Appendix 1. Phase II Permittees are not required to submit their local programs to Ecology for review and approval. Phase I Permittees are required to submit their local programs to ensure equivalency with Appendix 1 and the SWMMWW.

In the Phase I Permit, Appendix 10 has three Parts.

- Part 1 - lists of Ecology-approved local programs that meet the requirements for controlling runoff.
- Part 2 **–** lists the significant changes to Appendix 1.
- Part 3 **–** is the placeholder section which will list the local programs approved to meet the 2019 (or Part 2) local program requirements.

Because there are so few changes, Ecology created a streamlined Appendix 1 and manual equivalency process for Phase I as described below.

There were three main categories of changes that were considered enhancements that are required to be included in the 2019-2024 stormwater programs to be equivalent with Ecology's Appendix 1/SWMMEW update:

1. Adjustments to align with the Construction Stormwater General Permit (CSWGP),
2. Incorporation of an updated continuous runoff model that is more suitable to LID implementation, and
3. Updating the requirement for sites only subject to Minimum Requirements #1-5 choosing the LID Performance Standard to include Soil Quality and depth (BMP T5.13).

The focus of the required changes were where those changes were critical to ensuring that the practices put in place would provide an advancement in the level of protection provided equivalent to the 2019-2024 Permits and 2019 SWMMWW. Below are some examples where the new language is recommended, but not required to ensure equivalency.

Some construction BMPs that can be used to meet Minimum Requirement #2, were edited and some new BMPs were added in the 2019 SWMMWW. The 2019 SWMMWW BMPs may be useful to projects with compatible activities but are not required to ensure that a municipality complies with Minimum Requirement #2. The 2014 guidance is still valid and should result in the same level of protection.

There were also changes and additions to the Source Control BMPs within the 2019 SWMMWW, used to satisfy Minimum Requirement #3. Some of these additions provide guidance targeted to categories of pollutant sources not similarly categorized in the 2014 SWMMWW. While those pollutant sources were not similarly categorized in the 2014 SWMMWW, Ecology expects that the same level of source control can be attained using the information within similar categories within the 2014 SWMMWW.

In contrast, Minimum Requirements 5, 6, 7 and 8 in Appendix 1 of the Permits rely on the approved continuous runoff model to ensure the level of protection described. Ecology's enhancement for the 2019-2024 Permit cycle uses considering models that employ Ecology's approved LID algorithms and the accompanying 15-minute time step. These changes impact how the Minimum Requirements will be met and this change is required to ensure an equivalent program. The table in Appendix 10 indicates where those changes need to be made.

The 2014 SWMMWW has several reference to a 1-hour continuous runoff model option. The references do not need to be deleted since the approved model does not use that time step, so the option will simply not be used. Jurisdictions may choose to update their guidance to avoid confusion, but have recourse within the added enhancements (as shown in the table above) to indicate that the approved continuous runoff model only uses the 15-minute time step.

6.12.15 Appendix 11 – Western Washington only - Annual Contribution Amounts for Regional Monitoring

This new section in both the Phase I and W. WA Phase II 2019 Permits defines cost-share account contribution amounts required by Permittees in western Washington and WSDOT who choose to participate in SAM, the regional stormwater monitoring program. This appendix replaces the tables that were included in S8.B and S8.C and S8.D in the 2013 Permits. See fact sheet language for S8. Monitoring and Assessment for more information.

6.12.16 Appendix 12 – W.WA Phase II only - IDDE Reporting Data and Format

This appendix is provided in all three Permits, but with different appendix numbers. Ecology may remove this appendix when the WQWebIDDE is completed, prior to issuance of the Permits. It is included to document the information required to submit as well as the format for the Annual Report submittal, as described in the IDDE section.

6.12.17 Appendix 12 - Phase I only - Structural Stormwater Controls Project List

For general information about Appendix 12 see SSC section of this Fact Sheet. This was Appendix 11 in the 2013 Phase I Permit. The appendices in the Permits were reordered to align the Permits more consistently.

Ecology requires Permittees to include an updated list of planned individual projects scheduled for implementation during the term of the Permit with their Annual Reports. The proposed Appendix 11 provides a standardized reporting format that allows for transparent benefit and incentive point calculations and limited project details, such as costs and funding sources.

Ecology intends the SSC Program's defined level of effort as reflected in Retrofit Incentive Points to achieve the following goals:

- Allow for comparisons of runoff treatment and hydrological benefits. Benefits from LID BMPs are quantified for hydrological benefit separately from flow control facilities.
- Allow for comparisons of project types across jurisdictional landscapes. This acknowledges that Washington's Phase I Permittees consist of cities and unincorporated counties.
- Provide a standardized means to quantify the benefits each project and each jurisdiction achieves.
- Count the following types of projects within the structural controls requirement:
    - Regional facilities that provide hydrologic or treatment benefit for existing MS4 discharges that is not otherwise required. Regional facilities that do not have a system to credit new development and redevelopment projects will fully qualify. Regional facilities that provide for use of fee-in-lieu, minimum technical requirement transfer, or other new/redevelopment-benefitting program, only partially qualify under the SSC Program; the portion of the regional facility that is preserved to address existing MS4 service area (such as roadways) may be counted in the SSC program.
    - The retrofit of existing MS4 runoff by providing additional hydrologic or treatment capacity in a stormwater facility being constructed as part of a new or redevelopment project (i.e. those required under a development project approval but also providing additional new treatment or flow control). The portion of the project serving the existing area, not otherwise required to be addressed, will qualify for the SSC Program.
    - Projects not directly related to stormwater (i.e. not driven by stormwater capital planning) but providing stormwater benefits. This includes forest protection (i.e., acquisition), forest conservation easements, forest cover restoration, and riparian buffer restoration.
    - Operations and maintenance projects with large capital construction costs and projects that go beyond Permit O&M requirements (ex. whole system pipeline cleaning, or intensive facility maintenance/upgrades).
    - Source control work that goes beyond source control Permit requirements.

6.12.18 Appendix 13 – Phase I only- Adaptive Management Requirements

Appendix 13 was added to the Phase I Permit during the Permit modification in 2016. The appendix incorporates requirements in response to a significant long-term MS4 adaptive management response effort under Special Condition S4.F.3. Appendix 13 is applicable to one Permittee: the City of Seattle. Ecology expects that in the future, as additional significant adaptive management response plans applying to other municipal stormwater Permittees and/or other geographic areas are developed, they will become incorporated into Appendix 13 of the Phase I Permit, or similar Municipal Stormwater Permit appendices, as appropriate.

The proposed Appendix 13 contains requirements specific to the City of Seattle's MS4 discharges to the Lower Duwamish Waterway (LDW) in accordance with Special Condition S4.F.3. The City of Seattle has developed a comprehensive Source Control Implementation Plan (SCIP) to control sources of sediment pollution in the LDW to support the pending sediment Superfund cleanup. Ongoing relevant and applicable aspects of the SCIP are municipal stormwater adaptive management response actions described in Appendix 13 of the Permit. This Permit also includes the requirement to submit a SCIP update to reflect an updated assessment of data and priorities, and identify additional projects for the 2021 – 2026 timeframe.

6.12.19 Appendix 14 – Phase I only – IDDE reporting data and format

This appendix is provided in all three Permits, but with different appendix numbers. Ecology may remove this appendix when the WQWebIDDE is completed, prior to issuance of the Permits. It is included to document the information required to submit as well as the format for the Annual Report submittal, as described in the IDDE section.

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Appendix A: Citation List

This citation list contains references for data, factual information, studies, or reports on which the agency relied (RCW 34.05.370(f)).

At the end of each citation is a number in brackets identifying which of the citation categories below the sources of information belongs. (RCW 34.05.272). These are the same citations as the end notes used above, but this list includes the citation category.

Citation Categories	
1	Peer review is overseen by an independent third party.
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11	Sources of information that do not fit into one of the other categories listed.

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Control of Toxic Chemicals in Puget Sound

Phase 3 Data and Load Estimates

Publication No. 11-03-010

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Toxics in Surface Runoff to Puget Sound

Phase 3 Data and Load Estimates

by

Herrera Environmental Consultants, Inc.
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121

under contract to

Environmental Assessment Program
Washington State Department of Ecology
Olympia, Washington 98504-7710

April 2011

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Abstract

The Washington State Department of Ecology identified surface runoff as the most significant contributor of toxic chemicals to Puget Sound during earlier phases of the Puget Sound Toxics Loading Analysis. The objectives of the current study were to refine previous estimates of contaminant load contributions to Puget Sound via surface runoff by monitoring contaminant concentrations and discharge from four land uses: commercial/industrial, residential, agricultural, and forest/field/other. The relative loading contribution from each of the uses was then calculated based on the data collected.

From August 2009 through July 2010, water samples were collected from 16 streams in the Puyallup and Snohomish watersheds during two baseflow events and six storm events. Each stream received surface runoff primarily originating from one of the four land uses. Samples were analyzed for an extensive list of organic compounds, heavy metals, and conventional water quality parameters.

The majority of the chemicals analyzed were detected more frequently and at higher concentrations during storm events than baseflow conditions among all land uses. Contaminant concentrations and area-normalized loading rates were generally higher in the commercial/industrial basins and lower in the forested basins than the other land-use categories for both flow conditions. The fall storm had the highest incidence of oil and grease, TPH lube oil, triclopyr, and other parameters.

At the Puget Sound scale, the relative contaminant loading was strongly influenced by the relative amount of land area, rather than contaminant concentration; consequently, forested lands contributed the highest loads for most contaminants. Total loading rates were similar among the residential and agricultural areas even though residential land area was greater than agricultural in both study watersheds. However, Puget Sound may not be the most sensitive water body, and developed land uses likely influence conditions in smaller streams in the urban corridor.

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Executive Summary

Introduction

The primary objective of this 2009-10 study was to refine estimates of toxic chemical loadings from surface runoff in the Puget Sound basin. In this study, "surface runoff" is broadly defined to include stormwater, nonpoint source overland flow, and groundwater discharge to surface waters that flow to Puget Sound.

Beginning in 2006, the Washington Department of Ecology has been conducting studies to quantify the amount and to identify the primary sources of toxic chemicals in the Puget Sound ecosystem. Each successive study (Phase) improved upon the estimates of previous studies by including additional potential contaminant sources (i.e., land uses), or by increasing the number of parameters analyzed, or the sensitivity of analysis methods. Phase 1 and Phase 2 studies relied on existing data from literature sources. These two phases identified surface runoff as the primary source of toxic chemicals to Puget Sound relative to wastewater treatment plants, groundwater, spills, combined sewer overflows, and atmospheric deposition.

The current study is part of Phase 3. This study improves upon the Phase 1 and 2 loading estimates and advances understanding of the timing and sources of contaminant loading in the Puget Sound ecosystem by collecting and analyzing new local data on:

- Concentrations of toxic chemicals in 16 streams receiving surface runoff during storm events and periods between storms (baseflow).
- Concentrations of toxic chemicals associated with four specific land-use types: commercial/industrial, residential, agricultural, and forest/field/other (forest).
- Relative contributions of toxic chemicals in surface runoff (based on loadings) from the four major land-uses identified above.

The project team consulted with external experts to develop and apply the calculation methodology.

Methods

Monitoring occurred in the Snohomish and Puyallup watersheds. These watersheds were selected because they contain all four land uses and span the geography of Puget Sound watersheds. The project team collected surface-runoff samples from eight streams in the Snohomish River watershed (Figure E-1), and eight streams in the Puyallup River watershed (Figure E-2). Two subbasins within each watershed were selected to represent each land use. Each site was sampled six times during storm events and twice during dry periods for a total of 126 samples[1] collected between October 2009 and July 2010. The study also recorded continuous flows from August 2009 through July 2010. Storm events were defined as a

[1] Two sites were dry during one baseflow event.

minimum of 0.25 inches of precipitation in 24 hours and an antecedent dry period of 12 hours to characterize fall, winter, and spring storm events. Baseflow events were captured based on precipitation and stream hydrograph patterns. The monitoring period was wetter than average, particularly the months of October, November, April, May, and June.

Samples were analyzed for the following classes of toxic chemicals, using methods that yielded significantly lower detection limits than have been typically reported in previous studies:

- Polycyclic aromatic hydrocarbons (PAHs)
- Phthalates
- Base/neutral/acid (BNA) extractable compounds (semi-volatile organic compounds)
- Pesticides
- Herbicides
- Polybrominated diphenyl ethers (PBDEs)
- Polychlorinated biphenyls (PCBs)
- Metals
- Petroleum hydrocarbons
- Oil and grease
- Conventional parameters (hardness, nutrients, solids, and field parameters)

The study applied several rules in calculating pollutant loading. Non-detected values were replaced with a value of one-half the reporting limit. When greater than 50 percent of the data were non-detects, we flagged the computed loading rates as estimates. Finally, when all the data were non-detect values, we computed loading rates based on the maximum reporting limit from the data. These loading rates were then qualified with a less than (<) sign.

Summary statistics focus on the 25th and 75th percentiles to communicate uncertainty. Analyses include land use-based concentrations and loads, as well as load estimates at the watershed (Snohomish or Puyallup) and Puget Sound scales. Loads were extrapolated from the 16 monitoring locations to the watershed and Puget Sound scales based on unit-area loads. An alternative extrapolation method was evaluated that uses concentrations from this study multiplied by precipitation-based runoff. However, unit-area loads were selected for extrapolation because concentration-based loads would overestimate forested land contributions. In addition to loading analyses, principal components analysis was performed on land use-based concentrations in order to distinguish patterns in the data.

Results

Rigorous quality assurance protocols were followed in the field and in laboratory analyses. Lab quality assurance data were evaluated closely. Data met the project data quality objectives or were flagged as estimates where appropriate. A limited number of results were rejected, ranging from <1 to 5 percent of samples by parameter class. Stream gauging data for several locations were flagged as estimates with overall errors ranging from 12 to 50 percent.

Detection frequency varied by parameter class, land use, and event type (storms and baseflow). Overall, metals and conventional pollutants were detected in nearly all samples. PCBs and

PBDEs were detected in a majority of samples; however, only a few individual congeners from each of these classes were routinely detected. PAHs, phthalates, BNA extractable compounds, pesticides, herbicides, and petroleum hydrocarbons in the gasoline or diesel fraction were rarely detected or not detected at all in the analyzed samples. Detection frequency was highest in commercial/industrial subbasins and lowest in forest/field/other subbasins for most parameters, although exceptions occurred. Storm events had higher detection frequencies than baseflow events.

The PCA analysis assessed the concentration data structure of the 21 priority parameters as a function of land use. The analysis indicated that during storm events, the forested land uses and commercial land uses were chemically distinct from each other and the other land use types. Forested land uses were characterized by lower concentrations of nitrate+nitrite nitrogen, total phosphorus, total mercury, total arsenic, total copper, and total suspended solids. The commercial basins were characterized by relatively high concentrations of total PCBs, total zinc, total lead, and total PBDEs. Residential and agricultural basins had similar chemical signatures and generally exhibited higher concentrations than forested basins and lower concentrations than commercial basins. During baseflow conditions, the differences among the land uses were less pronounced, but in general followed the same pattern as in the storm-event PCA analysis.

At the subbasin scale, loading rates of toxic chemicals were substantially higher for storm events than baseflow. Figures E-3 and E-4 provide examples of this phenomenon for total copper and oil and grease, respectively. Rain-induced surface runoff during storm events resulted in higher measured streamflow rates. Higher flow rates coupled with increased chemical concentrations resulted in substantially higher loading rates for storm events than baseflow. This suggests that the greatest opportunity for toxic chemicals to be transported to Puget Sound and its fresh waters occurs during storm events.

Organic pollutants and metals were generally detected more frequently and at higher concentrations in the commercial/industrial basins compared to the other land uses. Total copper and oil and grease data are presented in Figures E-5 and E-6, respectively, as examples of this pattern in the dataset as a whole. Metals were occasionally detected more frequently and at higher concentrations in the agricultural subbasins. Agricultural subbasins also had higher concentrations of some nutrients. Except for metals and nutrients, contaminant concentrations were generally similar between the residential and agricultural land-use types. Contaminants were detected least frequently in the forested areas, and when they were detected, they were generally at substantially lower concentrations than any of the other land uses. In general, unit-area loading rates[2] for the four land-use types matched the same pattern that was observed for concentration patterns.

Stormwater runoff, particularly from commercial/industrial subbasins, did not meet water quality criteria or human health criteria for several parameters. These include dissolved copper, lead, and zinc; total mercury; total PCBs; bis(2-ethylhexyl) phthalate; several carcinogenic PAHs; and one pesticide.

[2] i.e., the quantity of a toxic chemical generated from a defined area (e.g., kilogram per square kilometer per year).

Loads at the Puget Sound scale are dominated by contributions from forested lands, which cover 83 percent of the land area tributary to Puget Sound and the Straits of Georgia and Juan de Fuca within Washington State. However, forested lands had the lowest frequency of detection of the four land uses studied. Therefore, the load estimates expressed by the 25th to 75th percentiles are strongly influenced by how non-detects were treated. Conversely, the commercial/industrial land uses contributed a smaller amount of contaminants at the Puget Sound scale than the residential or agricultural land uses. The contaminant concentrations in the commercial/ industrial areas were much higher, but they comprise a relatively small portion of the total watershed area. The watershed-scale (Table E-1) and Puget Sound-wide (Table E-2) total loading estimates by land use for total copper and oil and grease provide examples of this pattern in the dataset.

The study confirmed several land use-based and event-based patterns in the concentration data and load estimates:

- The detection frequency for each of the chemical classes was generally higher for samples collected during storm events than those collected in baseflow conditions. Likewise, the magnitude of concentrations for each chemical class was higher during storm events.
- Contaminants were generally detected more frequently and at higher concentrations in the commercial/industrial basins compared to the other land uses.
- Agricultural and residential stormwater also contained higher concentrations of many toxic chemicals than stormwater from forested lands.
- The fall storm generally had the highest incidence of oil and grease, lube oil total petroleum hydrocarbons, triclopyr, and other contaminants.
- At the Puget Sound scale, relative loads for most parameters were proportional to the relative areas covered by each land use.

Discussion

In this Phase 3 study, the use of newly collected data with much lower detection limits and a refined calculation approach resulted in improved overall loading estimates for toxic chemicals relative to the Phase 1 and 2 studies. However, several estimates were strongly influenced by how non-detects are factored into the load estimates, particularly given the high absolute loads from forested lands. The total loading rates from the Phase 3 study were lower than rates from the Phase 2 study for PCBs, copper, zinc, and oil and grease. Of these four parameters, the most substantial difference between the two studies was observed for total PCBs. Total loading rate for total PCBs from the Phase 3 study was over an order of magnitude lower than the rate from the Phase 2 study. In contrast, total PBDEs was the only parameter to have higher total loading rates from the Phase 3 study relative to Phase 2. These loads mirror the patterns in the concentration data collected in Phase 3 compared with the literature-based concentration data used to generate the Phases 1 and 2 loads.

Loading estimates from the Phase 3 study were likely lower because the Phase 2 study used literature sources of data from both stormwater conveyance systems and instream samples.

Phase 3 loading estimates were based on data collected only from streams, where concentrations are expected to be lower due to attenuation, degradation, deposition, or dilution. This will underestimate loads in areas that discharge directly to Puget Sound through stormwater conveyance systems. For those regions, conveyance system data will be more appropriate for estimating loads, but this was beyond the scope of this study.

Beyond the earlier phases, no other study has quantified loads for so many constituents at the Puget Sound scale. However, a recent study that focused on four land uses in the Green-Duwamish River watershed found similar unit-area loads as the current study. The most recent phase of the Puget Sound Basin National Water Quality Assessment (NAWQA) study found pesticides, herbicides, and insecticides in urban streams.

While the Phase 3 study was designed to minimize bias, several factors may have produced overestimates or underestimates of loads at various scales. Factors possibly leading to overestimates include instream processes and selection of forested basins close to population centers. Factors possibly leading to underestimates include land cover heterogeneity, particularly for commercial/industrial; residential characterized low density only; use of stream data to characterize lands discharging through conveyance systems; and under sampling fall storms. Other factors could produce either overestimates or underestimates, including use of grab samples, legacy contaminants, and the much smaller proportion of forested lands in the Puget Sound watershed characterized by the four forested subbasins

Total contaminant load to Puget Sound is not the only scale of importance. Given that the highest concentrations and unit-area loads were found in stormwater from the most highly developed land uses, controls may be needed to address levels that could be found in small streams in the urban corridor. In addition, while instream data were used to estimate loads by different land uses and at different spatial scales, these data may not represent stormwater that discharges to marine (salt) waters or near marine waters. As previously mentioned, conveyance system data may be more appropriate; however, this study did not distinguish loads in these areas.

Conclusions and Recommendations

Because the majority of the total chemical loading to Puget Sound is derived from very low-level concentrations in forested subbasins and from somewhat higher concentrations in residential subbasins, management strategies for controlling toxic chemical loadings to Puget Sound must be broadly applied across the large areas represented by these land uses. If load reductions are needed at the Puget Sound scale, then the most effective control strategies for some parameters may be source prevention (e.g., emission controls, removing toxics from consumer products); especially given that it may be difficult to reduce the low concentrations in runoff from forested areas using conventional stormwater treatment practices (Schueler 1996).

Though commercial/industrial land use did not contribute as much total mass of contaminants as forested basins, streams draining this land use did exhibit the highest concentrations of contaminants. This study did not evaluate adverse impacts to sensitive organisms in streams and other water bodies that receive direct runoff from this land-use type, although some high concentrations did not meet either water quality or human health criteria. Given the relatively large concentrations being exported from these areas and the relatively small geographic areas they occupy, effective management tools are generally available (e.g., structural and programmatic best management practices) to control the releases of contaminants.

Additional studies could further characterize and refine levels of toxic chemicals in surface runoff in the Puget Sound ecosystem. These include additional monitoring data as well as new analyses of data collected in this study. Efforts could target particular areas of uncertainty, including new monitoring:

- Characterize a seasonal first flush, especially in more developed watersheds.
- Install continuous monitoring equipment in a small number of basins to compare with grab samples.
- Evaluate whether pollutant loads scale up with precipitation in forested lands.
- Quantify how various instream processes affect pollutant loads.
- Characterize surface runoff from areas of higher-intensity residential development.
- Evaluate loads of toxics from specific types of agriculture.

Finally, several additional analyses could build from the information presented in this report. For example, a sample size power analysis is a statistical evaluation to quantify how many samples are required to reduce levels of uncertainty further. This would inform future monitoring studies in the region. The hydrologic monitoring data have not been evaluated in detail but suggest patterns that could inform stormwater design. Better estimates for those areas discharging stormwater to marine areas rather than small streams could be developed. Conveyance system data could be used to characterize these loads, and the estimates merged with those for lands discharging to small streams or larger rivers at the watershed scale or Puget Sound scale.

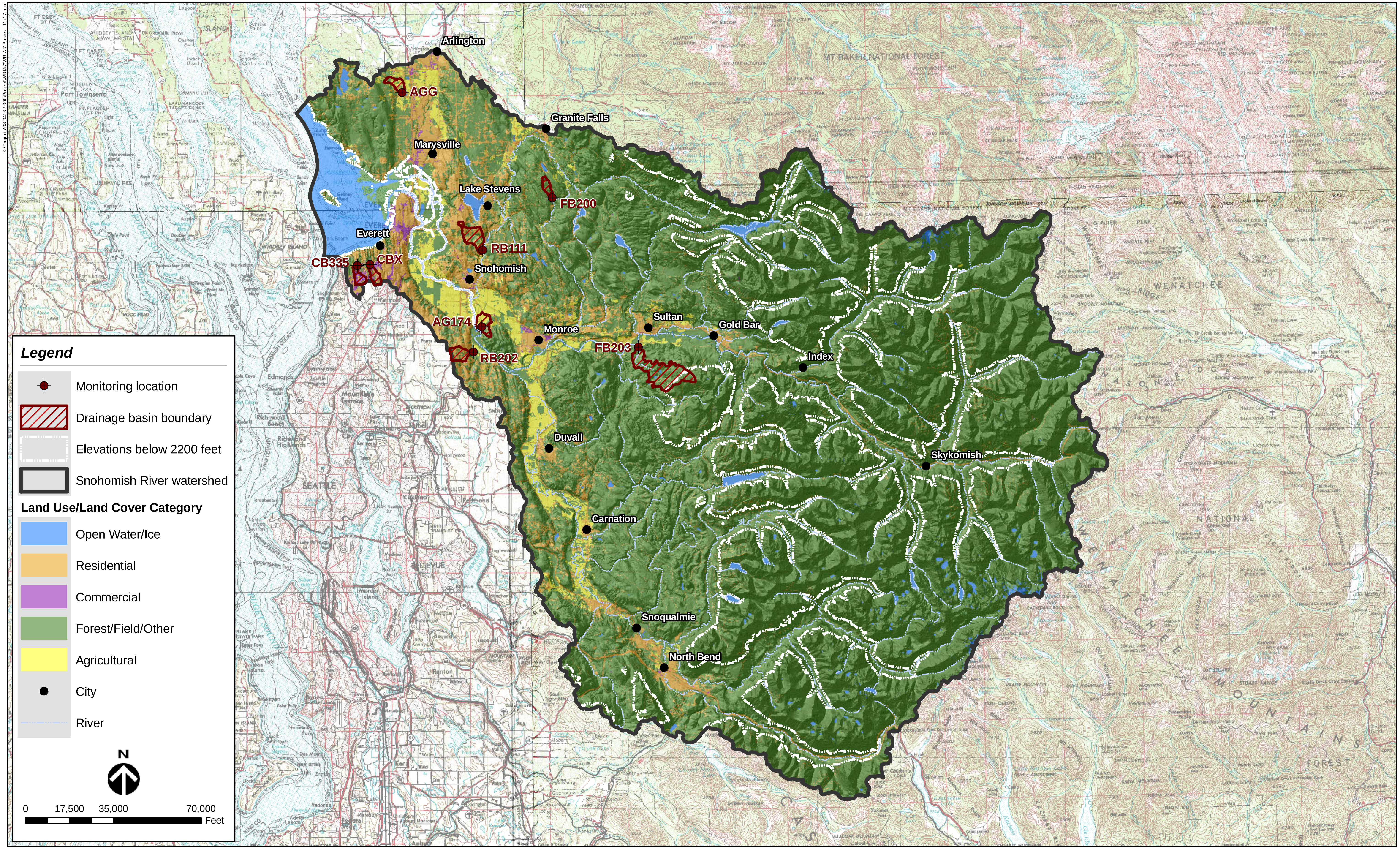

Figure E-1. Individual monitoring locations and their corresponding drainage basins within the Snohomish River Watershed.

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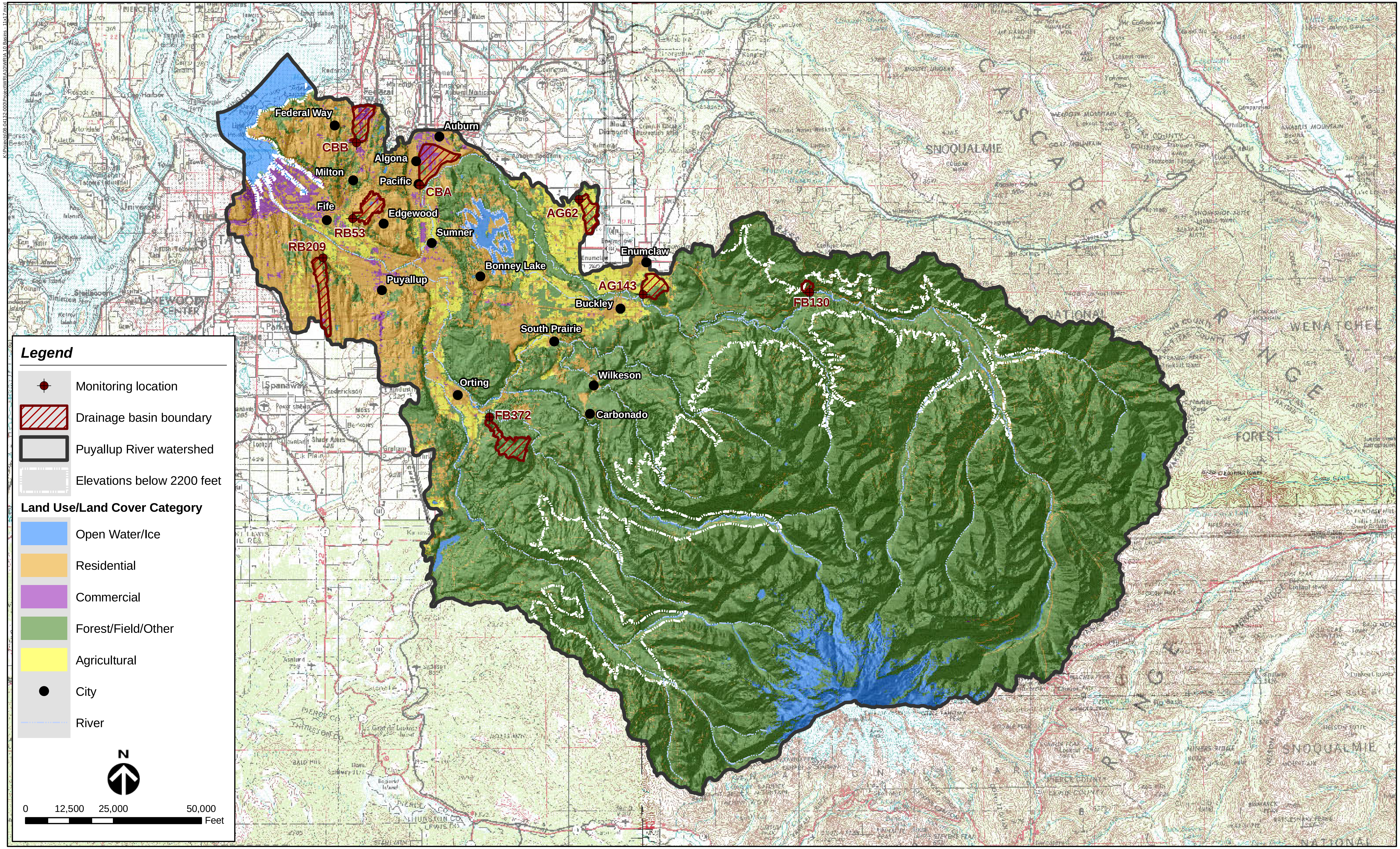

Figure E-2. Individual monitoring locations and their corresponding drainage basins within the Puyallup River Watershed.

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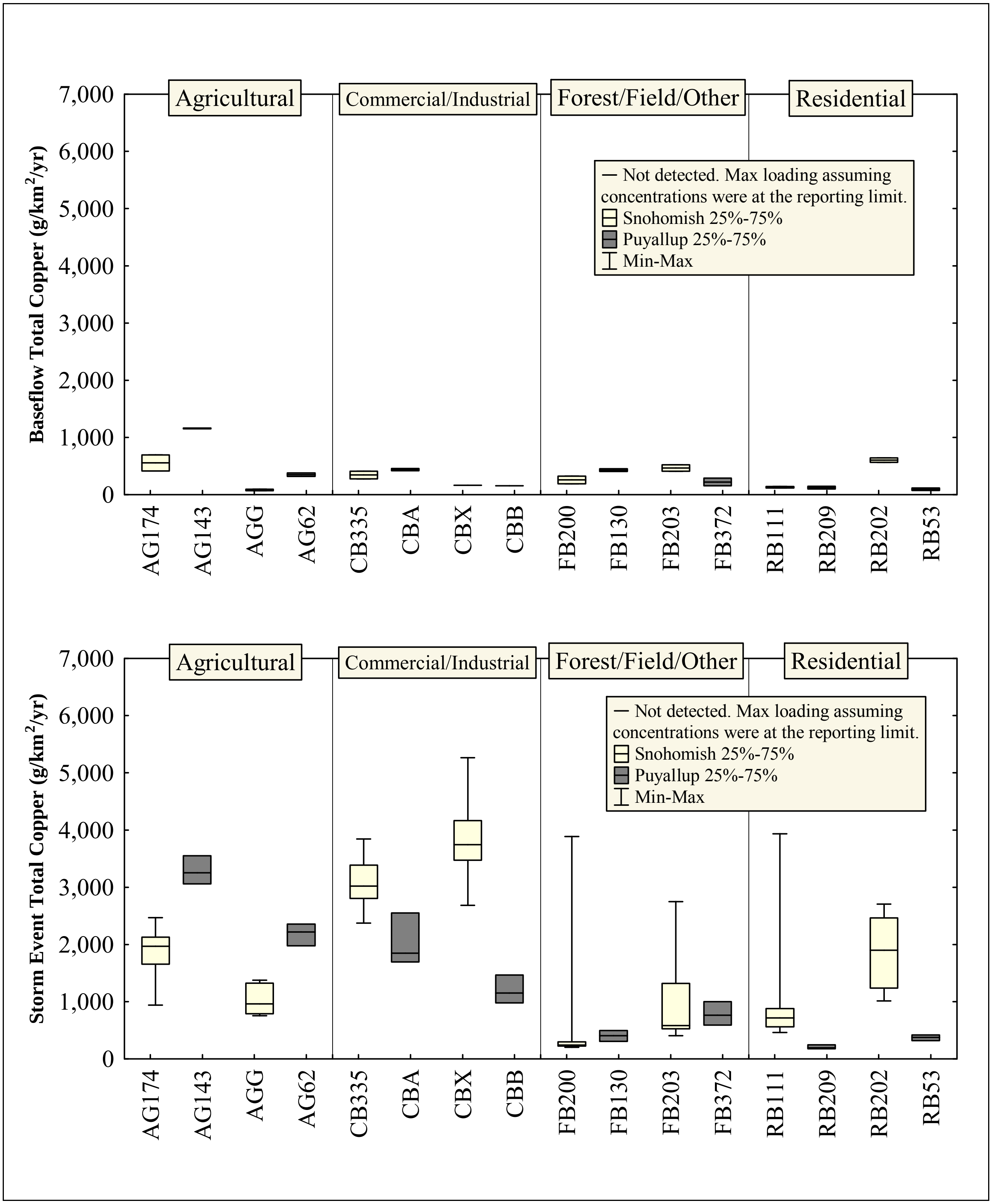

Figure E-3. Baseflow and storm-event unit-area chemical loading box plots for total copper for the Phase 3 study of toxics in surface runoff to Puget Sound.

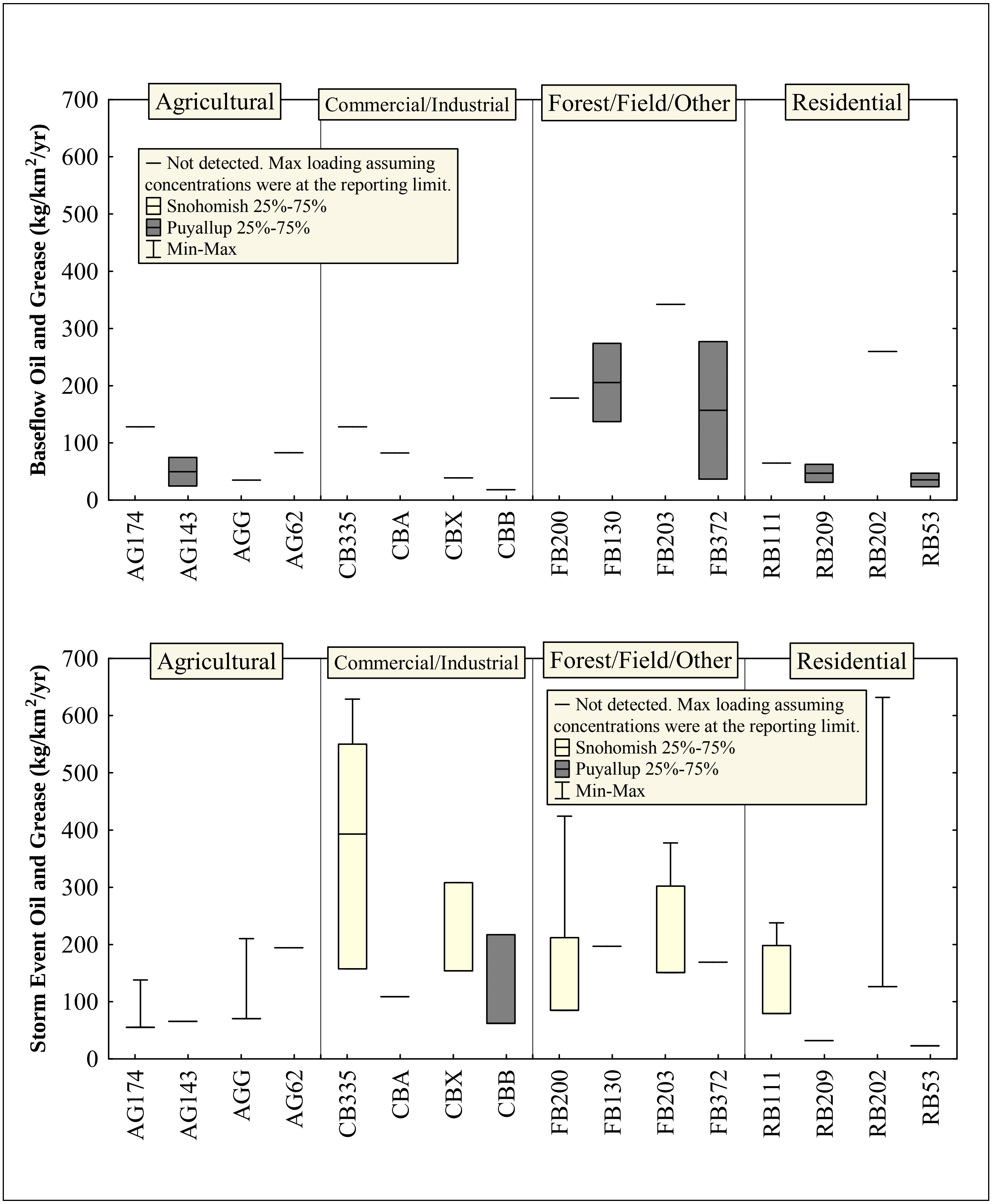

Figure E-4. **Baseflow and storm-event unit-area chemical loading box plots for oil and grease for the Phase 3 study of toxics in surface runoff to Puget Sound.**

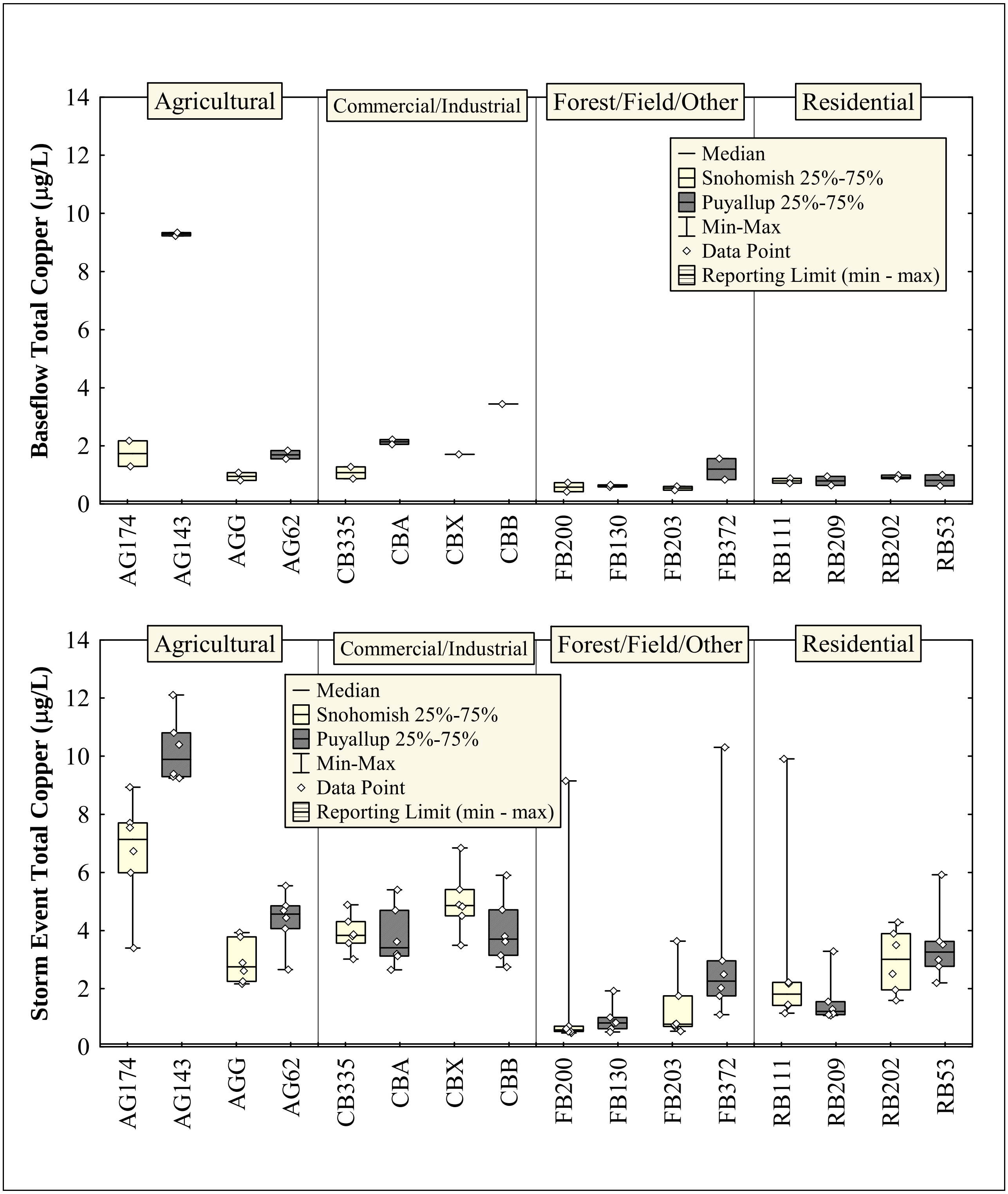

Figure E-5. **Baseflow and storm-event total copper concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.**

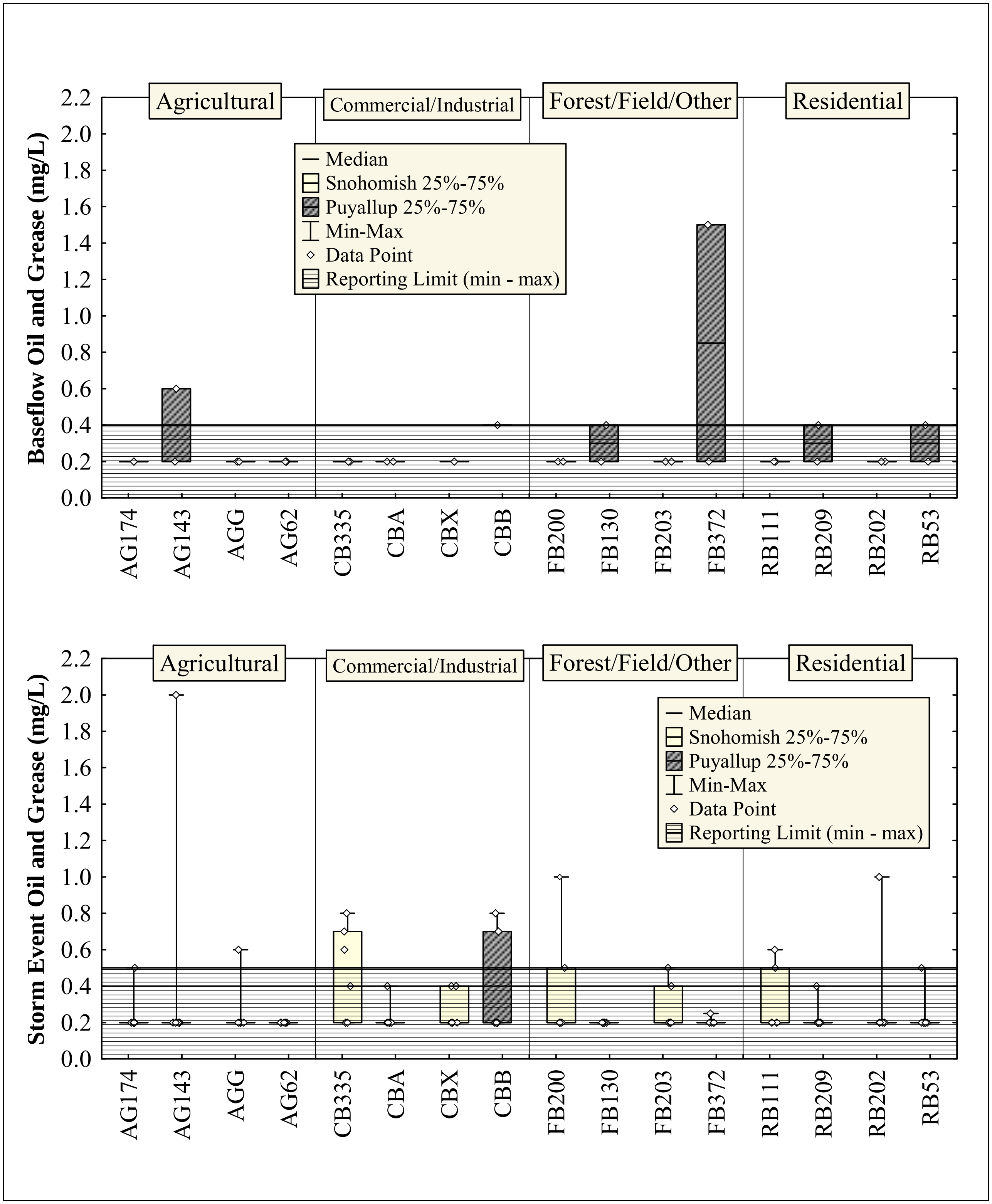

Figure E-6. Baseflow and storm-event oil and grease concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

Table E-1. Comparison of total loading rates by land use for the Snohomish and Puyallup watersheds.

Parameter	Units	Commercial/Industrial						Residential						Agricultural						Forest/Field/Other					
		Snohomish			Puyallup			Snohomish			Puyallup			Snohomish			Puyallup			Snohomish			Puyallup		
		25th	Median	75th	25th	Median	75th	25th	Median	75th	25th	Median	75th	25th	Median	75th	25th	Median	75th	25th	Median	75th	25th	Median	75th
Total Copper	kg/yr	31.2	37.6	42.1	24.0	27.3	36.1	429	579	894	78.6	140	187	145	200	355	182	334	474	3,040	3,870	5,940	929	1,450	2,290
Oil and Grease	MT/yr	1.59-2.43	2.37-3.21	3.96-4.80	1.67	1.67	2.60	40.9-99.0	40.9-99.0	71.6-130	17.0	21.3	25.6	8.53-20.2	8.53-20.2	8.53-20.2	9.75	9.75	12.6	588-1,910	588-1,910	1,320-2,640	104-474	156-526	492-862

Note: where a range of values is presented, the low value was calculated by assuming a zero for nondetect values, and the high value was calculated assuming the maximum method reporting limit for non-detect values.
25th = 25th percentile
75th = 75th percentile
kg/yr = kilograms per year
MT/yr = metric tons per year

Table E-2. Comparison of loading rates by land use for Puget Sound.

Parameter	Units	Commercial/Industrial			Residential			Agricultural			Forest/Field/Other		
		25th	Median	75th	25th	Median	75th	25th	Median	75th	25th	Median	75th
Total Copper	kg/yr	541	642	805	2,510	3,700	5,450	2,360	3,390	6,780	22,200	28,000	52,700
Oil and Grease	MT/yr	37.9	37.9	66.9	455	455	553	171	171	171	7,730	7,730	9,720

25th = 25th percentile
75th = 75th percentile
kg/yr = kilograms per year
MT/yr = metric tons per year

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Introduction

Project Background and History

Puget Sound is the largest fjord-like estuary in the continental United States. Located between the Cascade and Olympic mountain ranges in Washington State (Figure 1), the Puget Sound basin covers more than 43,400 square kilometers (16,800 square miles) of land and water (Hart Crowser et al. 2007). The basin is made up of a series of interconnected underwater basins, separated by shallow ridges or "sills." These basins include the deep Main basin and the shallower South Sound, Hood Canal, and Whidbey basins. Admiralty Inlet connects Puget Sound to the Pacific Ocean through the Strait of Juan de Fuca. For the purposes of this study, the term "Puget Sound" includes all of Puget Sound, Hood Canal, and the Straits of Georgia and Juan de Fuca within Washington State.

Over the past 150 years, human activity has introduced a wide range of toxic chemicals in the Puget Sound ecosystem at levels that are harmful to aquatic life (Puget Sound Partnership 2006). Despite a ban on some harmful chemicals in the 1970s and numerous cleanup efforts, toxic chemicals continue to persist and circulate throughout the Puget Sound ecosystem and are still being introduced via stormwater runoff, municipal sewage treatment plants, and atmospheric deposition. These toxic chemicals can have acute and chronic effects on nearshore organisms. Once in the food web, certain toxic chemicals can also be concentrated in larger predatory animals, ultimately affecting marine fish and mammals. These contaminants are also a significant concern for human health, especially for those who frequently consume fish with high contaminant levels.

Recognizing these concerns, the Washington State Department of Ecology (Ecology) has been collaborating with the Puget Sound Partnership and other state and federal agencies to conduct a multi-year, multi-phase effort to study toxic chemicals in the Puget Sound ecosystem from various sources. This report presents the results of the Phase 3 study of toxics in surface runoff to Puget Sound. The following summaries of the Phase 1 and 2 efforts are provided as context for understanding the objectives for Phase 3.

Phase 1: Initial Estimate of Toxic Chemical Loadings to Puget Sound

The Phase 1 study was completed in 2007 and provided estimates of the total amount (load) of 17 toxic chemicals, or classes of chemicals, entering Puget Sound from the following sources:

- Surface runoff
- Atmospheric deposition
- Wastewater
- Combined sewer overflows
- Unintentional spills

The Phase 1 study (Hart Crowser et al. 2007) provided loading estimates for the entire Puget Sound basin based on loading estimates derived for 14 hydrologically-based upland study areas (Figure 2) that comprise the Puget Sound basin. These 14 study areas are linked to Ecology's Puget Sound Box Model. This Box Model is a computerized tool for predicting contaminant movement within the Puget Sound ecosystem (Pelletier and Mohamedali 2009).

The Phase 1 report also provided toxic chemical loading estimates to Puget Sound from surface runoff originating from the following land uses within each study: commercial/industrial, residential, agricultural, and forest/field/other (forest). The Phase 1 results indicated that surface runoff was the highest contributor of toxic chemicals to Puget Sound. In this analysis, "surface runoff" included stormwater, nonpoint source overland flow, and groundwater discharge to surface waters that flow to Puget Sound.

Phase 2: Improved Loading Estimates

Phase 2 studies[3] were conducted in 2008 with the goal of improving the toxic chemical loading estimates developed during Phase 1. One of the Phase 2 studies provided revised toxic chemical loading estimates to Puget Sound (which were based on literature values) from surface runoff for the four land-use categories that were targeted in the Phase 1 analysis (EnviroVision et al. 2008; Herrera 2010). Estimates were improved by updating land-use data and including highways as a fifth land-use category. This generally resulted in reduced loadings estimates for some chemicals.

Results from this Phase 2 study confirmed that surface runoff remained the largest single contributor of toxic chemicals to Puget Sound. It also showed that residential and forested areas generally contributed more mass loading of toxic chemicals to Puget Sound than the other land-use types. This was not because runoff from residential and forested land use had higher concentrations of toxic chemicals than commercial/industrial areas; rather, it was because residential and forested land uses represented a much greater proportion of the land area. Runoff from commercial/industrial areas and highways were found to have higher concentrations of many toxic chemicals. These results were generally consistent with other regional studies of toxic chemical loading (Herrera 2007).

Despite these general conclusions, the estimates of the quantities of toxic chemicals released from different land uses and highway areas were still not certain enough to guide regulation and policy recommendations to reduce releases of toxic chemicals to Puget Sound. The datasets used for the Phase 1 and 2 estimates were developed from numerous regional and national studies. These studies had widely divergent objectives and varied sampling and analytical techniques. This meant that many assumptions had to be applied in order to incorporate the disparate sets of data into one analysis for the Puget Sound ecosystem. Another important limitation was that many of the data values were below quantifiable levels of detection that varied among the data sources and further weakened the analysis. Therefore, Ecology initiated the Phase 3 study of toxics in surface runoff to further improve loading estimates to Puget Sound and obtain new data from local watersheds for quantifying specific toxic chemicals by different land uses.

[3] More detailed information on the Phase 2 studies is available from www.ecy.wa.gov/programs/wq/pstoxics/index.html

Phase 3: Project Description

The Phase 3 studies (www.ecy.wa.gov/programs/wq/pstoxics/index.html) further quantify various sources and improve estimates of the quantities of toxic chemicals entering the Puget Sound ecosystem. Six of the 11 Phase 3 studies involved the collection and analysis of environmental samples from within the Puget Sound basin to improve the quality of the data sources; this included the Phase 3 study of toxics in surface runoff.

The project team for the Phase 3 study of toxics in surface runoff consisted of the following organizations:

- Washington State Department of Ecology (Ecology)
- Herrera Environmental Consultants (Herrera)
- Practical Stats, Inc.
- Ecology and Environment (E&E)
- Manchester Environmental Laboratory (MEL)
- Axys Analytical Services, Ltd. (Axys)
- Pacific Rim Laboratories (Pacific Rim)

Ecology provided technical oversight for the study, data quality assurance (QA) review, and report review. Under contract to Ecology, Herrera was the study lead and oversaw the development of the study's Quality Assurance Project Plan (QAPP) (Herrera et al. 2009). Herrera conducted the field monitoring, performed the data analysis, and led development of this report. Practical Stats, Inc. provided statistical analysis support during QAPP development and the data analysis for this report. E&E also provided support during QAPP development and oversaw the review and validation of laboratory data from the study. MEL coordinated all laboratory work and provided analytical support for selected parameters. Axys and Pacific Rim worked under contract to MEL and provided analytical support for the remaining parameters.

Ecology also convened two groups of experts to vet the approach for analyzing the data obtained through the Phase 3 study of toxics in surface runoff.

1. Three local professionals met to recommend a conceptual approach for analyzing the data in May 2010: USGS National Water Quality Assessment (NAWQA) scientist, City of Tacoma stormwater engineer, and King County toxicologist. This approach was developed further and presented through a facilitated discussion to a group of 13 experts in June 2010.

2. The calculation work group included biologists, toxicologists, biogeochemists, engineers, and other scientists and stormwater professionals from federal, state, county and city government; a university representative; a petroleum industry representative; a non-governmental organization representative; and a national laboratory representative. The group provided feedback on the conceptual approach and requested a subsequent briefing once initial study results were available. The project team briefed the group again in August 2010 and provided a draft memorandum explaining how the approach developed with input from the group was applied for several representative parameters.

Individuals also provided comments during the external review period.

At the outset of the Phase 3 study of toxics in surface runoff to Puget Sound, the project team defined the following study objectives:

- Perform an in-depth study within two pilot watersheds to determine the relative contributions of toxic chemicals in surface runoff from the four major land uses identified above (i.e., residential, commercial/industrial, agricultural, and forest/field/other).
- Reduce the uncertainty of the total loading estimates for toxic chemicals that are discharged to Puget Sound via surface runoff relative to the estimates determined in the Phase 1 and Phase 2 studies.

To meet these objectives, the project team conducted flow monitoring and water quality sampling during baseflow and storm-event conditions in representative streams within the Snohomish watershed and Puyallup watershed (Figure 1) that receive runoff from the four targeted land uses. The samples were collected using ultraclean techniques and analyzed for the following toxic chemicals, or classes of chemicals, and contaminants of concern in surface runoff:

- Heavy metals
- Polychlorinated biphenyls (PCBs) congeners
- Polybrominated diphenyl ethers (PBDEs) congeners
- Polycyclic aromatic hydrocarbons (PAHs)
- Base/neutral/acid (BNA) extractables (semi-volatile organic compounds)
- Pesticides
- Herbicides
- Petroleum hydrocarbons
- Oil and grease (n-hexane extractable material [HEM])
- Conventionals (hardness, nutrients, total suspended solids, and field parameters)

Because many of these parameters were not detected in other regional studies of toxic chemicals in surface runoff (Herrera 2004, 2007; USGS 2003) using generally available detection limits, the collection of new data for these parameters with lower detection limits was identified as a high priority by the project team in the early planning phases of the project.

The monitoring data were used to calculate the total load of toxic chemicals transported by surface runoff at each monitoring location (subbasin scale) over the period of a year. This value was then normalized based on the contributing land area to determine the quantity of toxic chemicals generated per area (e.g., square kilometer) of a subbasin which was chosen to represent one of the four land-use categories. These normalized or “unit-area” toxic chemical loading estimates at the subbasin scale were then used to estimate total toxic chemical loadings by land use for the 2 pilot watersheds (watershed scale) and extrapolated to the 14 study areas that are linked to the Puget Sound Box Model (Puget Sound scale).

Based on the results that were obtained from these analyses, the project team identified several broad management implications for controlling toxic chemicals in surface runoff. These management implications generally address toxic loading impacts at both the Puget Sound scale and the scale of smaller receiving waters that receive direct runoff from the land uses that were targeted in this study.

Document Organization and Content

This report summarizes and discusses results from the Phase 3 study of toxics in surface runoff to Puget Sound. The remainder of this report is organized to include the following sections:

- **Methods:** Summarizes the experimental design and describes the monitoring locations, sampling procedures, monitoring parameters, and data analysis methods.
- **Results:** Summarizes the results from the review and validation of analytical and hydrologic data, key trends in the data based on the detection frequency of individual parameters in each class of toxic chemicals, and contaminant loading estimates for priority toxic chemicals at the subbasin, watershed, and Puget Sound scale.
- **Discussion:** Presents an interpretation of the results that describes key trends in the data and their management implications for toxic chemicals, evaluates the representativeness of the collected data based on comparisons to data from other regional monitoring, and identifies key limitations of the data and results from this study.
- **Conclusions:** Compiles high-level findings from this study and summarizes their implications.
- **Recommendations:** Provides recommendations for further study and analysis.

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Methods

General Approach

The project team conducted monitoring at representative locations within the Snohomish watershed and Puyallup watershed (Figure 1). Within each watershed, eight monitoring locations were established, each to represent one of the following land uses: commercial/industrial, residential, agricultural, or forest/field/other (Appendix A). Two monitoring locations in each watershed were selected to represent each land-use type. Therefore, a total of four monitoring locations represent each of the four land uses.

The project team sampled each monitoring location eight times over a one-year period extending from August 2009 through July 2010. Two of the eight sampling events occurred during baseflow conditions, with one event in the summer (July 2010) and one event in winter (May 2010). The remaining six events occurred during storm events. One of the storm events occurred in October 2009 to target a fall event; three occurred from November 2009 through January 2010 to target winter storm events; and two occurred from April through May 2010 to target spring storm events.

Samples collected from all events were analyzed for an extensive list of toxic chemicals and contaminants of concern in surface runoff. In addition to sample collection, the project team established gauging stations at all 16 monitoring locations to obtain a continuous record of discharge over the study period. The discharge data were used in conjunction with the chemical data to calculate total and unit-area loading rates for each monitoring location. Data obtained from these samples were then used to evaluate differences in toxic chemical concentrations and loads in relation to land use, watershed, and flow conditions at the subbasin scale. In addition, the project team used these data to estimate total toxic chemical loadings by land use for the two pilot watersheds (watershed scale) and the 14 study areas linked to the Puget Sound Box Model (Puget Sound scale).

The following subsections provide a summary of the rationale and methods behind monitoring location selection; sample collection, stream gauging, and laboratory procedures; and data analysis techniques. More detailed information is provided in the QAPP for the study (Herrera et al. 2009).

Monitoring Locations

The process of selecting monitoring locations began with the selection of two watersheds. The project team selected the Snohomish River and Puyallup River watersheds for monitoring based on the following reasons:

- Each had areas representing all four land uses.
- Each had a U.S. Geological Survey (USGS) gauging station at or near its mouth that could provide a continuous record of flow during the sampling period.

- Each had available land-use/land-cover data to support the required analyses for this study.
- Each represented some of the geographic diversity within the Puget Sound basin and yet both were centrally located, which was critical to optimizing travel time and other sampling logistics.

The project team used geographic information system (GIS) analyses to select representative monitoring locations within each watershed using a stratified random approach. Appendix B documents the specific steps that were performed during the GIS analyses to select the final monitoring locations for this study. As documented in this appendix, a number of issues arose that required modifications to the site-selection criteria, and not all sites were randomly selected. In general, the stratified random approach was intended to eliminate potential bias in the monitoring location selection process by randomly selecting monitoring locations in each watershed that met pre-defined physical, geographic, and land-use criteria. These criteria were specifically developed to balance the following requirements of the study design during the selection of monitoring location:

- Identify monitoring locations with drainage basins that are sufficiently representative of the four targeted land-use categories.
- Identify monitoring that will remain accessible to field personnel over the entire monitoring period.
- Identify monitoring locations that have a sufficient baseflow component to the hydrograph for sampling during the summer months.

In keeping with these requirements, the project team limited monitoring location selection to subbasins for second-order streams that were below 2,200 feet in elevation. This step was performed to ensure the monitoring locations selected would not be rendered inaccessible due to winter snow conditions. It is recognized that this introduced a bias in that the areas therefore were closer to population centers than higher elevation locations would have been.

In addition, the project team used the National Land Cover Database (MRLC 2001) to select subbasins for second-order streams by representative land use for each specific category. While first-order streams would likely have more homogeneous land use, second-order streams were specifically targeted for monitoring due to concerns that baseflows would be intermittent through the monitoring year in first-order streams. The land-cover datalayer was developed from Landsat satellite imagery using a nationally standardized approach; 2001 was the most recently available compilation.

Originally the intent was to select the most homogeneous subbasins. However, few second-order streams were available with >90 percent coverage by specific land uses other than forested. Therefore, the percent cover threshold was decreased to identify sufficient potential sites for further evaluations. In particular, the threshold for commercial/industrial subbasins decreased to <50 percent cover, and other land uses likely affected results from those areas. Final subbasins were selected using the following criteria:

- **Commercial/Industrial:** At least 30 percent of the drainage subbasin must be classified as commercial/industrial land use.

- **Residential:** At least 50 percent of the drainage basin must be classified as residential land use, and no more than 10 percent may be classified as commercial/industrial land use.
- **Agricultural:** At least 50 percent of the drainage basin must be classified as agricultural land use.
- **Forest/Field/Other:** At least 90 percent of the drainage basin must be classified as forest/field/other land use.

Each of the 16 monitoring locations selected for this study received runoff from a relatively small drainage area with land uses corresponding to one of the four primary land-use categories. It should be noted that roads and highways were not specifically called out as unique land-use categories in this study because the contaminant contribution from these areas could not be explicitly separated from the contaminant contribution from the other four land uses given the experimental design for this study. As was noted in the Phase 2 study, roads and highways are both a unique contaminant source and a conduit for transporting contaminants from surrounding lands uses; therefore, a more focused sampling effort than the one used for this study would be required to quantify the associated contaminant loadings. Instead, roads are included in the four land-use categories used in this study.

Detailed monitoring location information, including GIS coordinates and drainage basin characteristics, are provided in Table 1. Figures 3 and 4 also show the eight monitoring locations and their corresponding drainage basins within the Snohomish and Puyallup watersheds, respectively. More detailed maps are also provided in Appendix A for each monitoring location with the following information:

- Monitoring locations relative to delineated basin boundaries
- Land use breakdown within the delineated basin boundaries
- Stream channel network within the delineated basin boundaries

For the purpose of this study, the project team computed toxic chemical loading estimates for each monitoring location based on the assumption that the entire drainage basin was representative of the targeted land use, even though Table 1 indicates there is actually a mix of land uses present, particularly in commercial/industrial subbasins. However, as noted above, the land-use breakdown in each drainage basin was determined from relatively low-resolution data that were obtained from the National Land Cover Database (MRLC 2001). In general, the maps provided in Appendix A suggest that the actual land use in the drainage basins is more representative of the targeted land use for each monitoring location than Table 1 implies. Despite this consideration, the implications for interpreting results from this study given the lack of uniform land use in each subbasin are presented in the Discussion section.

The following subsections provide a general description of each monitoring location, including its watershed characteristics, channel configuration, predominant substrate, and any known pollutant sources in the immediate vicinity of the monitoring site. In general, there are no point (discrete) sources tributary to any of these monitoring locations. As documented below, sampling at some monitoring locations occurred downstream of galvanized steel culverts that could have been a source from some pollutants (e.g., metals); the potential implications of this artifact of the sampling design are evaluated in the *Discussion* section of this report.

Snohomish Watershed

AGG

This monitoring location was on an unnamed tributary to the West Fork of Quilceda Creek in the Snohomish Watershed. The predominant land use in the 249.4-hectare basin is agricultural (49.7 percent) with lesser amounts of residential and forested areas (Table 1). At the sampling location, the channel width was approximately 7 feet. Relatively steep riparian buffers, approximately 5 feet wide, lined each side of the stream. No erosional features or channel incision were observed at the sampling location or immediately upstream, likely due to the low gradient of the stream. The stream substrate was characterized by a mix of various-sized rocks and cobbles. During low-flow periods, large quantities of duck weed (*Lemna* spp.) were observed in the stream.

The sampling location was immediately downstream of a large galvanized steel culvert and dirt road used to access a nearby residential property. Moderately consolidated rock and dirt were stacked on top of the culvert. The stream was bordered on the west side by a residential street and pasture land to the east.

AG174

This monitoring location was on an unnamed tributary to French Creek/French Slough in the Snohomish watershed. The predominant land use in the 360.5-hectare basin is agricultural (49.6 percent) with lesser amounts of forested and residential areas (Table 1). At the sampling location, the channel width was approximately 2 to 3 feet. Relatively steep riparian buffers lined each side of the stream. No erosional features or channel incision were observed at the sampling location or immediately upstream, likely due to the low gradient of the stream. The stream substrate was characterized by a mix of 1- to 2-foot diameter rip rap and asphalt, cobble, tires, woody debris, and other miscellaneous metal debris. Discharge at this monitoring location typically exhibited a tannin color.

The sampling location was immediately below a concrete culvert, which was in poor condition and had collapsed in some places, dispersing the flow. Streamflow from the broken culvert cascaded into a small pool below, where the stream gradient was low. Several large warehouses, storage sheds, and dirt roads associated with a large farm were located above the culvert.

FB200

This monitoring location was on an unnamed tributary to Carpenter Creek in the Snohomish watershed. The 174.2-hectare basin is primarily forested (90.7 percent) with a minor amount of residential area land use (Table 1). At the sampling location, the channel width was approximately 10 feet. Signs of channel incision were observed upstream of the culvert, and evidence of recent cobble deposition at the sampling location was also apparent. The stream substrate was characterized by a mix of cobbles that were 2 to 18 inches in diameter.

The sampling location was immediately downstream of a large galvanized steel culvert. Moderately consolidated rock and dirt were stacked on the top of the culvert. The majority of the forest area was immediately upstream, while at the sampling location, the stream was bordered on each side with small riparian buffers approximately 5 to 10 feet in width; land use outside the buffer was predominately agricultural (i.e., pasture) with a road paralleling the channel.

FB203

This monitoring location was on McCoy Creek in the Snohomish watershed. The 1,657.6-hectare basin is primarily forested (95.8 percent) with a minor amount of residential area land use (Table 1). At the sampling location, the channel width was approximately 25 feet. No erosional features or channel incision were observed at the sampling location or immediately upstream, likely due to the moderate gradient of the stream. The stream substrate was characterized by large, irregularly shaped rocks and cobbles ranging from 6 to 18 inches in diameter.

The sampling location was immediately downstream of a large galvanized steel culvert. Lush riparian growth surrounded the immediate area of the monitoring location, including areas on top of the culvert. Numerous pink and silver salmon (*Oncorhynchus gorbuscha* and *Oncorhynchus kisutch*, respectively) were observed spawning at this location during the fall.

CBX

This monitoring location was on Merrill and Ring Creek in the Snohomish watershed. The land use in the 224.2-hectare basin is predominantly residential (62.4 percent) and commercial/industrial (29.6 percent) (Table 1). At the sampling location, the channel width was approximately 15 feet. No erosional features or channel incision were observed at the sampling location or immediately upstream. The stream substrate was characterized by large, irregularly shaped rocks ranging from 6 to 24 inches in diameter.

The sampling location was immediately downstream of a large concrete box culvert and paved road used to access a commercial property. The immediate area around the monitoring location was characterized by a riparian buffer 10 to 15 feet wide on each side of the stream surrounded by commercial land use.

CB335

This monitoring location was on Powder Mill Creek in the Snohomish watershed. The land use in the 213.4-hectare basin is predominantly commercial/industrial (62.7 percent) with minor amounts of residential and forested areas (Table 1). At the sampling location, the channel width was approximately 10 feet. Channel incision approximately 1 foot in depth was observed at the sampling location and immediately upstream, likely due to the high gradient of the stream. The stream substrate was characterized by irregularly shaped rocks and cobbles ranging from 2 to 18 inches in diameter.

The sampling location was approximately 150 feet downstream of a 48-inch diameter concrete culvert with galvanized steel wing-walls. The immediate area around the monitoring location exhibited lush riparian growth approximately 10 to 15 feet wide. Snohomish County dirt access roads parallel the riparian buffers on each side of the stream.

RB111

This monitoring location was on an unnamed stream (WRIA-7: 0137) in the Snohomish watershed. The land use in the 581.2-hectare basin is predominantly residential (58.2 percent) with minor amounts of forested, agricultural, and commercial/industrial areas (Table 1). At the sampling location, the channel width was approximately 10 feet. No erosional features or channel incision were observed at the sampling location or immediately upstream, likely due to the low gradient of the stream. The stream substrate was characterized by cobbles that were 2 to 6 inches in diameter with minor amounts of woody debris and a large volume of sediment deposited in the culvert.

The sampling location was immediately downstream of a large galvanized steel culvert. The immediate area around the monitoring location included a steep bank with rip rap and Himalayan blackberries (*Rubus* spp.) to the west and north and a flat area with some riparian vegetation to the east. Numerous pink and silver salmon (*Oncorhynchus gorbuscha* and *Oncorhynchus kisutch*, respectively) were observed spawning in the creek during the fall.

RB202

This monitoring location was on Evans Creek in the Snohomish watershed. The land use in the 334.3-hectare basin is predominantly residential (64.0 percent) with minor amounts of forested and commercial/industrial areas (Table 1). At the sampling location, the channel width was approximately 12 feet. No erosional features or channel incision were observed at the sampling location or immediately upstream, likely due to the moderate gradient of the stream. The stream substrate was characterized by small cobbles that were 1 to 4 inches in diameter.

The sampling location was immediately downstream of a galvanized steel culvert and small pool. Flow typically emerged into the pool from below the perched culvert, as the stream typically short-circuited the culvert. The immediate area around the monitoring location included a small pool surrounded by heavy Himalayan blackberry (*Rubus* spp.) growth and lush riparian vegetation below.

Puyallup Watershed

CBA

This monitoring location was on an unnamed stream in the Puyallup watershed. The land use in the 655.9-hectare basin is predominantly residential (62.1 percent) and commercial/industrial (31.8 percent) with minor amounts of forested areas (Table 1). At the sampling location, the channel width was approximately 15 feet. No erosional features or channel incision were observed at the sampling location or immediately upstream, likely due to the low gradient of the stream. The stream substrate was characterized by cobbles approximately 2 to 12 inches in diameter with silty sand deposits located sporadically within the channel.

The sampling location was immediately downstream of four 18-inch diameter galvanized steel culverts. The immediate area around the monitoring location included grass-dominated riparian buffers approximately 10 feet wide bordered by residential houses and yards on each side of the stream. The culverts were stabilized with cobbles embedded in concrete with a metal railing and sidewalk above.

CBB

This monitoring location was on an unnamed tributary to West Hylebos Creek in the Puyallup watershed. The predominant land use in the 435.3-hectare basin is residential (48.4 percent) and commercial/industrial (38.1 percent) with minor amounts of forested areas (Table 1). At the sampling location, the channel width was approximately 5 feet. No erosional features or channel incision were observed at the sampling location or immediately upstream, likely due to the low gradient of the stream. The stream substrate was characterized by large irregularly shaped rocks and rip rap approximately 6 to 24 inches in diameter. Discharge at this monitoring location typically exhibited a tannin color.

No culverts were located within the immediate vicinity of the sampling location. The immediate area around the monitoring location included sporadic riparian vegetation intermixed with quarry spalls to the north and a grass-dominated border to the south that was approximately 15 feet wide. A large stormwater detention pond was located approximately 800 feet upstream of the sampling location.

RB53

This monitoring location was on a Surprise Lake Drain tributary to Hylebos Creek in the Puyallup watershed. The land use in the 435.3-hectare basin is predominantly residential (81.7 percent) with minor amounts of forested, commercial/industrial, and agricultural areas (Table 1). At the sampling location, the channel width was approximately 4 feet. No erosional features or channel incision were observed at the sampling location or immediately upstream, likely due to the low gradient of the stream. The stream substrate was characterized by silty sand mixed with fine organic debris.

The sampling location was immediately downstream of a galvanized steel culvert. The immediate area around the monitoring location contained extensive stands of reed canary grass (*Phalaris arundinacea*) intermixed with minor amounts of Himalayan blackberries (*Rubus* spp.).

RB209

This monitoring location was on an unnamed tributary to Clear Creek in the Puyallup watershed. The land use in the 548.7-hectare basin is predominantly residential (81.6 percent) with minor amounts of forested and commercial/industrial areas (Table 1). At the sampling location, the channel width was approximately 7 feet. No erosional features or channel incision were observed at the sampling location or immediately upstream, likely due to the moderate gradient of the stream. The stream substrate was characterized primarily by sand and minor amounts of woody debris.

The sampling location was immediately downstream of a concrete box culvert. The immediate area around the monitoring location included reed canary grass (*Phalaris arundinacea*) intermixed with minor amounts of Himalayan blackberries (*Rubus* spp.). A roadside ditch also discharged stormwater into the creek from the east. However, water samples were collected above the confluence of the ditch and the creek. Numerous chum salmon (*Oncorhynchus keta*) were observed staging in the creek during November.

AG143

This monitoring location was on an unnamed tributary in the Puyallup watershed. The land use in the 337.5-hectare basin is predominantly agricultural (53.1 percent) with forested, residential, and minor amounts of commercial/industrial areas (Table 1). At the sampling location, the channel width was approximately 6 feet. The channel was purposely incised, likely to help drain the surrounding pasture land. The stream substrate was characterized by gravel and sand mixed with minor amounts of cobbles approximately 2 to 6 inches in diameter.

The sampling location was immediately downstream of a large galvanized steel culvert. The culvert was heavily degraded; the bottom of the culvert at the sampling location was covered in rust and had several large holes in it. The immediate area around the monitoring location was dominated by Himalayan blackberries (*Rubus* spp.) intermixed with minor amounts of reed canary grass (*Phalaris arundinacea*) and other grass species. Cattle pasture land bordered each side of the riparian areas.

AG62

This monitoring location was on an unnamed tributary to the White River (WRIA-10: 0048) in the Puyallup watershed. The land use in the 330.9-hectare basin is predominantly agricultural (50.0 percent) with forested, residential, and minor amounts of commercial/industrial areas (Table 1). At the sampling location, the channel width was approximately 6 feet. A small cut bank was located at the monitoring location on the north side of the creek, likely due to increased stream velocities at the mouth of the concrete culvert. The stream substrate was characterized by gravel and cobbles, approximately 2 to 6 inches in diameter.

The sampling location was immediately downstream of a concrete culvert. The immediate area around the sampling location was characterized by heavy riparian growth and red alder (*Alnus rubra*) stands intermixed with Himalayan blackberries (*Rubus* spp.), approximately 20 feet wide on each side. Pasture land bordered each side of the riparian buffers.

FB130

This monitoring location was on an unnamed stream in the Puyallup watershed. The land use in the 80.4-hectare basin is predominantly forested (96.5 percent) with minor amounts of residential areas (Table 1). At the sampling location, the channel width was approximately 3.5 feet. The stream gradient was moderately high; however, no erosional features or channel incision were observed at the sampling location or immediately upstream. The stream substrate was characterized by cobbles approximately 4 to 16 inches in diameter with minor amounts of woody debris.

The sampling location was immediately downstream of a concrete culvert. The immediate area around the sampling location had been clear-cut recently and was characterized by sparse amounts of riparian vegetation intermixed with Himalayan blackberries (*Rubus* spp.).

FB 372

This monitoring location was on Coplar Creek in the Puyallup watershed. The land use in the 528.0-hectare basin is predominantly forested (97.5 percent) with minor amounts of residential areas (Table 1). At the sampling location, the channel width was approximately 9 feet. No erosional features or channel incision were observed at the sampling location or immediately upstream. The stream gradient was moderately high, and typically exhibited high stream velocities during storm events. The stream substrate was characterized by cobbles approximately 4 to 36 inches in diameter intermixed with minor amounts of woody debris.

The sampling location was immediately downstream of an oversized galvanized steel culvert. The immediate area around the sampling location was characterized by heavy riparian vegetation on both sides of the stream.

Water Quality Sampling

As described above, the project team collected baseflow samples at the 16 monitoring locations on two occasions. Table 2 identifies the specific date for each baseflow sampling event and its associated type (i.e., winter or summer). Baseflow samples consisted of a single grab sample that was collected from the thalweg of the channel at each monitoring location. Each baseflow sampling event was to occur following a period of at least one week without rainfall. Although the actual antecedent dry period ranged from only 28 to 124 hours (1 to 5 days) for the baseflow sampling events due to frequent rainfall conditions (see Table 2), water level data were evaluated prior to sampling to ensure that baseflow conditions were present at each location.

The project team collected storm-event samples at the 16 monitoring locations on six occasions. Table 2 identifies the specific date that each sampling event took place and its associated type (i.e., fall storm, winter storm, spring storm). The project team began storm-event sampling as early as possible during each event to ensure the full complement of samples could be collected before the end of the storm or the end of the high-flow period. The following guidelines for storm-event characteristics were established in the QAPP to ensure that representative storm samples would be collected:

- **Target storm precipitation depth:** Minimum of 0.25 inches of precipitation in a 24-hour period.
- **Antecedent conditions:** A period of at least 12 hours preceding the event with less than 0.01 inches of precipitation.

These storm-event guidelines were met based on data from representative rain gauges in the Snohomish watershed and Puyallup watershed (see Table 2).

Due to staffing and equipment resource constraints, the project team sampled only one of the two watersheds during any particular storm event. During storm-event sampling, the intent was to collect two grab samples from each monitoring location, with each of the grab samples separated by a period of approximately 4 hours. However, occasionally the rain stopped or the stream water level began to drop before the second grab sample could be collected. Overall, a second sample was not collected following 54 of the 96 first samples (i.e., 56 percent of the time). Information on the number of sampling rounds that were performed at each monitoring location during each sampling event is provided in Appendix C. Figures showing the sample collection times relative to the stream hydrograph at each monitoring location are presented in Appendix D.

In cases where two grab samples were collected during successive rounds within a storm event, the project team composited the two samples into a single sample. Compositing was done in proportion to the flow measured when the two individual samples were collected (see Appendix C). For parameters that could not be composited (see description below), only one grab sample was collected during the first round of sampling.

The project team also measured field parameters (dissolved oxygen, pH, specific conductance, and temperature) immediately following the collection of grab samples. When two field measurements were made during a storm event, they were averaged to obtain a single value for each event.

Monitoring Parameters

The project team submitted samples collected during baseflow and storm events to MEL where they were analyzed for the toxic chemicals and contaminants of concern identified in Appendix E. Since multiple laboratories provided analytical support, MEL staff coordinated preparation and delivery of the samples to the appropriate laboratory. Appendix E presents the target method reporting limits (MRLs) identified in the QAPP (Herrera et al. 2009) and the actual MRLs achieved by the laboratory for each parameter. Appendix E also identifies the field parameters measured *in situ* by the project team during both types of events. Appendix F contains detailed information on the analytical procedures used for this study.

The water quality sampling design described above should have resulted in a total of 128 samples for any given parameter if sampling occurred at all 16 monitoring locations across all the baseflow and storm events (16 locations × 8 events = 128 samples). However, some parameters were analyzed only for a subset of the locations while others were analyzed only for a subset of the events. In addition, two monitoring locations (CBX in the Snohomish watershed and CBB in the Puyallup watershed) were dry and not sampled during the summer baseflow sampling event, and the total number of samples was 126. Tables 3 and 4 identify the number of samples collected at each monitoring location for each parameter during baseflow and storm events, respectively. The actual number of samples available for each monitoring location may be less than the number collected if data were rejected during the data validation process.

Stream Gauging

The project team established stream gauging stations at each monitoring location identified in Table 1 to obtain a continuous record of discharge from August 2009 through July 2010. At each gauging station, a staff gauge was installed to manually measure stream level at a consistent reference point. A well point, pressure transducer, and data logger were also installed at each station. The data loggers were programmed to record water level at 15-minute intervals and were operated throughout the sampling period. Additional details about stream gauging equipment specifications and installation configurations can be obtained from Appendix G and H of the QAPP (Herrera et al. 2009). The specific configuration of this equipment at each monitoring location was documented in an addendum to the QAPP (Herrera 2011).

The project team conducted routine site visits approximately once every three weeks to ensure the data loggers were operating properly. During these visits, the water level data were uploaded and the project team collected a staff gauge reading. The uploaded data were immediately transferred to a secure server located in Herrera's Seattle office; the server was backed up on a daily basis. The project team then used AQUARIUS Time-Series software to process and analyze the compiled water level data.

The project team also made manual measurements of discharge during the routine site visits and sampling events. The AQUARIUS Rating Curve software was then used to develop stream discharge rating curves from these data for each monitoring location using USGS protocols. These rating curves were used to convert the continuous record of water level data from each station to a continuous record of discharge. The total flow volume derived from the stream discharge rating curves for each monitoring location over the 12-month monitoring period is summarized in Table 5. Figures are also provided in Appendix D that show the continuous discharge record over this period for each monitoring location.

Data Analysis

The project team performed the following analyses of the data compiled through the monitoring activities described above:

- Computation of summary statistics.
- Correlation analyses.
- Computation of loading estimates at the subbasin scale.
- Computation of loading estimates at the watershed scale.
- Computation of loading estimates at the Puget Sound-basin scale.

The specific steps we performed in each of these analyses are described separately below. These steps were developed in consultation with a calculation work group, comprising local experts in stormwater and related fields.

Computation of Summary Statistics

We computed the following summary statistics for each toxic chemical or contaminant identified in Appendix E:

- Number of samples
- Minimum reporting limit (concentrations only, not loading)
- Maximum reporting limit (concentrations only, not loading)
- Percentage of detected values
- Median
- Mean

- Minimum
- 25th percentile
- 75th percentile
- Maximum
- Interquartile range

For these calculations, we successively pooled the data obtained from the baseflow and storm-event sampling, respectively, to generate these summary statistics for the following groupings of data:

- Individual monitoring locations.
- Land-use categories within the Snohomish watershed and Puyallup watershed, respectively.
- Land-use categories across both watersheds combined.
- All data combined.

A high number of non-detect values in a dataset can introduce bias in calculated summary statistics (Antweiler and Taylor 2008; Helsel 2005). Therefore, we computed and qualified the summary statistics based on the following rules:

- If all data were non-detect values, we only reported the following summary statistics: number of samples, minimum reporting limit, maximum reporting limit, percentage of non-detect values (100 percent in all cases), and maximum value. The maximum value was assigned the same value as the maximum reporting limit and qualified with a less than (<) sign. All summary statistics were also assigned a "U" qualifier to indicate there were no detected values in the data.

- If there were detected values in the data, but the percentage of non-detect values represented 50 percent or more of the data, we computed all summary statistics identified above by assigning a value of one-half the MRL to the non-detect values. All summary statistics were assigned an "E" qualifier to indicate they were estimates with relatively low accuracy due to the high number of non-detect values.

- If the percentage of non-detect values represented less than 50 percent of the data, we computed all summary statistics identified above by assigning a value of one-half the MRL limit to the non-detect values. All summary statistics were then reported without qualification.

Our decision to use a 50 percent threshold to qualify the accuracy of the computed summary statistics based on non-detect values stemmed from a separate analysis that was performed by Antweiler and Taylor (2008). In comparisons to other methods for computing summary statistics from censored data (e.g., regression on order statistics), this analysis showed that reasonable estimates can be obtained by assigning a value of one-half the MRL limit to the non-detect values when up to 70 percent of the data are non-detect values; the accuracy of the computed summary statistics is highly questionable when the percentage of non-detect values exceeds this threshold. However, the analysis by Antweiler and Taylor was performed using 43 datasets with sample sizes ranging from 34 to 841. Because samples sizes for the Phase 3 study were much lower, we used a more conservative approach by qualifying all summary statistics as estimates when 50 percent or more of the data were non-detect values.

We presented the computed summary statistics in separate tables for each parameter in this study. We also used range plots and box plots to present summary statistics for the data from each individual monitoring location. The range plots show the median, minimum, and maximum values from each monitoring location; the box plots show the median, 25th, and 75th percentiles and the minimum and maximum values. In computing the summary statistics for these plots, we assigned a value of one-half the MRL to the non-detect values.

In addition to computing summary statistics for each toxic chemical or contaminant identified in Appendix E, we also computed summary statistics for the following major classes of toxic chemicals:

- Total PCBs
- Total PBDEs
- Total PAHs
- Carcinogenic PAHs
- High molecular weight PAHs
- Low molecular weight PAHs
- Total DDT
- Total chlordane

To obtain representative concentrations for each chemical class, we summed the reported concentrations of the individual parameters within each class of toxic chemicals for each sample. Specifically, concentrations for total PCBs were obtained by summing the concentrations from the 162 individual PCB congeners identified in Appendix E. Likewise, concentrations for total PBDE were obtained by summing the concentrations from the 36 individual PBDE congeners identified in Appendix E. Total DDT concentrations were obtained by summing the concentrations of the 2,4' and 4,4' isomers of DDT, DDE, and DDD. Total chlordane concentrations were obtained by summing five compounds; cis- and trans-chlordane, cis- and trans-nonachlor, and oxychlordane. The specific parameters that were summed to obtain concentrations for PAH classes shown above are identified in Appendix E.

For these summations, we substituted a value of zero (0) for all non-detect values of individual parameters unless all the reported values for the individual parameters in a given chemical class/event/monitoring location combination were non-detects. In that case, we used the highest reporting limit of all the individual parameters within that chemical class/event/monitoring location combination to represent the non-detect concentration. Once these representative concentrations were obtained for each chemical class, we computed and qualified the summary statistics for each chemical class using the same rules that are described above for the individual toxic chemicals and contaminants of concern identified in Appendix E.

Principal Component Analysis

Principal component analysis (PCA) is a technique for simplifying a dataset so that broad patterns may be more readily detected. In PCA, the data are transformed to a new coordinate system such that the greatest variance by any projection of the data comes to lie on the first coordinate (referred to as the *first principal component*), the second greatest variance on the second coordinate, and so on (Ludwig and Reynolds 1988; StatSoft 1994). PCA can be used for dimensionality reduction in a dataset while retaining those characteristics of the dataset that contribute most to its variance, by keeping lower order principal components and ignoring higher order ones. Such low-order components often contain the most important aspects of the data.

We performed PCA independently on data that were obtained from storm-event and baseflow samples, respectively. Inputs to the PCA were median storm-event or baseflow concentrations from each monitoring location for the following toxic chemicals: total arsenic, total copper, total lead, total mercury, total zinc, total PCBs, total PBDEs, total suspended solids, total phosphorus, and nitrate+nitrite nitrogen. The specific toxic chemicals used in the analysis were a subset of the 21 priority parameters having greater than 40 percent detection frequency. In cases where the dissolved and total fractions of specific heavy metals were frequently detected, we only used data for the total fraction in the PCA analysis. Data for all toxic chemicals were log transformed, centered, and standardized by their standard deviations prior to the PCA analysis. This step was necessary since the concentrations in the input matrix have different units, distributions, and magnitudes.

We ran the PCA in the Matlab Statistics Toolbox and extracted the first and second principal components with their associated eigenvalues. (An eigenvalue is a measure of the variance accounted for by each principal component.) We used this information to generate principal component ordinations for both the individual monitoring locations and the parameters included in the analysis. Separate scatter plots were then generated to show the principal components that were derived from the individual monitoring locations (across all the parameters) and the individual parameters (across all monitoring locations). The monitoring locations were labeled with the associated land-use category and watershed (i.e., Snohomish or Puyallup).

The monitoring location and the parameter plots are related in that the monitoring locations that form a group in the same region of the ordination as the water quality parameters are the monitoring locations that are responsible for the trend in the water quality data. For example, a heavily impacted agricultural site will project in the same area as the constituents usually associated with such sites (e.g., sediment, nutrients, temperature). By analyzing parameter groupings and the associated groupings of land-use categories, patterns in the dataset can be discerned.

Computation of Loading Estimates at the Subbasin Scale

To determine which of the four targeted land uses were significant sources for specific toxic chemicals and contaminants, we computed total and unit-area loading estimates for each subbasin (see Table 1) using the summary statistics described in the *Computation of Summary Statistics* section. Because toxic chemical concentrations in baseflow were expected to be different from storm-event flow due to physical, chemical, and/or biological processes that occur in the ground, these loading estimates were computed separately for the “baseflow” and “storm event” components of the hydrograph over the one-year monitoring period for this study.

In this analysis, the baseflow loading component is defined as the mass of toxic chemical that is exported to receiving waters via groundwater and shallow subsurface flow during periods *between* storm events. The storm-event loading component is defined as the mass of a toxic chemical that is exported to receiving waters via groundwater, shallow subsurface flow, and overland flow *during* storm events. These components of the hydrograph are shown graphically in Figure 5.

To obtain these estimates, we performed the following computational steps for each combination of toxic chemicals or contaminants identified in Appendix E and the major classes of chemicals identified in the *Computation of Summary Statistics* section:

1. The continuous discharge data from each monitoring location were processed using a hydrograph separation algorithm developed for the *Green/Duwamish Watershed Water Quality and Contaminant Loading Analysis* that was implemented by the King County Department of Natural Resources and Parks (Herrera 2007). This algorithm identifies the baseflow and storm-event components of a hydrograph using a sliding interval to assign a preliminary baseflow discharge rate based on the minimum flow over a 3-day window. It then adjusts the baseflow and identifies storm periods using the following user input variables:

    - Starting baseflow discharge rate (cubic feet per second [cfs]) if the initial flow value is missing from the hydrologic record.
    - Maximum percent increase per day in baseflow discharge.
    - Maximum amount (cfs) of increase per day in baseflow discharge.
    - Minimum percent that the maximum daily discharge must exceed the daily average baseflow discharge rate to be categorized as a storm event.

    Additional documentation on this algorithm and the specific inputs that were used for each monitoring location are presented in Appendix H. Note that the QAPP had originally indicated that hydrograph separation for this study would be performed using the HYSEP algorithm (USGS 1996). The HYSEP algorithm uses an empirical relationship that is derived from the drainage area to estimate the maximum duration of surface runoff in days following a rain event. However, the minimum duration of three days that can be computed from this relationship was considered too high given that some of the drainage basins in this study were relatively small and contained a high percentage of impervious surfaces. Due to this consideration, the algorithm developed for the *Green/Duwamish Watershed Water Quality and Contaminant Loading Analysis* was used instead. The baseflow and storm-event volumes computed for each monitoring station using this algorithm are summarized in Table 5.

2. Total loads (i.e., the total mass of contaminants discharged from each subbasin) for the baseflow component of the hydrograph were estimated by multiplying the baseflow volume derived from Step 1 by representative concentrations obtained from samples collected during baseflow. The resultant total load estimates were then divided by the area of each subbasin to obtain unit-area loads (i.e., the mass of contaminants that is discharged from each subbasin from a defined area of land).

3. Total loads for the storm-event component of the hydrograph were estimated by multiplying the storm-event volume derived from Step 1 by representative concentrations obtained from samples collected during storm events. The resultant total load estimates were also divided by the area of each subbasin to obtain unit-area loads.

In these analyses, we successively summed the flow volumes identified in Table 5 for baseflow and storm events, respectively, and multiplied these volumes by appropriate representative concentrations (see *Computation of Summary Statistics* section) to generate total and unit-area load estimates for the following groupings of data:

- Individual monitoring locations
- Land-use categories within the Snohomish watershed and Puyallup watershed, respectively
- Land-use categories across both watersheds combined

For example, to obtain total load estimates for baseflow from all commercial/industrial land use in the Snohomish watershed, we summed the flow volumes for baseflow from the two monitoring locations for commercial/industrial land use in that watershed (CB335 and CBX). We then multiplied this volume by representative concentrations that were computed using the pooled data from the baseflow samples collected at both stations. To obtain the unit-area loading rate, we divided the calculated total loading rate by the combined area for the two commercial/industrial subbasins. This process was repeated, as appropriate, for each different grouping of data identified above.

In all these calculations, the following summary statistics were used as representative concentrations for each grouping of data: minimum, 25th percentile, median, 75th percentile, and maximum. To account for bias that might be introduced in the load estimates due to non-detect values in the concentration data, we computed and qualified the load estimates for each grouping of data based on the following rules:

- If all the concentration data were non-detect values, we computed the total and unit-area load estimates based on the maximum reporting limit from the data. These total and unit-area load estimates were qualified with a less than (<) sign. A “U” qualifier was also assigned to these load estimates to indicate there were no detected values in the concentration data.
- If there were detected values in the concentration data but the percentage of non-detect values represented 50 percent or more of the data, we computed the total and unit-area load estimates based on all summary statistics identified above. All computed loads were assigned an “E” qualifier to indicate they are estimates with relatively low accuracy due to the high number of non-detect values in the concentration data.
- If the percentage of non-detect values represented less than 50 percent of the data, we computed the total and unit-area load estimates based on all summary statistics identified above. All the computed load estimates were then reported without qualification.

The computed total and unit-area load estimates are presented in separate tables for each parameter in this study. We also used range plots and box plots to summarize the unit-area load estimates for each individual monitoring location. The range plots show the unit-area load estimates computed based on the median, minimum, and maximum concentration values from each monitoring location. The box plots show the unit-area load estimates computed based the median, 25th, and 75th percentiles and the minimum and maximum concentrations values.

Computation of Loading Estimates at the Watershed Scale

To determine the contribution of toxic chemicals from the aggregate area for each of the four land-use types within the Snohomish watershed and Puyallup watershed, we computed watershed-scale total load estimates for baseflow and storm events for a subset of 21 priority parameters that are identified in Table 6. Sixteen of the 21 parameters were previously identified as priority parameters during the Phase 1 and Phase 2 studies of toxic chemical loading to Puget Sound. Five additional parameters and dissolved metals were subsequently identified as priorities by the Phase 3 project team.

We computed the watershed-scale total load estimates by multiplying unit-area loading rates for each parameter, land use, and watershed combination by the area represented by the land use in each watershed. The unit-area loading rates in these calculations were derived from the subbasin-scale loading analysis described above. For example, to obtain total load estimates for baseflow from commercial/industrial land use in the Snohomish watershed, we multiplied the total area of commercial/industrial land use in the watershed by the unit-area loading rate that was derived from baseflow samples collected from the two monitoring locations for commercial/industrial land use in the watershed (CB335 and CBX). This process was repeated for each combination of parameter, land use, and watershed. The actual drainage areas used in these calculations for each watershed are shown in Table 7.

In all these calculations, the unit-area loading rates were derived from the following summary statistics for the underlying concentration data: minimum, 25th percentile, median, 75th percentile, and maximum. To account for bias that might be introduced in the load estimates due to non-detect values in the concentration data, we computed and qualified the load estimates for each combination of parameter, land use, and watershed based on the following rules:

- If all the concentration data were non-detect values, we computed the total load estimates based on the maximum reporting limit from the data. These total load estimates were qualified with a less than (<) sign. A "U" qualifier was also assigned to these load estimates to indicate there were no detected values in the concentration data.

- If there were detected values in the concentration data but the percentage of non-detect values represented 50 percent or more of the data, we computed the total load estimates based on all summary statistics identified above. All computed loads were assigned an "E" qualifier to indicate they were estimates with relatively low accuracy due to the high number of non-detect values in the concentration data.

- If the percentage of non-detect values represented less than 50 percent of the data, we computed the total load estimates based on all the summary statistics identified above. All computed load estimates were then reported without qualification.

The computed total load estimates are presented in separate tables for each of the 21 priority parameters in this study.

The project team also considered an alternative method for computing watershed load estimates in this study that was based on the method used for the Phase 2 study (Herrera 2010). This alternate method has different underlying assumptions relative to the method above. Specifically, the method above generally assumes that contaminant export from any given land use is “source limited”; or, in other words, there is a finite amount of contaminant available for export via surface runoff. In contrast, the alternative method that is described in Appendix G assumes that pollutant export is “flow-limited.” In this case, the amount of contaminant that is present in association with any given land use is not the limiting factor for export; rather, the amount of runoff that is available for mobilizing the contaminant is the limiting factor.

Both approaches, extrapolation based on unit-area loads (Herrera 2007) and extrapolation based on concentrations times spatially varying flows (Herrera 2010), have been used in the region and nationally, and the selected method was discussed and preferred by the calculation work group. Appendix G describes this alternative method and compares the associated results for a subset of parameters with the results from the method described above. In general, extrapolating using unit-area loads produces lower overall load estimates for a subset of parameters evaluated than estimated using concentration times flow. The results from this alternative method are not presented in detail within the main body of this report, but Appendix G contains representative calculations and comparisons. The specific rationale for not calculating all pollutant loads based on this alternative method is presented in the *Discussion* section. The *Discussio*n section also compares the unit-area loading rates developed in this study with other studies.

Computation of Loading Estimates at the Puget Sound Scale

The goal of this study was to refine the previous toxic loading estimates from Phase 1 and Phase 2 studies using new data from local watersheds with substantially lower detection limits relative to data from previous studies of toxic chemicals in the region. To do this, total load estimates from the 14 study areas linked to the Puget Sound Box Model (Figure 2) for the subset of 21 priority parameters that are identified in Table 6 were re-computed using the new results generated in this study. Separate estimates were provided for the baseflow and storm-event contribution of the load.

To compute these Puget Sound-scale total load estimates, we multiplied unit-area loading rates for each parameter, land use, and study area combination by the area represented by the land use in each study area. The unit-area loading rates in these calculations were derived from the subbasin scale loading analysis described above. For example, to obtain total load estimates for baseflow from commercial/industrial land use in the Main basin study area, we multiplied the total area of commercial/industrial land use in the study area by the unit-area loading rate that was derived from baseflow samples collected from the four monitoring locations representing commercial/industrial land use (CB335, CBX, CBA, CBB). This process was repeated for each combination of parameter, land use, and study area. The actual drainage areas used in these calculations for each study area are shown in Table 8.

In all these calculations, the unit-area loading rates were derived from the following summary statistics for the underlying concentration data: minimum, 25th percentile, median, 75th percentile, and maximum. To account for bias that might be introduced in the load estimates due to non-detect values in the concentration data, we computed and qualified the load estimates for each combination of parameter, land use, and watershed based on the following rules:

- If all the concentration data were non-detect values, we computed the total load estimates based on the maximum reporting limit from the data. These total load estimates were qualified with a less than (<) sign. A “U” qualifier was also assigned to these load estimates to indicate there were no detected values in the concentration data.
- If there were detected values in the concentration data but the percentage of non-detect values represented 50 percent or more of the data, we computed the total load estimates based on all summary statistics identified above. All computed loads were assigned an “E” qualifier to indicate they were estimates with relatively low accuracy due to the high number of non-detect values in the concentration data.
- If the percentage of non-detect values represented less than 50 percent of the data, we computed the total load estimates based on all summary statistics identified above. All the computed load estimates were then reported without qualification.

The computed total load estimates are presented in separate tables for each of the 21 priority parameters in this study.

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Results

This section presents results from monitoring conducted for the Phase 3 study of toxic chemicals in surface runoff in the Puget Sound ecosystem. We begin by summarizing the results from QA reviews that were performed on laboratory analytical and hydrologic data from the study. To provide some context for interpreting the results, precipitation patterns during the monitoring period are summarized next. Key trends in the data are then identified based on the detection frequency of individual parameters. Finally, toxic chemical loading estimates are presented from calculations performed at the subbasin, watershed, and Puget Sound scales.

Review of Data Quality

Laboratory Analytical Data

Appendix I contains copies of the Data Usability Summary Reports that document the results of the Level 1 data quality review. Brief descriptions of the data quality are provided below for each analytical method.

Appendix R identifies when field duplicate samples were collected and presents the calculated relative percent difference (RPD) between sample and the field duplicate concentrations. Based on these data, the potentially uncertainty in the data from these sources averaged 30 percent across all the monitoring parameters. PCB congeners had the highest mean RPD (40 percent), followed by PBDE congeners (29 percent); however, 52 percent of these results were very close to the reporting limit. The remaining parameters averaged 14 percent RPD.

For individual parameters, this error ranged from <1.0 to 131.0 percent on average; however, extremely high error values were typically associated with sample and duplicate concentrations that were near the reporting limit where the analysis error is generally greatest but of low concern. All parameters with mean RPDs >20 percent were associated with values less than five times the reporting limit except 4-Nitrophenol and Chlorpyrifos.

Metals

MEL analyzed all samples for total and dissolved metals[4] using U.S. Environmental Protection Agency (EPA) Method 200.8 (*Inductively Coupled Plasma – Mass Spectrometry*), and total and dissolved mercury using EPA Method 245.7, in accordance with the QAPP. MEL also analyzed one storm-event sample from 12 locations for a secondary set of total and dissolved metals[5] using EPA Method 200.8. The metals results generally met the project data quality objectives for reporting and quality control (QC) limits. The project team qualified a small number of results as tentatively identified when qualitative QC criteria were not met and qualified several results as estimated to indicate uncertainty in the quantitative measurements.

[4] Arsenic, cadmium, copper, lead, and zinc
[5] Aluminum, antimony, barium, beryllium, cobalt, manganese, nickel, selenium, and thallium

Polychlorinated Biphenyls (PCBs)

Test America Tacoma analyzed samples collected on the following dates from the Snohomish watershed for PCBs: October 17 and November 19, 2009, and April 2 and May 14, 2010. Samples collected on the following dates from the Puyallup watershed were also analyzed for PCBs: October 26 and December 15, 2009, and May 13 and 19, 2010. Samples were analyzed for PCB congeners using EPA Method 1668 (*Chlorinated Biphenyl Congeners by HRGC/HRMS*) in accordance with the QAPP. Test America Sacramento analyzed all the required congeners. The following sets of congeners were reported as combinations rather than single congeners.

- PCB-004/010
- PCB-007/009
- PCB-008/005
- PCB-012/013
- PCB-016/032
- PCB-020/021/033
- PCB-024/027
- PCB-041/064/068
- PCB-043/049
- PCB-047/048/075
- PCB-052/073
- PCB-056/060
- PCB-061/074
- PCB-066/080
- PCB-083/108
- PCB-085/120
- PCB-086/087/097/111/115/116/117/125
- PCB-088/121
- PCB-089/090/101
- PCB-093/095
- PCB-098/102
- PCB-105/127
- PCB-107/108
- PCB-118/106
- PCB-131/142/165
- PCB-132/168
- PCB-135/144
- PCB-138/163/164
- PCB-139/149
- PCB-158/160
- PCB-170/190
- PCB-172/192
- PCB-182/187
- PCB-196/203

The inability of the laboratory to separate these very similar congeners did not negatively impact the data usability. The PCB results generally met the project data quality objectives for reporting and QC limits. The project team qualified a small number of results as tentatively identified when qualitative QC criteria were not met, and qualified others as estimated to indicate uncertainty in the quantitative measurements. Between the initial data screening performed by MEL and the Level 1 QA review performed by E&E, 28 results were rejected for failing to meet QC criteria (representing less than 1 percent of the total possible PCB results). Results were rejected for the following 14 compounds:

1. PCB-001: 5 rejected
2. PCB-002: 6 rejected
3. PCB-003: 5 rejected
4. PCB-006: 1 rejected
5. PCB-007/009: 1 rejected
6. PCB-012/013: 1 rejected
7. PCB-014: 1 rejected
8. PCB-029: 1 rejected
9. PCB-030: 1 rejected
10. PCB-034: 1 rejected
11. PCB-035: 1 rejected
12. PCB-036: 1 rejected
13. PCB-038: 1 rejected
14. PCB-039: 1 rejected

Polybrominated Diphenyl Ethers (PBDEs)

Pacific Rim Laboratories analyzed samples collected on the following dates from the Snohomish watershed for PBDEs: October 17, November 5, and November 19, 2009, and April 2 and May 14, 2010. Samples collected on the following dates from the Puyallup watershed were also analyzed for PBDEs: October 26, November 16, and December 15, 2009, and May 13 and 19, 2010. Samples were analyzed for PBDE congeners using EPA SW-846 Method 1614 (*Brominated Diphenyl Ethers in Water, Soil, Sediment, and Tissue by HRGC/HRMS*) rather than EPA Method 1668 as specified in the QAPP. This variation was acceptable because it provided equivalent or better data than required to meet project data quality objectives.

Pacific Rim analyzed all the required congeners. Results for BDE-156 and BDE-169 were reported as a combination rather than separate congeners. Results for BDE-197 and BDE-204 were also reported as a combination rather than separate congeners. The inability of the laboratory to separate these very similar congeners did not negatively impact the data usability. In addition, Pacific Rim provided data for the following three congeners not specified in the QAPP, but incorporated into this report:

1. BDE-007
2. BDE-010
3. BDE-015

The PBDE results generally met the project data quality objectives for reporting and QC limits. The project team qualified a small number of results as tentatively identified when qualitative QC criteria were not met and qualified several results as estimated to indicate uncertainty in the quantitative measurements. Between the initial data screening performed by MEL and the Level 1 QA review performed by E&E, 67 results were rejected for failing to meet QC criteria (representing less than 3 percent of the total possible PBDE results). Results were rejected for the following four compounds:

1. BDE-007: 22 rejected
2. BDE-010: 22 rejected
3. BDE-015: 22 rejected
4. BDE-077: 1 rejected

Polycyclic Aromatic Hydrocarbons (PAHs)

MEL analyzed all samples for PAHs using EPA SW-846 Method 8270D SIM (Polycyclic Aromatic Hydrocarbons by gas chromatography/mass spectrometry [GC/MS]) in accordance with the QAPP. The PAH results generally met the project data quality objectives for reporting and QC limits. The project team qualified several results to indicate uncertainty in the quantitative measurements. Between the initial data screening performed by MEL and the Level 1 QA review performed by E&E, seven results for Acenaphthylene were rejected for failing to meet QC criteria (representing less than 1 percent of the total possible PAH results).

Base/Neutral/Acid (BNA) Extractable Compounds

MEL analyzed all samples for BNAs using EPA SW-846 Method 8270 (Semi-volatile Organic Compounds by GC/MS) in accordance with the QAPP. The laboratory provided data for the following additional five toxic chemicals that were not specified in the QAPP, but were incorporated into this report:

1. 2-Methylphenol
2. 4-Methylphenol
3. Cholesterol
4. 2-Chloroethanol phosphate (3:1)
5. Pentachlorophenol

The BNA results generally met the project data quality objectives for reporting and QC limits. The project team qualified several results to indicate uncertainty in the quantitative measurements. Between the initial data screening performed by MEL and the Level 1 QA review performed by E&E, 243 results were rejected for failing to meet QC criteria (representing approximately 5 percent of the total possible BNA results). Results were rejected for the following six compounds:

1. 3,3'-Dichlorobenzidine: 40 rejected
2. 3-Nitroaniline: 44 rejected
3. 4-Chloroaniline: 104 rejected
4. 4-Nitrophenol: 7 rejected

5. Cholesterol: 16 rejected
6. N-Nitrosodiphenylamine: 32 rejected

Pesticides

MEL analyzed all samples for pesticides using EPA SW-846 Method 8081 (Chlorinated Pesticide Compounds by gas chromatography/electron capture detector [GC/ECD]) in accordance with the QAPP (Herrera et al. 2009). In addition, MEL provided data for the following seven toxic chemicals not specified in the QAPP, but incorporated into this report:

1. 2,4'-DDD
2. 2,4'-DDE
3. 2,4'-DDT
4. Dacthal (DCPA)
5. DDMU
6. Mirex
7. Pentachloroanisole

The pesticide results generally met the project data quality objectives for reporting and QC limits. The project team qualified a small number of results to indicate uncertainty in the quantitative measurements.

Herbicides

MEL analyzed all samples for herbicides using EPA SW-846 Method 535/8270 (Chlorinated Herbicides by Solid-Phase Extraction and GC/MS) in accordance with the QAPP. Results for all herbicide chemicals specified in the QAPP were received with the exception of Chloramben.

The herbicide results generally met the project data quality objectives for reporting and QC limits. The project team qualified a small number of results as tentatively identified when qualitative QC criteria were not met, and qualified others as estimated to indicate uncertainty in the quantitative measurements. Between the initial data screening performed by MEL and the level one QA review performed by E&E, 29 results were rejected for failing to meet QC criteria (representing less than 2 percent of the total possible herbicide results). Results were rejected for the following two compounds:

1. Acifluorfen (Blazer): 7 rejected
2. Dinoseb: 22 rejected

Petroleum and Oil

MEL analyzed all samples for gasoline using Method NWTPH-GX, #2 diesel using Method NWTPH-DX, lube oil using Method NWTPH-DX, oil and grease (n-hexane extractable material) using EPA 1664/EPA 1664A, and lube oil using EPA 1664/EPA 1664A and Method NWTPH-DX on the dissolved oil and grease (DOG) extract in accordance with the QAPP. The petroleum and oil results generally met the project data quality objectives for reporting and QC limits. The project team qualified a small number of results as tentatively identified when qualitative QC criteria were not met and qualified several results as estimated to indicate uncertainty in the quantitative measurements.

Conventional Parameters

MEL analyzed all samples for ammonia using SM 4500-NH3 H, dissolved and total organic carbon using SM 5310 B, hardness as calcium carbonate ($CaCO_3$) using SM 2340B, nitrate+nitrite nitrogen using SM 4500NO3 I, orthophosphate phosphorus using SM 4500 P G, total persulfate nitrogen using SM 4500NB/SM 4500-NH3 H, total phosphorus using SM 4500 P F, and total suspended solids using SM 2540D. The conventional parameter results generally met the project data quality objectives for reporting and QC limits. The project team qualified a small number of results as tentatively identified when qualitative QC criteria were not met and qualified several results as estimated to indicate uncertainty in the quantitative measurements.

Stream Gauging Data

This section presents a QA summary of the hydrologic data collected at each of the 16 monitoring locations in the Snohomish and Puyallup watersheds. A detailed presentation of the rating curves, data corrections, bias testing of the sensors, and overall assessment of the hydrograph is presented for each monitoring location in a separate memorandum in Appendix J.

After assessing the quality of the hydrologic data at each location, it was determined that all hydrologic data for five of the 16 locations should be flagged as estimates and used with caution (i.e., locations AG174 and FB200 in the Snohomish watershed and locations RB53, RB209, and FB130 in the Puyallup watershed; see Table 5). This is because these data failed to meet the minimum measurement quality objectives (MQOs) specified in the QAPP for completeness and bias. In addition, some data from these stations were flagged as estimates following quantitative evaluations of rating curve quality and qualitative evaluations of hydrograph form. Loading calculations based on the hydrologic data from those five locations should be considered estimates.

Snohomish Watershed

Monitoring Location CB335

All hydrologic MQOs identified in the QAPP were met for the water level and stream discharge data collected at location CB335. There were no data gaps or shifts in the rating curve, and the rating curve error was relatively low. After assessing the quality of the hydrologic data at CB335, it was determined that the data could be used without qualification.

Monitoring Location CBX

All hydrologic MQOs identified in the QAPP were met for the water level and stream discharge data collected at location CBX. There were no data gaps or shifts in the rating curve. Although there was a relatively high degree of rating curve error, most of the error was on the low end of the rating curve (i.e., only affecting low flows) and the data are otherwise of a high quality. After assessing the quality of the hydrologic data at CBX, it was determined that the data could be used without qualification.

Monitoring Location RB111

All hydrologic MQOs identified in the QAPP were met for the water level and stream discharge data collected at location RB111. There was one shift in the rating curve and the rating curve errors were reasonably low, which is generally expected when rating small dynamic stream channels. After assessing the quality of the hydrologic data at RB111, it was determined that the data should be used without qualification.

Monitoring Location RB202

All hydrologic MQOs identified in the QAPP were met for the water level and stream discharge data collected at location RB202. There were two shifts in the rating curve and the rating curve errors were relatively low. This amount of flow conversion error is generally expected when rating small dynamic stream channels. After assessing the quality of the hydrologic data at location RB202, it was determined that the data should be used without qualification.

Monitoring Location AG174

The water level and streamflow data from location AG174 had numerous QA issues. The data from January 18 to April 7, 2010 were missing and replaced with modeled data from RB202. In addition, rating curve had a high degree of error and the hydrograph form was unusual. These combined factors resulted in a hydrograph of poor quality. After assessing the quality of the hydrologic data at AG174, it was determined that the hydrologic data should be flagged as estimates and used with caution. In addition, all loading calculations based on the hydrologic data from AG174 should be considered estimates.

Monitoring Location AGG

All hydrologic MQOs identified in the QAPP were met for the water level and stream discharge data collected at location AGG. Data from May 14 to July 8, 2010 were missing and replaced with modeled data from AG174. A moderate amount of error was observed in the modeled data (25 percent) and the rating curves. These combined factors resulted in a hydrograph of average quality. After assessing the quality of the hydrologic data and characteristics of the hydrograph at AGG, it was determined that the hydrologic data should be used without qualification. Although there were some QA issues, the overall form of the hydrograph was judged to be reasonably accurate.

Monitoring Location FB200

The water level and streamflow data from location FB200 have numerous QA issues. The data from August 1 to December 12, 2009 were noisy and had to be replaced with modeled data from FB203. In addition, the rating had a relatively high degree of error and one erroneous manual discharge measurement had to be excluded from the rating. These combined factors resulted in a hydrograph of average quality. After assessing the quality of the hydrologic data at FB200, it was determined that the hydrologic data should be flagged as estimates and used with caution. In addition, all loading calculations based on the hydrologic data from FB200 should be considered estimates.

Monitoring Location FB203

All hydrologic MQOs identified in the QAPP were met for the water level and stream discharge data collected at location FB203. There were no major data gaps or shifts in the rating curve, and the rating curve error was very low. After assessing the quality of the hydrologic data at FB203, it was determined that the data should be used without qualification.

Puyallup Watershed

Monitoring Location CBA

All hydrologic MQOs identified in the QAPP were met for the water level and stream discharge data collected at location CBA. There was one shift in the rating curve and the rating curve errors were relatively low, which is generally expected when rating in small dynamic channels. After assessing the quality of the hydrologic data at CBA, it was determined that the data should be used without qualification.

Monitoring Location CBB

All hydrologic MQOs identified in the QAPP were met for the water level and stream discharge data collected at location CBB. There were no significant gaps in the data record, and the rating curve error was relatively low. After assessing the quality of the hydrologic data at CBB, it was determined that the data should be used without qualification.

Monitoring Location RB53

The water level and streamflow data from location RB53 had numerous QA issues. Noisy data from August 1 to December 12, 2009 were replaced with modeled data from FB372, and a data gap from April 1, 2009 to April 29, 2009 was also filled with modeled data from FB372. The remaining data had intermittent issues with noise. The rating curve for RB53 was extrapolated by a factor of 3.3 and the total error in the rating was high. All of these combined factors resulted in a hydrograph of poor quality. After assessing the quality of the hydrologic data at RB53, it was determined that all of the hydrologic data should be flagged as estimates and used with caution. In addition, all loading calculations based on the hydrologic data from RB53 should be considered estimates.

Monitoring Location RB209

The water level and streamflow data from location RB209 had numerous QA issues. The data from August 1 to November 3, 2009 were noisy and replaced with modeled data from FB372. In addition, the channel bottom was sandy and unstable, which contributed to a relatively inaccurate rating curve. The combination of these factors resulted in a hydrograph of poor quality. After assessing the quality of the hydrologic data at RB209, it was determined that the hydrologic data should be flagged as estimates and used with caution. In addition, all loading calculations based on the hydrologic data from RB209 should be considered estimates.

Monitoring Location AG143

All hydrologic MQOs identified in the QAPP were met for the water level and stream discharge data collected at location AG143. There was one shift in the rating curve and the rating curve errors were relatively high, but this amount of flow conversion error is generally expected when rating small dynamic stream channels. After assessing the quality of the hydrologic data at AG143, it was determined that the data should be used without qualification.

Monitoring Location AG62

All hydrologic MQOs identified in the QAPP were met for the water level and stream discharge data collected at location AG62. There was one shift in the rating curve and the rating curve errors were relatively high, but this amount of flow conversion error is generally expected when rating small dynamic stream channels. After assessing the quality of the hydrologic data at AG62, it was determined that the data should be used without qualification.

Monitoring Location FB130

All hydrologic MQOs identified in the QAPP were met for the water level and stream discharge data collected at location FB130. However, the level data were noisy, the rating curve error was high, and much of the high-flow records exceeded the maximum discharge measurement. For these reasons, all flow data for this location should be flagged as estimates and used with caution. In addition, all loading calculations based on the hydrologic data from FB130 should be considered estimates.

Monitoring Location FB372

All hydrologic MQOs identified in the QAPP were met for the water level and stream discharge data collected at location FB372. There were no major data gaps or shifts in the rating curve, and the rating curve error was reasonably low. After assessing the quality of the hydrologic data at FB372, it was determined that the data should be used without qualification.

Precipitation Patterns During the Monitoring Period

To provide some context for interpreting the results from this study, monthly and annual precipitation totals for August 2009 through July 2010 (the monitoring period) were compiled from a National Weather Service gauge (Station #457473) at the SeaTac Airport in SeaTac, Washington and compared to historical totals from the same gauge (Table 9). The historical totals were derived from data collected from 1948 to 2009. These data indicate the monitoring period was generally wetter than normal and close to the annual 75th percentile. For example, the precipitation total for the 12-month monitoring period was 42.73 inches. In comparison, the annual average from the historical data was 38.12 inches. The months of October, November, April, May, and June were particularly wet: each had monthly totals that exceeded the 75th percentile total for the respective month from the historical data. Only July was drier than normal based on comparisons of the measured total to the 25th percentile total from the historical data.

In general, these data suggest that higher than normal flows may have occurred at each monitoring location in response to the higher precipitation totals. It follows that toxic chemical loading estimates that were derived from this study may overestimate loads that might be expected during periods with more typical precipitation patterns if loads continue to increase as flows increase; however, if loads are source limited, then there is no expected bias in the estimates.

Detection Frequency Analysis

This section summarizes the detection frequency of the major chemical groups analyzed for this study. The detection frequency results for the priority parameters identified in Table 6 are summarized in Table 10, and results for all parameters are summarized in Appendix K.

Detection frequency is the percentage of samples for which the concentration of a parameter was high enough to be detected in the sample. Analyzing patterns in detection frequency (i.e., where, and under what conditions, specific chemicals were detected) provides a valuable understanding of the sources of the chemicals. Additionally, pinpointing which compounds were rarely or never detected can help improve the efficiency and cost effectiveness of future studies.

The following paragraphs compare the detection frequency for each of the major chemical groups for the four different land uses that were examined (commercial/industrial, agricultural, residential, and forest/field/other) under baseflow and storm-event conditions. Thanks to improved laboratory techniques, low detection limits were achieved for this study compared to previous studies.

Metals

Fifteen metals were analyzed for this study. The following five metals were rarely detected (less than 10 percent frequency):

1. Beryllium
2. Cadmium
3. Selenium
4. Thallium
5. Tin

With the exception of cadmium, these five metals were analyzed only in one storm-event sample from 12 locations. The following four metals were detected but were analyzed only in one storm-event sample from 12 locations:

1. Aluminum
2. Barium
3. Cobalt
4. Manganese

The following six metals were among “key contaminants” identified in Phase 2. All six metals will be discussed in more detail below:

1. Arsenic
2. Cadmium
3. Copper
4. Lead
5. Mercury
6. Zinc

Arsenic, cadmium, and copper were generally detected with equal frequency in storm-event and baseflow samples. In contrast, lead, mercury, and zinc were detected more frequently in storm-event samples (Appendix K, Table K-1). Most of these metals were also detected with equal frequency in samples from the four different land uses. However, the following exceptions were identified based on the data presented in Table K-2:

- Cadmium was generally detected only in samples from the commercial/industrial subbasins.
- Lead and mercury were detected less frequently in samples from forest/field/other subbasins relative to samples from the other three lands use types.

There were no substantial differences in the detection frequency for metals between the Snohomish watershed and Puyallup watershed (Appendix K, Table K-3). Finally, it should be noted that the detection frequency was substantially higher for the dissolved fraction of some metals relative to the total fraction of that metal. This discrepancy in detection frequency is an artifact of using a higher MRL for the total metal compared to the dissolved metal. For example, the detection frequency was 90.0 percent for dissolved zinc versus 46.7 percent for total zinc in baseflow samples because the MRL was 1.0 µg/L for dissolved zinc and 5.0 µg/L for total zinc.

Polychlorinated Biphenyl (PCB) Congeners

The majority of PCB congeners were detected in a small percentage of the samples collected or were not detected in any sample. The following PCB congeners were detected in 50 percent or more of the samples from any of the land-use types:

- PCB-043/049
- PCB-044
- PCB-052/073
- PCB-066/076/080
- PCB-070
- PCB-084
- PCB-086/087/097/ 111/115/116/117/125
- PCB-089/090/101
- PCB-092
- PCB-093/095
- PCB-099
- PCB-105/127
- PCB-110
- PCB-118/106
- PCB-128
- PCB-132/168
- PCB-138/163/164
- PCB-135/144
- PCB-136
- PCB-139/149
- PCB-141

- PCB-146
- PCB-151
- PCB-153
- PCB-170/190
- PCB-174
- PCB-180
- PCB-182/187
- PCB-183

Most of the PCB congeners were detected more frequently during storm events than during baseflow, while a few PCB congeners had similar detection frequencies during baseflow and storm events (Appendix K, Table K-1). The PCB congeners listed above were detected more frequently in commercial/industrial subbasin samples compared to the other land uses (Table K-2). However, PCB detection frequencies for samples from the other land-use types were often above 30 percent. Detection frequencies of PCBs were substantially higher in samples from the Puyallup watershed than the Snohomish watershed (Table K-3). Total PCBs will be discussed in more detail in this report, but the individual congeners will not be described in further detail although data results are available in Appendix L.

Polybrominated Diphenyl Ether (PBDE) Congeners

Of the 36 PBDE congeners analyzed for this study, only the following three congeners were detected at a frequency higher than 50 percent in at least one of the land-use types:

1. PBDE 100
2. PBDE 153
3. PBDE 209

PBDEs were generally detected more frequently in storm-event samples than baseflow samples when compared across all land uses with the exception of PBDE 100 (Appendix K, Table K-1). PBDEs were detected most frequently in commercial/industrial subbasin samples and least frequently in forested and residential subbasin samples (Table K-2). PBDEs were detected somewhat more frequently in the Puyallup watershed than the Snohomish watershed (Table K-3). Total PBDEs will be discussed in more detail in this report, but the individual parameters will not be described in further detail although data results are available in Appendix L.

Polycyclic Aromatic Hydrocarbons (PAHs)

Carcinogenic PAHs

Out of a total of seven carcinogenic PAHs (cPAHs), the following two cPAHs were only detected in a small percentage of the samples collected:

1. Benzo(k)fluoranthene
2. Dibenzo(a,h)anthracene

In contrast, the following five cPAHs were detected at a frequency higher than 50 percent for at least one of the land-use types:

1. Benzo(a)anthracene
2. Benzo(a)pyrene
3. Benzo(b)fluoranthene
4. Chrysene
5. Indeno(1,2,3-cd)pyrene

The latter five compounds were only detected in storm-event samples (Appendix K, Table K-1). These five compounds were primarily detected in commercial/industrial subbasin samples and were almost never detected in agricultural or forested subbasin samples (Table K-2). There was no substantial difference in detection frequency of cPAHs between the Snohomish and Puyallup watersheds (Table K-3). Total cPAHs will be discussed in more detail in this report, but the individual parameters will not be described in further detail although data results are available in Appendix L.

High Molecular Weight PAHs

Out of a total of 10 high molecular weight PAHs (HPAHs), the following two HPAHs were only detected in a small percentage of the samples collected:

1. Benzo(k)fluoranthene
2. Dibenzo(a,h)anthracene

In contrast, the following eight HPAHs were detected at a frequency higher than 50 percent for at least one of the land-use types:

1. Benzo(a)anthracene
2. Benzo(a)pyrene
3. Benzo(b)fluoranthene
4. Benzo(ghi)perylene
5. Chrysene
6. Fluoranthene
7. Indeno(1,2,3-cd)pyrene
8. Pyrene

All 10 HPAHs were detected more frequently in storm-event samples than baseflow samples (Appendix K, Table K-1). These 10 compounds were also primarily detected in commercial/industrial subbasin samples and were almost never detected in agricultural or forested subbasin samples (Table K-2). There was no substantial difference in detection frequency of HPAHs between the Snohomish and Puyallup watersheds (Table K-3). Total HPAHs will be discussed in more detail in this report, but the individual parameters will not be described in further detail although data results are available in Appendix L.

Low Molecular Weight PAHs

Out of a total of six low molecular weight PAHs (LPAHs), the following five LPAHs were detected in a very small percentage of the collected samples or not at all:

1. Acenaphthene
2. Acenaphthylene
3. Anthracene
4. Fluorene
5. Naphthalene

Only one of the LPAHs analyzed (phenanthrene) was detected at a frequency higher than 50 percent of the samples from any land use. Phenanthrene was detected substantially more frequently in storm-event samples than baseflow samples (Appendix K, Table K-1). Phenanthrene was detected almost exclusively in commercial/industrial subbasin samples, and was never detected in agricultural or forested subbasin samples (Table K-2). Phenanthrene was detected slightly more frequently in samples from the Puyallup watershed than the Snohomish watershed (Table K-3). Total LPAHs will be discussed in more detail in this report, but the individual parameters will not be described in further detail although data results are available in Appendix L.

Other Base/Neutral/Acid (BNA) Extractable Compounds

Samples were tested for 52 semi-volatile organic compounds that fall in the category of other BNA extractable compounds. Of this list of 52, only the following six compounds were detected at frequencies higher than 50 percent for any of the land-use types:

1. Bisphenol A
2. Caffeine
3. Cholesterol
4. Ethanol, 2-Chloro-,Phosphate (3:1)
5. Pentachlorophenol (PCP)
6. Retene

When compared across all land-use types, these six BNA compounds were detected more frequently in storm-event samples than baseflow samples (Appendix K, Table K-1). Most of these compounds were detected with the highest frequency in commercial/industrial subbasin samples, with the exception that cholesterol and PCP were detected most frequently in agricultural subbasin samples (Table K-2). The detection frequency for all six of these compounds was the lowest in the forested subbasin samples. There was no substantial difference in the detection frequency of BNA compounds between the Puyallup and Snohomish watersheds (Table K-3).

Nonylphenol was listed as a “key contaminant” in the Phase 2 report (EnviroVision et al. 2008; Herrera 2010), but was rarely detected in this study (Appendix K). Therefore, a comparison in detection frequency among land uses, watersheds, or storm and baseflow samples cannot be made. Nonylphenol is the only BNA compound discussed in more detail in this report. Data for the BNA compounds not discussed are available in Appendix L.

Phthalates

None of the six phthalates analyzed for this study had a detection frequency higher than 50 percent for any of the land-use types. The most frequently detected phthalate was bis(2-ethylhexyl) phthalate (Appendix K).

Bis(2-ethylhexyl) phthalate was listed as a "key contaminant" in the Phase 2 report (EnviroVision et al. 2008; Herrera 2010). This compound was detected more frequently in storm-event samples than baseflow samples when compared across all land uses (Appendix K, Table K-1). Bis(2-ethylhexyl) phthalate was also detected most frequently in commercial/industrial subbasin samples (Table K-2). There was no substantial difference in detection frequency among samples from the other three land-use types. There was also no notable difference in detection frequency of bis(2-ethylhexyl) phthalate or any of the other phthalates between the Snohomish and Puyallup watersheds (Table K-3). Bis(2-ethylhexyl) phthalate is the only phthalate discussed in more detail in this report. Data for the phthalates compounds not discussed are available in Appendix L.

Pesticides

None of the 34 pesticides analyzed had a detection frequency higher than 50 percent for any of the land-use types. The most frequently detected pesticide was pentachloroanisole (Appendix K). For this particular pesticide, the detection frequency was higher for baseflow samples than storm-event samples when compared across all land uses (Table K-1). Pentachloroanisole was detected most frequently in agricultural subbasin samples (Table K-2). There was no substantial difference in detection frequency of pentachloroanisole between the Puyallup and Snohomish watersheds (Table K-3).

DDT was highlighted as being a "key contaminant" in the report for the Phase 2 study of toxics in surface runoff (EnviroVision et al. 2008; Herrera 2010). However, DDT was infrequently detected during this study. Total DDT was detected in 8.3 percent of the storm-event samples and 6.7 percent of the baseflow samples (Appendix K, Table K-1) for all land-use types. Total DDT was detected almost solely in commercial/industrial subbasin samples (Table K-2). Lastly, DDT was detected more frequently in the Puyallup watershed than the Snohomish watershed (Table K-3). Total DDT is the only pesticide discussed in more detail in this report. Data for the pesticides not discussed are available in Appendix L.

Herbicides

Of the 18 herbicides analyzed (see Appendix E), only the following two herbicides were detected at frequencies close to 50 percent for any of the land-use types:

1. 2,4-D
2. Triclopyr

The detection frequency of these two herbicides was higher for storm-event samples than baseflow samples when compared across all land uses (Appendix K, Table K-1). Both 2,4-D and triclopyr were detected most frequently in commercial/industrial subbasin samples (50 percent and 47 percent, respectively) and were rarely detected in forested subbasin samples

(Table K-2). These two herbicides were detected slightly more frequently in the Puyallup watershed than the Snohomish watershed (Table K-3). 2,4-D will not be discussed further in this report because it was analyzed only in 25 percent of the storm-event samples and 13 percent of the baseflow samples. Triclopyr was detected more frequently during storm events (37.5 percent of samples) compared to baseflow conditions (20.0 percent of samples) and is the only herbicide discussed in more detail in this report. Data for the herbicides not discussed are available in Appendix L.

Petroleum and Oil

The following two classes of petroleum hydrocarbons were not detected at all during this study:

1. #2 Diesel
2. Gasoline

In contrast, the following three petroleum and related compound groups were detected more frequently:

1. Lube oil (TPH-Dx method)
2. Lube oil (TPH-DOG method)
3. Oil and grease

These three groups were detected more frequently in storm-event samples than baseflow samples (Appendix K, Table K-1). These three groups were detected at a much higher frequency in commercial/industrial subbasin samples than samples from the other land uses (Table K-2). These compounds were also detected somewhat more frequently in the Snohomish watershed than in the Puyallup watershed when compared across all land-use types (Table K-3). Oil and grease and lube oil (TPH-DOG method) are the only petroleum and related compounds discussed in more detail in this report. Data for the petroleum compounds not discussed are available in Appendix L.

Conventional Parameters

The following conventional parameters were detected in virtually 100 percent of the samples collected:

- Dissolved organic carbon
- Hardness as $CaCO_3$
- Nitrate+nitrite nitrogen
- Total organic carbon
- Total persulfate nitrogen
- Total phosphorus

Only three of the conventional parameters reported were detected in fewer than 100 percent of the samples from any given land use or flow condition:

1. Ammonia
2. Ortho-phosphate
3. Total suspended solids (TSS)

Ammonia and TSS were detected more frequently in storm-event samples than baseflow samples (Appendix K, Table K-1). There was not a substantial difference in ortho-phosphate detection frequency between storm and baseflow samples (Table K-1). Ortho-phosphate and ammonia were detected least frequently in forested subbasin samples and more frequently in the commercial/industrial and agricultural subbasin samples (Table K-2). There was little apparent difference in detection frequency of TSS among the land uses (Table K-2).

Ammonia, ortho-phosphate, and TSS were detected less frequently in samples from the Snohomish watershed than the Puyallup watershed (Table K-3). Otherwise, the detection frequency of conventional parameters was uniform between the two watersheds. Nitrate+nitrite nitrogen, total phosphorus, and TSS are the three conventional parameters discussed in more detail in this report. Data for the conventional parameters not discussed are available in Appendix L.

Principal Component Analysis

Results from the PCA are summarized using scatter plots that show the first principal component projected along the x-axis and the second principal component projected along the y-axis. As described in the *Methods* section, the first principal component explains the most variance in the data while each additional component that is extracted from the data represents successively lesser amounts of variance.

In the PCA that was performed on the data from storm-event sampling, the first and second principal components explain 48 and 25 percent of the variance, respectively. The scatter plot in Figure 6 shows the scores for the monitoring locations (based on median concentrations) in the principal component space while the scatter plot in Figure 7 shows the parameters that are associated with each of the principal components.

- The x-axis in Figure 6 (i.e., first principal component) generally shows that forested monitoring locations group to the right and the remainder of the monitoring locations are mixed in the center and to the left of the plot. At the same time, nitrate+nitrite nitrogen, total phosphorus, total mercury, total arsenic, total copper, and TSS group to the left on the x-axis in Figure 7. This indicates that forested monitoring locations are distinct from the remainder of the monitoring locations because they have particularly low concentrations of these parameters. Thus, the first principal component can generally be interpreted as explaining the chemical differences between developed and undeveloped land.

- If the y-axis in Figure 6 (i.e., second principal component) is then examined, it is evident that commercial/industrial monitoring locations are grouping far from the other monitoring locations in the lower region of the plot (Figure 6). This is apparently explained by commercial/industrial monitoring locations having particularly high concentrations of total PCBs, total zinc, total lead, and total PBDEs relative to the other monitoring locations, as indicated by the y-axis in Figure 7.

In the PCA that was performed on the data from baseflow sampling (Figures 8 and 9), the first and second principal components explained 29 and 25 percent of the variance, respectively.

This is less variance than was explained by the first two principal components of the storm-event data, an indication that the baseflow data are more randomly distributed.

- The x-axis in Figure 8 (i.e., first principal component) shows the forested monitoring locations are generally grouping on the right side of the plot and the rest of the monitoring locations are grouped together. The separation between the forested monitoring locations and the other monitoring locations is less pronounced relative to the pattern in Figure 6 for data that were collected during storm sampling; this is an indication that the chemistry among the land uses is more homogeneous during baseflow in comparison to storm events.

- The x-axis in Figure 9 indicates that the forested monitoring locations are grouping away from the other monitoring locations because they generally have lower concentrations of total phosphorus, total mercury, total arsenic, total lead, total copper, and total PCBs during baseflow conditions.

- Similar to the storm-event analysis, the second principal component for data that were collected during baseflow illustrates the difference between concentrations in the commercial/industrial monitoring locations versus the remainder of the monitoring locations (see y-axis in Figure 8). The difference is defined by relatively high concentrations of total zinc and total PBDEs and relatively low concentrations of nitrate+nitrite nitrogen and TSS in baseflow that was measured at the commercial/industrial monitoring locations (Figure 9).

Subbasin-Scale Contaminant Concentration and Loading Analysis

This section summarizes the contaminant concentrations and loadings for the 21 priority parameters for this study that are identified in Table 6. The goal of this section is to evaluate differences in concentrations and loads for these priority parameters in relation to land use and flow condition (baseflow versus storm-event) at the subbasin scale. Where applicable, exceedances of water quality criteria from the following sources are also compared across the different land uses:

- Acute and chronic freshwater criteria from WAC 173-201A.
- Human health freshwater criteria from National Toxics Rule (40 CFR 131.36)
- EPA National Recommended Water Quality Criteria (EPA 822-R-02-47)

To support this evaluation, summary statistics computed from the concentrations and load estimates for these parameters are provided in Table 10 and 11, respectively. In addition, Figures 10 through 36 present box plots for these parameters showing the following summary statistics for the concentrations: minimum and maximum (whiskers), median, and 25th and 75th percentiles. These same summary statistics are also presented in Figures 37 through 63 for the unit-area loading estimates that were computed for these parameters. Finally, to provide additional context for interpreting these results, the following appendices provide summary statistics for all parameters:

- **Appendix L:** summary statistics for toxic chemical concentrations by monitoring location, land use, and watershed
- **Appendix M:** box plots comparing toxic chemical concentrations between monitoring locations
- **Appendix N:** subbasin-scale total and unit-area toxic chemical loading estimates
- **Appendix O:** whisker plots comparing unit-area toxic chemical loading estimates between monitoring locations

Arsenic

Summary statistics for arsenic concentrations (total and dissolved) are presented in Table 10, Appendix L (Tables L-30 and L-31), and Figures 10 and 11. A comparison to water quality criteria is summarized in Table 12. Summary statistics for arsenic unit-area loading rates are presented in Table 11, Appendix N (Tables N-30 and N-31), and Figures 37 and 38.

Arsenic concentrations were generally similar in storm-event and baseflow samples, and well above the reporting limit of 0.10 micrograms per liter (µg/L). For example, the median dissolved arsenic concentration from all baseflow samples (0.75 µg/L) was only slightly higher than the median concentration from all storm-event samples (0.60 µg/L). Similarly, the median total arsenic concentration from all baseflow samples (0.77 µg/L) was only slightly lower than the median from all storm-event samples (0.81 µg/L).

The median dissolved and total arsenic concentrations were relatively similar for the commercial/industrial and agricultural subbasins, but were generally lower for residential and forested subbasins. For example, the median dissolved arsenic concentrations from all baseflow samples collected in the commercial/industrial and agricultural subbasins were both 1.31 µg/L. In comparison, the median dissolved arsenic concentrations from all baseflow samples collected in the residential and forested subbasins were 0.64 and 0.34 µg/L, respectively. A similar pattern was observed for total arsenic.

Dissolved arsenic concentrations were also compared to acute and chronic water quality criteria for Washington State (WAC 173-201A). No water quality criteria exceedances occurred for dissolved arsenic.

The median unit-area loading rate for dissolved arsenic was nearly the same for storm events (292 g/km^2/yr) and baseflow (279 g/km^2/yr) for all subbasin samples combined. The median unit-area loading rate for total arsenic was higher during storm events (394 g/km^2/yr) than baseflow (287 g/km^2/yr).

The median unit-area loading rates for dissolved and total arsenic were similar among the commercial/industrial and agricultural subbasins, but were generally lower for the residential and forested subbasins. For example, during storm events, the median unit-area loading rates for total arsenic from commercial/industrial and agricultural subbasins were 500 and 427 g/km^2/yr, respectively. In comparison, the median unit-area loading rates during storm events for total arsenic from residential and forested subbasins were 264 and 234 g/km^2/yr, respectively.

Cadmium

Summary statistics for cadmium concentrations (total and dissolved) are presented in Table 10, Appendix L (Tables L-36 and L-37), and Figures 12 and 13. A comparison to water quality criteria is summarized in Table 12. Summary statistics for cadmium unit-area loading rates are presented in Table 11, Appendix N (Tables N-36 and N-37), and Figures 39 and 40.

As noted in the *Detection Frequency Analysis* section, cadmium was generally only detected in samples from the commercial/industrial subbasins. For this land-use category, median dissolved cadmium concentrations were generally similar between storm-event and baseflow samples. For example, the median dissolved cadmium concentration for all samples collected during baseflow conditions from commercial/industrial subbasins was equivalent to the reporting limit of 0.02 µg/L, whereas the median dissolved cadmium concentration for samples collected during storm events was 0.03 µg/L. Total cadmium was not detected in samples collected from the commercial/industrial subbasins during baseflow conditions. The median total cadmium concentration for all storm-event samples was 0.05 µg/L, which is equivalent to one-half the reporting limit of 0.10 µg/L.

Cadmium concentrations showed a similar pattern across the four subbasin types to the pattern that was observed for detection frequency. Specifically, samples from commercial/industrial subbasins tended to have the highest concentrations of cadmium relative to the other subbasin types. For example, median storm-event concentrations of dissolved and total cadmium for the commercial/industrial subbasins were 0.03 and 0.05 µg/L, respectively. In comparison, the median storm-event dissolved cadmium concentration for the agricultural subbasins (the only other land use where cadmium was detected) was 0.01 µg/L (i.e., one-half the reporting limit).

Dissolved cadmium concentrations were also compared to acute and chronic water quality criteria for Washington State (WAC 173-201A). No water quality criteria exceedances occurred for dissolved cadmium.

The median storm-event unit-area loading rates for dissolved and total cadmium for commercial/industrial subbasins were 16.3 and 27.1 g/km^2/yr, respectively. In contrast, the median dissolved cadmium storm-event loading rate for the agricultural subbasins was 3.65 g/km^2/yr. The median loading rates for the remaining subbasin types (i.e., forested and residential) could not be calculated because cadmium was not detected in those subbasins.

Copper

Summary statistics for copper concentrations (total and dissolved) are presented in Table 10, Appendix L (Tables L-40 and L-41), and Figures 14 and 15. A comparison to water quality criteria is summarized in Table 12. Summary statistics for copper unit-area loading rates are presented in Table 11, Appendix N (Tables N-40 and N-41), and Figures 41 and 42.

Copper concentrations were generally higher in storm-event samples than baseflow samples, and well above the reporting limit of 0.10 µg/L. For example, the median dissolved copper concentration for storm-event samples from all subbasins (2.03 µg/L) was substantially higher than the median concentration for baseflow samples (0.74 µg/L). Similarly, the median total copper concentration for storm-event samples (3.24 µg/L) was higher than the median for baseflow samples (0.97 µg/L).

For storm-event samples, median dissolved and total copper concentrations were highest for agricultural subbasins and lowest for forested subbasins. Commercial/industrial and residential subbasin samples fell into the middle of this range. For example, the median storm-event total copper concentration was 5.19 µg/L for agricultural subbasins, 3.84 µg/L for commercial/ industrial subbasins, 2.21 µg/L for residential subbasins, and 0.82 µg/L for forested subbasins.

For baseflow samples, median total copper concentrations were higher for agricultural and commercial/industrial subbasins relative to the medians for the residential and forested subbasins. For example, the median baseflow concentrations of total copper were 1.88 and 1.69 µg/L for the commercial/industrial and agricultural subbasins, respectively. In comparison, the median baseflow concentration of total copper was 0.88 and 0.63 µg/L for residential and forested subbasins, respectively.

Dissolved copper concentrations were also compared to acute and chronic water quality criteria for Washington State (WAC 173-201A). Two exceedances of the acute criterion for dissolved copper occurred during the monitoring period. Both exceedances occurred in commercial/industrial basins during storm-event monitoring. Ten exceedances of the chronic criterion for dissolved copper also occurred during the monitoring period. Nine of these exceedances occurred during storm-event monitoring. Five exceedances were measured in commercial/industrial subbasins, and four exceedances were measured in agricultural subbasins. One exceedance was found in a forested basin (FB372).

Unit-area loading rates for both dissolved and total copper were much higher during storm events than during baseflow. For example, the median unit-area loading rate for dissolved copper for all subbasin types was 988 $g/km^2/yr$ for storm events and 276 $g/km^2/yr$ for baseflow. The median unit-area loading rate for total copper for all subbasin types was 1,580 $g/km^2/yr$ for storm events and 361 $g/km^2/yr$ for baseflow.

Unit-area loading rates for copper were relatively similar among land uses during baseflow despite the apparent pattern in copper concentrations. For example, the median baseflow unit-area loading rates for dissolved copper only ranged from 152 to 317 $g/km^2/yr$ among all the subbasin types. For storm events, the commercial/industrial and agricultural subbasins had substantially higher median loading rates than the residential and forested subbasins. For example, the median unit-area loading rates of total copper for commercial/industrial and agricultural subbasins during storm events were 2,090 and 1,890 $g/km^2/yr$ respectively. In comparison, the median unit-area loading rates of total copper for residential and forested subbasins were 686 and 518 $g/km^2/yr$, respectively.

Lead

Summary statistics for lead concentrations (total and dissolved) are presented in Table 10, Appendix L (Tables L-42 and L-43), and Figures 16 and 17. A comparison to water quality criteria is summarized in Table 12. Summary statistics for lead unit-area loading rates are presented in Table 11, Appendix N (Tables N-42 and N-43), and Figures 43 and 44.

Lead concentrations were generally higher in storm-event samples than baseflow samples. For example, the median dissolved lead concentration for storm-event samples for all subbasins (0.12 μg/L) was substantially higher than median concentration for baseflow samples (0.04 μg/L). Similarly, the median total lead concentration for storm-event samples (0.50 μg/L) was higher than the median total lead concentration for baseflow samples (0.13 μg/L). These median concentrations are within six times the reporting limit of 0.02 μg/L for dissolved lead and 0.10 μg/L for total lead.

In general, higher concentrations of lead were observed in commercial/industrial subbasins relative to the other three subbasin types. For example, the median storm-event concentration of total lead for commercial/industrial subbasins was 1.68 µg/L. In contrast, the second highest median total lead concentration was only 0.52 µg/L for residential subbasins. In general, forested subbasin samples yielded the lowest median dissolved and total lead concentrations among the four subbasin types. The pattern of higher median lead concentrations for commercial/industrial subbasin samples and lower median lead concentrations for the forested subbasin samples was observed for both storm and baseflow samples.

Dissolved lead concentrations were also compared to acute and chronic water quality criteria for Washington State (WAC 173-201A). Dissolved lead concentrations did not exceed the acute criterion for dissolved lead during the monitoring period. Six exceedances of the chronic criterion for dissolved lead occurred during the monitoring period, all of which were measured in commercial/industrial subbasins during storm-event monitoring.

Unit-area loading rates for both dissolved and total lead were much higher for storm events than baseflow. The median unit-area loading rate for dissolved lead for all land uses was 58.4 g/km^2/yr for storm events and 14.9 g/km^2/yr for baseflow. The median unit-area loading rate for total lead across all land uses was 243 g/km^2/yr for storm events and 48.4 g/km^2/yr for baseflow.

Unit-area loading rates for lead were relatively similar among land uses during baseflow despite the apparent pattern in lead concentrations. For example, the median unit-area loading rates for total lead ranged from 17.7 to 43.3 g/km^2/yr across all the land-use categories during baseflow. For storm events, the commercial/industrial subbasins yielded substantially higher median unit-area loading rates than the other subbasins. For example, the median unit-area loading rates of total lead for commercial/industrial subbasins during storm events was 912 g/km^2/yr, whereas the median unit-area loading rates for the other three subbasin types ranged from 82.2 to 161 g/km^2/yr.

Mercury

Summary statistics for mercury concentrations (total and dissolved) are presented in Table 10, Appendix L (Tables L-46 and L-47), and Figures 18 and 19. A comparison to water quality criteria is summarized in Table 12. Summary statistics for mercury unit-area loading rates are presented in Table 11, Appendix N (Tables N-46 and N-47), and Figures 45 and 46.

Mercury concentrations were generally similar for storm-event and baseflow samples. For example, the median dissolved mercury concentration for storm-event samples across all subbasins was 0.004 µg/L while the median concentration for baseflow samples was 0.002 µg/L. The median total mercury concentration for storm-event samples (0.008 µg/L) was also higher than the median concentration from baseflow samples (0.003 µg/L). These median concentrations are within four times the reporting limit of 0.002 µg/L for dissolved and total mercury.

The median dissolved and total mercury concentrations were relatively similar among samples from the commercial/industrial, residential and agricultural subbasins. In contrast, median mercury concentrations were lower for forested subbasin samples. For example, the median storm-event concentrations of total mercury for the commercial/industrial subbasins, residential subbasins, and agricultural subbasins were 0.007, 0.008, and 0.011 µg/L, respectively. In contrast, the median total mercury storm-event concentration for all of the forested subbasins was 0.004 µg/L. The same pattern was observed for dissolved mercury.

Total mercury concentrations were also compared to acute and chronic water quality criteria for Washington State (WAC 173-201A) and human health criteria from the National Toxics Rule (40 CFR131.36). Total mercury concentrations did not exceed the acute criterion or the human health criterion during the monitoring period. Three exceedances of the chronic criterion for total mercury occurred during storm-event monitoring. Two exceedances occurred in forested subbasins (FB200 and FB372), and one exceedance occurred in an agricultural subbasin (AG 143).

Unit-area loading rates for both dissolved and total mercury were higher for storm events than baseflow. For example, the median unit-area loading rate for dissolved mercury across all land uses was 1.95 g/km^2/yr for storm events and 0.745 g/km^2/yr for baseflow. Similarly, the median unit-area loading rate for total mercury for all land uses was 3.89 g/km^2/yr for storm events and 1.12 g/km^2/yr for baseflow.

Unit-area loading rates for mercury were generally higher in the forested subbasins than the other subbasins during baseflow despite the reverse pattern in mercury concentrations. For example, the median baseflow unit-area loading rate for dissolved mercury for all of the forested subbasins was 0.675 g/km^2/yr. In contrast, the median dissolved mercury values for the other three subbasin types were below 0.590 g/km^2/yr. For storm events, the agricultural subbasins had substantially higher median unit-area loading rates than the other subbasin types. For example, the median storm-event unit-area loading rate for dissolved mercury for all the agricultural subbasins was 2.55 g/km^2/yr. In contrast, the other three subbasin types all had median loading rates less than or equal to 1.63 g/km^2/yr.

Zinc

Summary statistics for zinc concentrations (total and dissolved) are presented in Table 10, Appendix L (Tables L-56 and L-57), and Figures 20 and 21. A comparison to water quality criteria is summarized in Table 12. Summary statistics for zinc unit-area loading rates are presented in Table 11, Appendix N (Tables N-56 and N-57), and Figures 47 and 48.

Median zinc concentrations were substantially higher for storm-event samples than baseflow samples. For example, the median storm-event dissolved zinc concentration for all samples was 5.5 µg/L. In contrast, the median baseflow dissolved zinc concentration was 2.3 µg/L. Likewise, the median storm-event concentration of total zinc (8.4 µg/L) was higher than samples collected during baseflow (2.5 µg/L). This pattern was generally observed across all of the individual subbasin types. These median concentrations are within six times the reporting limit of 1.0 µg/L for dissolved zinc and 5.0 µg/L for total zinc.

Zinc concentrations showed a similar pattern across the four land uses to the pattern that was observed for detection frequency. Specifically, commercial/industrial subbasin samples tended to have the highest concentrations (and detection frequency) of zinc relative to the samples collected from the other subbasin types. For example, median storm-event concentrations of dissolved and total zinc for all of the commercial/industrial subbasin samples were 29.1 and 37.2 µg/L, respectively. In comparison, the median dissolved zinc concentrations for samples from the other three subbasin types were less than 6.7 µg/L and median total zinc concentrations were less than 9.0 µg/L. Baseflow samples also showed the same pattern of median zinc concentrations relative to subbasin type.

Dissolved zinc concentrations were also compared to acute and chronic water quality criteria for Washington State (WAC 173-201A). Eleven exceedances of the acute criterion and 13 exceedances of the chronic criterion for dissolved zinc occurred during the monitoring period. All of the exceedances occurred in storm-event samples collected from commercial/industrial subbasins.

The median unit-area loading rate was generally higher in the commercial/industrial subbasins relative to the other subbasin types. This was especially true for storm-event samples. For example, the median storm-event unit-area loading rate for total and dissolved zinc was 20,200 and 15,800 g/km^2/yr, respectively. In comparison, median total zinc unit-area loading rates for the other three land uses were not higher than 3,280 g/km^2/yr, and the median dissolved zinc unit-area loading rate was not higher than 15,800 g/km^2/yr. During baseflow, there were generally less absolute differences in median unit-area loading rates for zinc among the land-use types. However, the median unit-area loading rate for the commercial/industrial subbasins was higher compared to the medians for other three subbasin types. The median unit-area loading rate for the residential subbasins was also lower than the medians for other three land-use types.

Total Polychlorinated Biphenyls (PCBs)

Summary statistics for total PCBs are presented in Table 10, Appendix L (Table L-194), and Figure 22. A comparison to water quality criteria is summarized in Table 12. Summary statistics for total PCB unit-area loading rates are presented in Table 11, Appendix N (Table N-194), and Figure 49.

In general, the median concentration of total PCBs was higher in storm-event samples than baseflow samples. For example, across all of the subbasins, the median total PCB concentration was 348.00 picograms per liter (pg/L) for storm-event samples compared to 226.95 pg/L for baseflow samples. For comparison, the reporting limit for total PCBs ranged from 10 to 820 pg/L.

The concentration of PCBs was much higher for the commercial/industrial subbasins relative to the other three subbasin types. For example, the median storm-event PCB concentration from storm-event samples for the commercial/industrial subbasins was 2,019.75 pg/L. In comparison, the median PCB concentrations for the other three subbasin types were all less than 275.50 pg/L.

Total PCBs were also compared to acute and chronic water quality criteria for Washington State (WAC 173-201A) and human health criteria from the National Toxics Rule (40 CFR131.36). Total PCB concentrations did not exceed the acute criterion; however, one exceedance of the chronic criterion and 23 exceedances of the human health criterion occurred during the monitoring period. The single exceedance of the chronic criterion for total PCBs occurred in one of the commercial/industrial subbasins during storm-event monitoring. Thirteen of the 23 exceedances of the human health criterion for PCBs occurred in commercial/industrial subbasins; however, exceedances also occurred in forested, residential, and agricultural subbasins. A majority of the exceedances (i.e., 18 out of 23 samples) occurred during storm-event monitoring.

Unit-area loading rates for total PCBs were generally higher during storm events than baseflow. The median unit-area loading rate for storm events for all subbasins was 169 mg/km^2/yr, compared to 84.5 mg/km^2/yr for baseflow.

Based on unit-area loading rates, the primary sources for total PCBs varied depending on the flow conditions. For example, the forested subbasins had the highest median unit-area loading rate (81.6 mg/km^2/year) during baseflow whereas the commercial/industrial subbasins had the highest unit-area loading rate (1,100 mg/km^2/yr) during storm events.

Total Polybrominated Diphenyl Ethers (PBDEs)

Summary statistics for total PBDEs are presented in Table 10, Appendix L (Table L-157), and Figure 23. Summary statistics for total PBDE unit-area loading rates are presented in Table 11, Appendix N (Table N-157), and Figure 50. No water quality criteria currently exist for total PBDEs, thus no evaluation of water quality exceedances was performed for this parameter as part of this study.

The same median concentration of total PBDEs (125.0 pg/L) was reported for both storm and baseflow samples across all subbasin types. However, interpretation of these median values is confounded by the high number of non-detect values in the underlying data and the wide range of reporting limits for total PBDEs (121 to 12,900 pg/L).

Substantially higher concentrations of PBDEs were generally observed in commercial/industrial subbasin samples where they were much higher during storm events than baseflow. Across all the commercial/industrial subbasin samples combined, the median total PBDE concentration was 436.0 pg/L for baseflow compared to 3,273.1 pg/L for storm events. PBDEs were detected infrequently in samples from the other three subbasin types (i.e., the median concentration reported for the other three land-use types was one-half the reporting limit), thus meaningful median concentration values could not be provided.

The median unit-area loading rate for total PBDEs was higher for storm events (60.8 mg/km^2/year) than baseflow conditions (46.6 mg/km^2/year) for all subbasins. As with the total PBDE concentration data, the true difference between storm and baseflow is masked by the high number of non-detect samples. For the commercial/industrial subbasins, where most of the PBDEs and the highest concentrations of PBDEs were detected, the difference is more apparent. The median storm-event unit-area loading rate for total PBDEs for all of the commercial/industrial subbasins was 1,780 mg/km^2/yr, and only 69.9 mg/km^2/yr for baseflow.

The median unit-area loading rate for total PBDEs was much higher for the commercial/industrial subbasins than for the other three land-use types. For example, the median storm-event unit-area loading rate for total PBDEs was 1,780 mg/km^2/yr for the commercial/industrial subbasins. In comparison, the medians for all other subbasin types were less than 79.0 mg/km^2/yr (based on median concentrations equal to one-half the reporting limit).

Total Polycyclic Aromatic Hydrocarbons (PAHs)

Summary statistics for total PAHs are presented in Table 10, Appendix L (Table L-357), and Figure 24. Summary statistics for total PAH unit-area loading rates are presented in Table 11, Appendix N (Table N-357), and Figure 51. No water quality criteria currently exist for total PAHs, thus no evaluation of water quality exceedances were performed for this parameter as part of this study. (Carcinogenic PAHs do have criteria, and these are described in the next subsection.)

Total PAHs were rarely detected during baseflow. For this reason, it is not worthwhile to make generalizations about the concentration or unit-area loading rates of these compounds for baseflow conditions. Only data for storm-event samples are discussed below.

Much higher concentrations of total PAHs were observed in the commercial/industrial subbasin samples. Across all of the commercial/industrial subbasins, the median total PAH concentration for storm-event samples was 0.1756 µg/L. In contrast, the next highest median total PAH concentration in storm-event samples for the other three subbasin types was 0.0098 µg/L for the residential subbasins. For reference, the reporting limit for total PAHs ranged from 0.0097 to 0.0340 µg/L.

The unit-area loading rates for total PAHs were also much higher in the commercial/industrial subbasins. The median storm-event unit-area loading rate for total PAHs for all of the commercial/industrial subbasins was 95.3 g/km^2/yr. In contrast, the median storm-event unit-area loading rates for the other three subbasin types were less than 6.07 g/km^2/yr.

Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)

Summary statistics for total cPAHs are presented in Table 10, Appendix L (Table L-392), and Figure 25. Summary statistics for total cPAH unit-area loading rates are presented in Table 11, Appendix N (Table N-392), and Figure 52. No water quality criteria currently exist for cPAHs as a sum. However, the six constituents that comprise the sum do have human health criteria, and these exceedances are summarized in Table 12; no acute or chronic freshwater criteria have been developed.

Total cPAHs were not detected during baseflow. Therefore, only data for storm-event samples are discussed below. Likewise, total cPAHs were never detected in forested subbasin samples so these parameters have been omitted from this discussion as well.

In general, substantially higher median concentrations of total cPAHs were observed in the commercial/industrial subbasin samples. Across all the commercial/industrial subbasins, the median total cPAH concentration for storm-event samples was 0.0845 µg/L. In contrast, the median storm-event total cPAH concentration for the residential subbasins was 0.0075 µg/L.

Six cPAHs were compared to human health criteria from the National Toxics Rule (40 CFR131.36). Sixty-six exceedances of the human health criteria occurred during the monitoring period. All 66 exceedances occurred during storm events, and all occurred in streams draining commercial/industrial subbasins.

The unit-area loading rates for total cPAHs were also much higher in the commercial/industrial subbasins. The median storm-event unit-area loading rate for total cPAHs for all of the commercial/industrial subbasins was 45.9 g/km^2/yr. In contrast, the median storm-event unit-area loading rates for the residential and agricultural subbasins were less than 2.33 g/km^2/yr.

High Molecular Weight Polycyclic Aromatic Hydrocarbons (HPAHs)

Summary statistics for total HPAHs are presented in Table 10, Appendix L (Table L-374), and Figure 26. Summary statistics for total HPAH unit-area loading rates are presented in Table 11, Appendix N (Table N-374), and Figure 53. No water quality criteria currently exist for HPAHs, thus no evaluation of water quality exceedances for this parameter were performed as part of this study. However, the six cPAHs included in total HPAHs do have criteria, and these are described above.

Total HPAHs were rarely detected during baseflow. For this reason, it is not worthwhile to make generalizations about the concentration or unit-area loading rates of these compounds for baseflow conditions. Only data for storm-event samples are discussed below. Likewise, total HPAHs were never detected in forested subbasin samples so these parameters have been omitted from discussion as well.

In general, substantially higher median concentrations of total HPAHs were observed in the commercial/industrial subbasin samples. Across all the commercial/industrial subbasins, the median total HPAH concentration for storm-event samples was 0.1516 µg/L. In contrast, the highest median storm-event total HPAH concentration for the residential subbasins was 0.0082 µg/L.

The unit-area loading rates for total HPAHs were much higher in the commercial/industrial subbasins. The median storm-event unit-area loading rate for total HPAHs for all of the commercial/industrial subbasins was 82.3 g/km^2/yr. In contrast, the median storm-event unit-area loading rates for the residential and agricultural subbasins were less than 2.56 g/km^2/yr.

Low Molecular Weight Polycyclic Aromatic Hydrocarbons (LPAHs)

Summary statistics for total LPAHs are presented in Table 10, Appendix L (Table L-385), and Figure 27. Summary statistics for total LPAH unit-area loading rates are presented in Table 11, Appendix N (Table N-385), and Figure 54. No water quality criteria currently exist for total LPAHs or for the individual constituents, thus no evaluation of water quality exceedances was performed for this parameter as part of this study.

Total LPAHs were rarely detected during baseflow. For this reason, it is not worthwhile to make generalizations about the concentration or unit-area loading rates of these compounds for baseflow conditions. Only data for storm-event samples are discussed below.

In general, substantially higher median concentrations of total LPAHs were observed in the commercial/industrial subbasin samples. Across all the commercial/industrial subbasins, the median total LPAH concentration for storm-event samples was 0.0135 µg/L. In comparison, the median total LPAH concentration for storm-event samples for each of the other three subbasin types was approximately 0.0050 µg/L.

The unit-area loading rates for total LPAHs were highest in the commercial/industrial subbasins. The median storm-event unit-area loading rate for total LPAHs for all of the commercial/ industrial subbasins was 7.33 $g/km^2/yr$. In contrast, the median storm-event unit-area loading rates for the other three subbasin types were less than 3.14 $g/km^2/yr$.

Bis(2-ethylhexyl) phthalate

Summary statistics for bis(2-ethylhexyl) phthalate are presented in Table 10, Appendix L (Table L-151), and Figure 28. A comparison to water quality criteria is summarized in Table 12. Summary statistics for bis(2-ethylhexyl) phthalate unit-area loading rates are presented in Table 11, Appendix N (Table N-151), and Figure 55.

Bis(2-ethylhexyl) phthalate was rarely detected during baseflow. For this reason, it is not worthwhile to try to make generalizations about the concentration or unit-area loading rates of this compound for baseflow conditions. Only data for storm-event samples are discussed below.

Substantially higher concentrations of bis(2-ethylhexyl) phthalate were observed in commercial/industrial subbasin samples. Across all the commercial/industrial subbasins, the median bis(2-ethylhexyl) phthalate concentration during storm events was 0.340 µg/L. Bis(2-ethylhexyl) phthalate was detected too infrequently in the other three subbasins to provide meaningful median concentration values (i.e., the median concentration reported for each of the other three land-use types was one-half the reporting limit).

No Washington State water quality criteria currently exist for bis(2-ethylhexyl) phthalate; however, there is a human health criterion for this parameter from the National Toxics Rule (40 CFR131.36). Only one exceedance of the human health criterion occurred in a residential basin during baseflow monitoring.

The unit-area loading rate for storm events for bis(2-ethylhexyl) phthalate was much higher (185 g/km^2/yr) for all the commercial/industrial subbasins combined compared to the other land-use types. The median unit-area loading rates for bis(2-ethylhexyl) phthalate for the other subbasin types ranged from 24.8 to 50.6 g/km^2/yr for residential and forested subbasins, respectively (based on median concentrations equal to one-half the reporting limit).

Triclopyr

Summary statistics for triclopyr are presented in Table 10, Appendix L (Table L-27), and Figure 29. Summary statistics for triclopyr unit-area loading rates are presented in Table 11, Appendix N (Table N-27), and Figure 56. No water quality criteria currently exist for triclopyr, thus no evaluation of water quality exceedances was performed for this parameter as part of this study.

It is difficult to meaningfully compare the median triclopyr concentrations for baseflow conditions and storm events. Triclopyr was detected in less than 50 percent of the samples for any of the subbasin types for either storm-event or baseflow conditions. Therefore the median reported value (approximately 0.0310 µg/L for all land-use types) reflects an estimate based on one-half the reporting limit and not actual conditions.

Trying to compare triclopyr concentrations between land-use types is also difficult due to the low detection frequency. For each of the subbasin types, the median triclopyr concentration is reported as approximately 0.0310 µg/L, which is equal to one-half the reporting limit.

Unit-area loading rates of triclopyr were higher during storm events than baseflow. The median storm-event unit-area loading rate was 15.1 g/km^2/yr for all subbasins combined, compared to 11.4 g/km^2/yr for baseflow. Because the loading rates for all of the subbasin types were based on median concentrations equal to one-half the reporting limit, differences in loading estimates reflect differences in land area and median discharge.

Nonylphenol

Summary statistics for nonylphenol are presented in Table 10, Appendix L (Table L-58), and Figure 30. A comparison to water quality criteria is summarized in Table 12. Summary statistics for nonylphenol unit-area loading rates are presented in Table 11, Appendix N (Table N-58), and Figure 57.

Nonylphenol was detected in only 1 percent of the samples collected for this study. Therefore, any comparisons of concentrations or loading rates among land uses or flow conditions would simply reflect differences in reporting limit and flow. No exceedances of acute or chronic water quality criteria for Washington State (WAC 173-201A) occurred in the collected samples. Based on the low detection frequency and the low concentrations of nonylphenol measured, an evaluation of nonylphenol is not provided in this section.

Total Dichlorodiphenyltrichloroethane (DDT)

Summary statistics for total DDT are presented in Table 10, Appendix L (Table L-111), and Figure 31. Summary statistics for total DDT unit-area loading rates are presented in Table 11, Appendix N (Table N-111), and Figure 58. Several forms or byproducts of DDT have water quality criteria; however, total DDT does not. Table 12 includes comparisons of DDT-related compounds to acute and chronic freshwater criteria and human health criteria.

It is difficult to meaningfully compare the median total DDT concentrations for baseflow and storm events based on the median concentrations for all land uses combined, due to the low detection frequencies. In this case, it is more useful to compare storm-event and baseflow DDT concentrations for the commercial/industrial subbasin samples only, because that is where DDT was the most frequently detected. For example, the median storm-event DDT concentration for commercial/industrial subbasins was 1.250 nanograms per liter (ng/L). In comparison, the median baseflow concentration for commercial/industrial subbasins was 0.100 ng/L.

The median DDT concentration for storm-event samples for three land-use types (i.e., commercial/industrial, agricultural, and forest) is reported as 1.250 ng/L (i.e., one-half the reporting limit). DDT was not detected in the residential subbasins. For baseflow samples, total DDT was only detected in commercial/industrial subbasins.

DDT-related compounds were also compared to acute and chronic water quality criteria for Washington State (WAC 173-201A) and human health criteria from the National Toxics Rule (40 CFR131.36). Results did not exceed the acute water quality criteria for 4,4'-DDD, 4,4'-DDE, or 4,4'-DDT. However, 13 exceedances of the chronic water quality criteria occurred during the monitoring period. All occurred in commercial/industrial subbasins and all but one during storm-event monitoring. Thirteen results exceeded the human health criteria, also for commercial/industrial subbasins and all but one during storm-event monitoring.

Unit-area loading rates of total DDT were higher during storm events than during baseflow. The median storm-event unit-area loading rate was 0.608 $g/km^2/yr$ during storm events compared to 0.0372 $g/km^2/yr$. Because all unit-area loading rates for total DDT were based on median concentrations equal to one-half the reporting limit, differences in loading rates reflect differences in land area and median discharge.

Oil and Grease

Summary statistics for oil and grease concentrations are presented in Table 10, Appendix L (Table L-149), and Figure 32. Summary statistics for oil and grease unit-area loading rates are presented in Table 11, Appendix N (Table N-149), and Figure 59. No water quality criteria currently exist for oil and grease, thus no evaluation of water quality exceedances was performed for this parameter as part of this study.

It is difficult to meaningfully compare the median oil and grease concentrations for baseflow conditions and storm events or between land uses. The detection frequency was less than 50 percent for each of the land-use types. The reported median value for all land-use types for both storm and baseflow was calculated as 0.20 mg/L, which is equivalent to one-half the detection limit of 0.40 mg/L.

The median oil and grease unit-area loading rate for all land uses combined was slightly higher for storm events (97.3 $kg/km^2/year$) compared to baseflow (74.5 $kg/km^2/year$). Median unit-area loading rates for oil and grease were higher in the forested subbasins than the other land-use types for both storm and baseflow. For example, the median baseflow unit-area loading rate for the forested subbasins was 135 $kg/km^2/year$. In contrast, the next highest oil and grease baseflow loading rate (48.2 $kg/km^2/year$) occurred in the residential subbasins. Because these values were based on median concentrations equal to one-half the reporting limit, differences in loading rates only reflect differences in land area and median discharge.

It should be noted that baseflow from the forested subbasins was proportionally greater than from the other land uses. For example, the area-normalized baseflow discharge averaged 1.6 cubic feet per second per square mile (cfs/mi^2) among the four forested subbasins. The same values for the commercial/industrial, residential, and agricultural subbasins were 0.5, 0.8, and 0.4 cfs/mi^2, respectively (Table 5). This discrepancy explains why equivalent concentrations of oil and grease from each land use (Table 10) resulted in much higher unit-area loading rates from forested subbasins (Table 11). The source of oil and grease in the forested subbasins is likely different than in the other subbasins because there are no readily available anthropogenic sources of petroleum hydrocarbons in the forested subbasins. Decaying plant and animal matter is one potential natural source for oil and grease in the forested subbasins.

Lube Oil (TPH-DOG)

Summary statistics for lube oil analyzed by the total petroleum hydrocarbons – oil and grease (TPH-DOG) method are presented in Table 10, Appendix L (Table L-150), and Figure 33. Summary statistics for lube oil (TPH-DOG) unit-area loading rates are presented in Table 11, Appendix N (Table N-150), and Figure 60. No water quality criteria currently exist for lube oil (TPH-DOG), thus no evaluation of water quality exceedances was performed for this parameter as part of this study.

It is difficult to meaningfully compare the median lube oil (TPH-DOG) concentrations for baseflow conditions and storm events or between land uses. The detection frequency was less than 50 percent for each of the land-use types. The reported median value for agricultural subbasins during baseflow and agricultural, residential, and forested subbasins during storm events was 0.016 mg/L. Therefore, the reported median concentration values for lube oil (TPH-DOG) reflect an estimate based on the MRL and not actual conditions. One exception was commercial/industrial subbasins during storm events where lube oil (TPH-DOG) was detected 75 percent of the time with a median concentration of 0.075 mg/L.

Lube oil (TPH-DOG) was not detected in enough baseflow samples to draw meaningful comparisons regarding loading among land uses. For storm events, the highest median lube oil (TPH-DOG) unit-area loading rate (40.7 $kg/km^2/year$) occurred in the commercial/industrial subbasins. Median unit-area loading rates were less than 10.1 $kg/km^2/year$ for the other three land-use types. Because these values were based on median concentrations equal to one-half the reporting limit, differences in loading rates only reflect differences in median discharge.

Total Suspended Solids (TSS)

Summary statistics for TSS are presented in Table 10, Appendix L (Table L-9), and Figure 34. Summary statistics for TSS unit-area loading rates are presented in Table 11, Appendix N (Table N-9), and Figure 61. No water quality criteria currently exist for TSS, thus no evaluation of water quality exceedances was performed for this parameter as part of this study.

TSS concentrations were generally higher for storm-event samples than baseflow samples when compared across all of the subbasins. The median TSS concentration for storm-event samples for all subbasin types was 9.00 milligrams per liter (mg/L). The median TSS concentration for baseflow samples was 2.00 mg/L.

During storm-event samples, median TSS concentrations were generally higher in the commercial/industrial and residential subbasins than in the agricultural or forested subbasins. For example, the median storm-event sample concentrations for the commercial/industrial and residential subbasins were 10.00 and 14.0 mg/L, respectively. In comparison, the median storm-event concentrations for the agricultural and forested subbasins were 5.50 and 7.00 mg/L, respectively.

Unit-area loading rates of TSS were generally higher during storm events than during baseflow when compared across all land uses. For example, the median unit-area loading rate for TSS for all land uses combined was 4,380 $kg/km^2/yr$ for storm events and 745 $kg/km^2/yr$ for baseflow.

For storm events, median TSS unit-area loading rates were generally higher for the commercial/industrial, residential, and forested subbasins, compared to the agricultural subbasins. For example, the storm-event TSS unit-area loading rates for the commercial/industrial, residential, and forested subbasins were 5,430, 4,340, and 4,420 $kg/km^2/yr$, respectively. In comparison, the median storm-event unit-area loading rate for the agricultural subbasins was 2,010 $kg/km^2/yr$. For baseflow, the median TSS unit-area loading rates were generally similar for the residential, agricultural, and forested subbasins, but were substantially lower for the commercial/industrial subbasins. For example, the median loading rate for the commercial/industrial subbasins was 80.2 $kg/km^2/yr$, whereas the median unit-area loading rate for the other three subbasin types was greater than or equal to 590 $kg/km^2/yr$.

Total Phosphorus (TP)

Summary statistics for TP are presented in Table 10, Appendix L (Table L-8), and Figure 35. Summary statistics for TP unit-area loading rates are presented in Table 11, Appendix N (Table N-8), and Figure 62. No statewide water quality criteria currently exist for total phosphorus, thus no evaluation of water quality exceedances was performed for this parameter as part of this study.

TP concentrations were generally similar between storm-event samples and baseflow samples when compared across all of the subbasins. The median TP concentration for storm-event samples for all subbasins was 0.054 mg/L. The median concentration for baseflow samples was 0.038 mg/L.

Median TP concentrations were generally higher for the agricultural subbasin samples than samples from the other three subbasin types. For example, the median storm-event TP concentration for all agricultural subbasins was 0.206 mg/L. In comparison, the median storm-event sample TP concentration for the other three subbasin types ranged from 0.024 to 0.067 mg/L.

Unit-area loading rates of TP were generally slightly higher for storm events than baseflow when compared across all land uses. For example, the median unit-area loading rate for TP for all land-use types was 26.3 kg/km^2/yr for storm events and 14.2 kg/km^2/yr for baseflow.

The median TP unit-area loading rate was generally higher for the agricultural subbasins than for the other subbasin types. For example, the median storm-event TP unit-area loading rate for the agricultural subbasins was 75.2 kg/km^2/yr. In comparison, the median storm-event TP unit-area loading rate for the other three subbasin types ranged from 15.3 to 23.8 kg/km^2/yr.

Nitrate+Nitrite Nitrogen

Summary statistics for nitrate+nitrite nitrogen are presented in Table 10, Appendix L (Table L-4), and Figure 36. A comparison to water quality criteria is summarized in Table 12. Summary statistics for nitrate+nitrite nitrogen unit-area loading rates are presented in Table 11, Appendix N (Table N-4), and Figure 63.

Nitrate+nitrite nitrogen concentrations were generally similar between storm-event samples and baseflow samples when compared across all of the subbasins. The nitrate+nitrite nitrogen concentration for storm-event samples for all subbasins was 0.345 mg/L. The nitrate+nitrite nitrogen concentration for baseflow samples was 0.308 mg/L. However, unique patterns in concentration relative to flow condition were observed among the among the four land uses. These patterns are described below.

For baseflow samples, nitrate+nitrite nitrogen concentration was generally higher for the residential subbasins relative to the other subbasin types. For example, the median baseflow nitrate+nitrite nitrogen concentration for the residential subbasins was 1.027 mg/L. In comparison, the median baseflow nitrate+nitrite nitrogen concentrations for the other three land-use types ranged from 0.089 to 0.230 mg/L.

For storm-event samples, the median nitrate+nitrite nitrogen concentrations were generally higher in both the residential and agricultural subbasins relative to the commercial/industrial and forested subbasins. For example, the median storm-event nitrate+nitrite nitrogen concentrations for the residential and agricultural subbasins were 0.994 and 1.025 mg/L, respectively. In comparison, median storm-event nitrate+nitrite nitrogen concentrations for the commercial/ industrial and forested subbasins were 0.174 and 0.228 mg/L, respectively.

No Washington State water quality criteria currently exist for nitrate+nitrite nitrogen in surface water; however, there is a human health criterion for this parameter in the EPA National Recommended Water Quality Criteria (EPA 822-R-02-47). Three exceedances of the human health criterion occurred during the monitoring period. All three exceedances occurred in agricultural subbasins during storm-event monitoring.

Unit-area loading rates of nitrate+nitrite nitrogen were generally higher during storm events than during baseflow. For example, the median unit-area loading rate for nitrate+nitrite nitrogen for all land-use types was 168 kg/km^2/yr for storm events and 115 kg/km^2/yr for baseflow. The higher loading rates observed during storm events as opposed to baseflow are primarily the result of higher flow volume during storm events, because similar concentrations were observed under both flow conditions.

Unit-area loading rates for nitrate+nitrite nitrogen were generally higher for the residential subbasins during baseflow and higher in both the residential and agricultural subbasins during storm events. The median baseflow unit-area loading rate for nitrate+nitrite nitrogen for the residential subbasins was 247 kg/km^2/yr, whereas the median baseflow unit-area loading rates for the other subbasin types ranged from 36.9 to 60.1 kg/km^2/yr. For storm events, the median unit-area loading rates for the residential and agricultural subbasins were 308 and 374 kg/km^2/yr, respectively. In comparison, the median storm-event unit-area loading rate for the commercial/industrial subbasins was 94.5 kg/km^2/yr, and 144 kg/km^2/yr for the forested subbasins.

Toxic Chemical Loading Estimates at the Watershed Scale

Total loads by land use from the Snohomish watershed are presented in Table 13 for the 21 priority parameters identified in Table 6. Total loads by land use for the Puyallup watershed are presented in Table 14 for these same parameters. In addition, both Tables 13 and 14 present total loads for each watershed from baseflow and storm events, respectively (by summing the loads from the individual land uses), and total loads for each watershed across all hydrologic conditions (by summing the baseflow and storm-event loads). Finally, more detailed summaries of the total loads for both watersheds are presented in Appendix P.

For parameters where one or more land uses or events were entirely non-detects, the tables reflect a range. The low end of the range treats all combinations of land use and event type as zero if all results were non-detects. The high end treats all categories composed of only non-detects as equal to the reporting limit. For example, dissolved cadmium was detected in both baseflow and storm events from commercial lands and only in storm events from agricultural lands. The agricultural contributions range from only the storm-event contributions to a higher value that treats baseflow non-detects as equivalent to the reporting limit. This range is carried through to the totals across land uses and over baseflow and storm events. The low end of the range represents what was documented from the detected results, while the high end represents that maximum that may have occurred if actual values were just below the reporting limit.

In general, these results show forested areas in both watersheds produced much higher total loads for the 21 priority parameters relative to the other land uses, even though forested land use had lower concentrations and unit-area loading rates for these parameters compared to the other land uses (Tables 10 and 11). These results, similar to the Phase 1 and Phase 2 findings, reflect the much greater land area that forests represent within each watershed compared to the other land uses (Table 8). Forested lands represent 88 percent of the Puyallup watershed and 84 percent of the Snohomish watershed areas (Table 7). When these large areas are multiplied by the unit-area loading rates for forested land use, a large total load is computed; however, this is likely an overestimation of the true contaminant yield from these areas (see *Discussion* section).

Among the developed land uses (commercial/industrial, residential, and agricultural), total loading rates for the 21 priority parameters were generally highest for the residential areas of both watersheds and lowest for commercial/industrial areas because of the proportion of these land uses in each watershed. As shown in Table 7, the residential land use in both watersheds (9.1 and 12.2 percent) represented a substantially larger area than commercial/industrial land use (0.2 and 0.6 percent). Thus, despite the fact that the commercial/industrial land use generally had higher concentrations of the 21 priority parameters, total loads were higher for the residential areas. Total loads for agricultural areas generally fell between these two values, which is consistent with its relative land area and unit-area loads. However, the following exceptions were observed, even considering differences in areas:

- **Copper and Lead**: The storm-event loads for copper and lead were higher for the agricultural area of the Puyallup watershed than for the other two developed land uses within the watershed.
- **Total PCBs**: The total PCB storm-event loads were higher for the commercial/industrial areas than for the other developed land uses in both watersheds.
- **Total PBDEs**: The total PBDE storm-event loads were higher for the commercial/industrial areas than for the other developed land uses in both watersheds.

Aside from the exceptions listed above, the total loads computed at the watershed scale were more influenced by relative land area than contaminant concentration. For example, the commercial/industrial subbasins generally had higher concentrations (and unit-area loading rates) of the 21 priority parameters than the other land uses. In contrast, total loads were smaller for the commercial/industrial land use in both watersheds compared to the other three land uses in almost all cases.

Toxic Chemical Loading Estimates for the Puget Sound Scale

The goal of the Phase 3 study was to refine the results from the previous Phase 1 and Phase 2 surface runoff studies using site-specific data. Phase 3 included collecting new environmental data with low detection limits and a more refined calculation approach. Appendix Q presents total loads for the priority parameters identified in Table 6 by land use for the 14 study areas linked to the Puget Sound Box Model.

Table 15 presents total loads for these same parameters by land use for the Puget Sound basin based on the combined loads from the individual study areas. In addition, Table 15 presents total loads for the Puget Sound basin from baseflow and storm events, respectively (by summing the loads from the individual land uses), and the total loads for the Puget Sound basin across all hydrologic conditions (by summing the baseflow and storm-event loads).

Ranges are included for any parameters with at least one combination of land use and event type where results were entirely non-detects. The range reflects treating this contribution as zero or equal to the reporting limit. The range spans several orders of magnitude for several parameters, including cadmium, total DDTs, and nonylphenol.

Heavy metal loads to Puget Sound in both total and dissolved form were not affected by detection limits, with the exception of cadmium. Detection frequency strongly included estimates of both total and dissolved cadmium, and load estimates are not as well constrained as for other metals. For all other metals, forested contributions dominate total loads at the Puget Sound scale due to the larger land area. Among developed lands, residential was the biggest contributor for arsenic, total copper, lead, mercury, and zinc, while agriculture was the biggest contributor for dissolved copper. Relative land area strongly influences relative metals contribution at the Puget Sound scale.

Total PCBs and total PBDEs from various land uses and event types were not strongly influenced by detection limits. Of the developed land uses, commercial lands contribute the most to Puget Sound-scale loads, although residential loads are comparable. Agricultural lands produce the lowest contributions of the four land uses. Forested lands contribute the highest loads at the Puget Sound scale due to the relative land area.

PAH loads at the Puget Sound scale were strongly influenced by non-detects, particularly during baseflow events. Storm-event PAH contributions from commercial areas were well characterized, but few or no detects in the other three land uses, even during storm events, produce ranges in the overall loads depending on how non-detects are treated. Among developed land uses, commercial lands contributed the highest loads of carcinogenic PAHs (treating non-detected contributions as zero). Carcinogenic PAHs were not detected at all in baseflow or storm events in streams draining forested lands, and these loads are not well described.

Bis(2-ethylhexyl) phthalate, triclopyr, nonylphenol, and total DDT load estimates at the Puget Sound scale were strongly influenced by non-detects, particularly in baseflow. Bis(2-ethylhexyl) phthalate was only found at high frequencies in storm events in commercial areas, while triclopyr was only detected in storm events in residential areas. Nonylphenol was only found in storms in commercial basins. At the Puget Sound scale, forested lands produced the highest loads due to the large forested land area. Among the developed lands, residential lands produced highest loads of bis(2-ethylhexyl) phthalate and triclopyr. Nonylphenol was not well characterized in the estimate, which spans several orders of magnitude depending on how non-detects are treated. Total DDT loads at the Puget Sound scale were influenced by non-detects, although resulting load estimates were better constrained than parameters such as nonylphenol.

Oil and grease and total petroleum hydrocarbon (TPH-Dog, lube oil) loads were strongly influenced by detection limits. Among developed land uses, residential lands produce the highest loads of both at the Puget Sound scale. Forested lands produce more oil and grease load due to the relative area. TPH was frequently found in storm events in commercial lands but load contribution at the Puget sound scale was low compared with other land uses due to relative land area and the treatment of non-detects. TPH was not found in forested baseflow and was found infrequently in storm events from forested lands, yet forested lands contributed the highest TPH loads at the Puget Sound scale. Among developed land uses, residential lands produced the highest loads at the Puget Sound scale.

TSS, total phosphorus, and nitrate+nitrite nitrogen loads at the Puget Sound scale were not influenced by reporting limits, and the estimates are well characterized. Forested lands produced the highest loads and commercial lands produced the lowest loads of all land uses. Relative contributions primarily reflect relative land area.

The following discussion compares the contaminant loading estimates between the Phase 2 and Phase 3 studies for the following five representative parameters:

1. Total copper
2. Total zinc
3. Total PCBs
4. Total PBDEs
5. Oil and grease

These parameters were chosen for comparison because they were included in all phases, and they were detected in the Phase 3 study at relatively high frequencies. Table 16 compares total loading rates from the Puget Sound basin between the Phase 2 Addendum (Herrera 2010) and Phase 3 studies for the combined loads from all land-use types using data from the five parameters listed above. In this table, the combined load for the Phase 3 study was derived by summing the individual loads from baseflow and storm events across all four land-use types within each of the 14 study areas. Additionally, Table 17 compares total loads for the Puget Sound basin between the two studies across the individual land-use types.

The data presented in Table 16 indicate the total loads from the Phase 3 study were lower than loads from the Phase 2 study for four of the five parameters compared. Of these four parameters, the most substantial difference between the two studies was observed for total PCBs. For example, the total loading rate for total PCBs from the Phase 3 study was 96 percent less than the rate from the Phase 2 study, or over an order of magnitude, due to the lower concentrations measured in the Phase 3 study. Total loads for three parameters (total copper, total zinc, and oil and grease) were approximately one-half the values calculated in the Phase 2 study. As shown in Table 16, total PBDEs had much higher total loads in the Phase 3 study relative to the Phase 2.

Differences in total loads between the Phase 2 and Phase 3 studies across the four land-use types generally showed a similar pattern to that observed for all land uses combined. Specifically, total loads from the Phase 2 study were generally higher than those from the Phase 3 study across all land-use types (Table 17). However, the following exceptions were noted:

- **Total Zinc:** Total zinc total loads from the forested land areas were slightly higher for the Phase 3 study relative to the Phase 2 study.
- **Oil and Grease:** Oil and grease total loads from the forested land areas were substantially higher for the Phase 3 study relative to the Phase 2 study. This is due to how non-detects were treated and the fact that the previous phases used 50th percentile concentrations that were below the detection limit for this parameter.
- **Total PBDEs**: Total PBDE total loads from all four land-use types were higher for the Phase 3 study relative to the Phase 2 study.

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Discussion

The data presented in the *Results* section provide a detailed description of the toxic contaminant concentrations and loads that were measured in this 2009-10 study. This section presents a discussion of these results in relation to the overall objectives of the study and use of the data. It begins with a description of potential sources of error in the data and provides some guidelines for their interpretation. It then discusses key patterns that were identified in the data and their implications for managing toxic chemicals in surface runoff. Finally, it evaluates the representativeness of the compiled data for computing loads at the Puget Sound scale based on comparisons to data from other regional and national studies.

Data Limitations and Guidelines for Interpretation

Accurately estimating contaminant loadings in stormwater remains one of the more challenging aspects of water resource investigations. Sources of error associated with loading estimates include:

- Flow gauge error – e.g., 5 to 10 percent for most USGS gauges or more for other gauges (USGS 1984)
- Chemical analysis error – e.g., 5 to 20 percent for most analyses or more for trace compounds (APHA et al. 1992)
- Error associated with extrapolating sampling results, which varies widely depending on method
- Sampling bias

In all loading estimates, there is a propagation of error when extrapolated or interpolated chemistry values are multiplied by discharge to generate a mass per unit of time. Consequently, the final loading value is not likely to be more accurate than ±20 percent, and in most cases loading values may be in error by more than 50 percent (Webb et al. 1997). This error was accounted for in this study by reporting the 25th and 75th percentile range of the water quality data for each loading calculation as opposed to one median loading value.

A brief explanation of specific sources of error and implications of this error in the study data is provided below regarding site selection, flow measurement, sample collection and analysis, and data extrapolation or interpolation.

Site Representativeness

Site selection can introduce error in contaminant load estimates for specific land-use types if the monitoring locations do not accurately represent the targeted land use. For this study, initially a stratified random site selection design was used to reduce site selection bias; the design was modified to account for low commercial land uses. However, each land-use category was represented by only four sites in the final design, and some results varied considerably within each land-use category. When relatively few sites are monitored and the land use in each basin is not entirely composed of one specific land use, a random study design does not ensure that each of the sites is typical of the land use it represents. For example, our study results indicate that metals concentrations and unit-areal loading rates were particularly low for the residential and commercial/industrial land-use categories based on comparison to other studies, as discussed below. Without additional sampling at other representative sites, we cannot know if these data are indeed representative or if the sites selected were disproportionally low in metals.

This is confounded by the fact that the subbasins did not consist of 100 percent of their representative land use (Table 1). Based on the National Land Cover Database (MRLC 2001) used in this study to delineate land use, commercial/industrial land use represented, on average, only 40 percent of the area in the representative subbasins. Similarly, residential and agricultural land uses represented, on average, only 72 and 50 percent of the area, respectively, in the representative subbasins. Forested subbasins were the most homogeneous with an average of 90 percent forested land use.

For the commercial/industrial subbasins, the majority of the remaining land use was composed of residential. The data indicated that residential land use was characterized by lower concentration of contaminants than commercial/industrial; consequently, the estimate of commercial/industrial land-use contaminant export was likely reduced by the residential land-use contributions in the subbasins and the actual commercial contribution is higher than presented in this report. Likewise, for the residential basins, the next greatest land use was forest; the estimates of residential contaminant export was likely conservative as well.

For the agricultural basins, both residential and forest comprised equal parts of the remaining land uses in the associated subbasins. This complicates the interpretation of the data from the agricultural basins because it is difficult to interpret if the residential or agricultural areas were the primary contributor of some of the contaminants. For instance, metals concentrations from the agricultural basins tended to be higher than expected. These metals may have originated from either the residential or agricultural areas within the subbasins; however, without further investigations, the specific source cannot be determined. The forested subbasins were likely less affected by other land uses due to the fact that the vast majority of the land area within the forested basins was, in fact, forest.

In addition to incomplete land-use coverage in the subbasins, the land-use categorization was relatively coarse and did not, for example, differentiate between high-density and low-density residential. Consequently, because the subbasins that were finally selected through a random process were generally low-density residential, caution should be used when extrapolating these results to high-density residential areas; commercial/industrial water quality may be more representative. Likewise, not all commercial/industrial, agricultural, and forested areas are homogenous within their land-use categories; consequently, this caveat must accompany loading extrapolations beyond the monitored subbasins.

Another potential source of bias is the influence of factors close to the actual sampling locations. For example, results could vary if the sampling station was near or far from major roadways or highways, or was near other potential sources of specific chemicals. As noted in the *Methods* section, roads and highways were not specifically called out as unique land-use categories in this study. This is because the contaminant contribution from these areas could not be explicitly separated from the contaminant contribution from the other four land uses given the experimental design for this study. As described in the *Methods* section, sampling at some monitoring locations also took place downstream of galvanized steel culverts that could be a potential pollution source, most notably for zinc. However, if these culverts were a significant source of zinc, higher concentrations would generally be expected during baseflow when there was less water at the monitoring station from up gradient sources to dilute the zinc coming from the culverts. In general, the data from this study generally show an opposite pattern occurred at each monitoring location; storm-event concentrations of zinc were typically higher than baseflow concentrations (Figures 20 and 21). Finally, there may be geologic or topographic variations which would influence groundwater flow patterns that may or may not interact with surface flow collected at the sampling station.

When scaling results up to represent land uses within the entire Puyallup and Snohomish watersheds, as well as the entire Puget Sound basin, we are assuming that the sampled basins are representative of their respective land uses on a broad scale. As discussed below, this assumption may not be true in many cases, particularly for forested land use because a proportionally smaller percentage of the associated area was sampled in this study and because site selection was limited to locations below an elevation of 2,200 feet.

Flow Measurement

Proper installation and routine calibration of flow gauging equipment are vital for reducing flow measurement error. Sensor error, loss of data due to instrument failure, shifting channel morphology, and stage-discharge regression error can also contribute to flow measurement error. To consistently control all these potential sources of error can be extremely difficult with temporary gauging installations in small channels. Consequently, errors of at least ±10 percent should be expected (USGS 1984).

Indeed, the error associated with the flow gauging component of this project ranged from 12 to 50 percent (see Appendix J) and therefore should be taken into account when interpreting the pollutant loading values in this report. However, it should be noted that variability in the water quality data has been quantified by reporting the 25th and 75th percentile load estimates that were derived using the 25th and 75th percentile concentrations for each parameter; the error reflected in the range between these values is typically several orders of magnitude and greatly exceeds the error associated with the flow measurements.

Sample Collection and Analysis

Grab sampling was selected for use in this study for the following reasons:

1. The sample volume, preservation, and handling requirements for the target analytes precluded the use of automated samplers.
2. The expense associated with automated sampling would have required fewer sites be monitored and fewer samples collected.

The primary drawback of not using automated sampling is that event mean concentrations are more difficult to approximate with grab sample data. Whenever possible, field crews collected two grabs for each event and composited the samples to better approximate the event mean concentration; however, this type of sampling was difficult in the flashier basins where storm durations were short relative to the time needed to conduct a full round of monitoring. Consequently, only a little over 50 percent of the targeted events were sampled twice.

There has been a limited amount of research regarding bias from grab versus automated sampling. Haraldsen and Stalnacke (2006) found that grab sampling was the least accurate method of estimating annual TSS loading, while time-weighted and flow-weighted composites provided better accuracy. However, Haraldsen and Stalnacke's study involved sampling at fixed time intervals (weekly) and did not specifically target storms. Lee et al. (2007) found that concentrations from storm-event grab sampling approached event mean concentrations from automated sampling if the grab sample was collected between the first 10 percent and last 10 percent of the event flow. In a similar study, Khan et al. (2006) examined 22 oil and grease pollutographs from highway drainages to determine when a single grab sample most closely approximated a flow-weighted composite sample. They found that grab samples collected between one and six hours after the beginning of the event generally provided a good approximation of the event mean concentration.

In this Phase 3 study, we collected 25 percent of the storm-event grab samples within the first 10 percent of the event flow and none during the last 10 percent of the event flow (Table 18). This indicates that we collected a majority of samples during the period when the event mean concentration would be estimated with the greatest accuracy based on grab samples.

The frequency of grab sampling has been shown to affect the accuracy of loading estimates for synthetic datasets (Webb et al. 1997). Using the same interpolation methods for calculating loading as was used in this study, Webb et al. (1997) found that weekly sampling was associated with an uncertainty of 33 percent and monthly sampling was associated with an uncertainty of 62 percent (based on 50 iterations). These results are useful for contextualizing the impact on accuracy that is likely induced by calculating annual loads from only eight samples in each subbasin.

Higher variability in the sample population decreases the likelihood of capturing the variability based on a small set of discrete samples. Many of the toxic chemicals evaluated in this study were only detected during the fall storm event. Consequently, the potential of the Phase 3 sampling design to capture the variability of the true population is low.

In addition, the transport of toxic chemicals in fluvial environments occurs within the water column, on the surface of the water, and within the alluvium. The sampling design used in this study focused on the contaminants within the water column and consequently did not account for transport on the water surface or within the alluvium. The seasonal export pattern observed in the data indicates that contaminant transport is most concentrated during early-season storm events. In order to gain a more robust estimate of total contaminant loading in streams, future studies should consider focusing on sampling the water surface, the water column, and the alluvium during these large early-season events.

All loading studies must address and mitigate the sources of sample collection and analysis error. In this study, the following steps were taken to reduce sample collection and analysis error in the loading estimates:

- Samples were collected using ultraclean technique, and field procedures were consistently employed according to approved methodology.
- Storm events were targeted for sampling, and more storm events than baseflow events were sampled.
- Two rounds of storm-event sampling were planned to more accurately estimate average contaminant concentrations for each event.
- Laboratory analyses were performed with rigorous QA controls and low detection limits.
- Advanced data processing tools were employed to correct spurious water level data.
- A flow-stratified interpolation technique was used to calculate contaminant loading.

Potential uncertainty in the results that stems from sampling and analysis error was quantified based on an analysis of field duplicate samples that were routinely collected for QA purposes. As presented in the *Results* section, Appendix R identifies when these field duplicate samples were collected and presents the calculated relative percent difference between sample and the field duplicate concentrations. Based on these data, the potentially uncertainty in the data from these sources averaged 30 percent across all the monitoring parameters.

Overall variability in the water quality data has also been quantified by reporting the 25th and 75th percentile load estimates that were derived using the 25th and 75th percentile concentrations for each parameter; the error reflected in the range between these values is typically several orders of magnitude. Despite this large error, the resultant data from this study are, in the majority of cases, consistent with previous studies, as discussed below. Consequently, the patterns in the data described below are our best estimate of actual conditions in the Puyallup and Snohomish watersheds.

Extrapolation and Interpolation of Loadings

Error originating from extrapolation and interpolation has been closely studied by numerous researchers. Webb et al. (1997) found that extrapolation or interpolation of discrete chemistry/loading results to create an annual loading estimate resulted in error ranging from -45 to +322 percent of the actual annual TSS loading. In a separate study of nitrate export, Webb et al. (2000) found that different extrapolation and interpolation techniques could produce median errors of up to 1,603 percent of the actual nitrate load.

Webb et al. (1997) assessed five loading interpolation methods using a synthetic dataset and iterative calculations of loading relative to the "true" dataset. Of the five methods, the method used for the Phase 3 study performed better than three of the other methods with an average underestimation in loading of approximately 50 percent. However, Webb et al. (1997) did not flow stratify the sampling strategy, a technique used in this study to avoid underestimation of loads.

Extrapolation Across Spatial Scales

In addition to concentration extrapolation error, error may have been introduced in this study by extrapolating unit-area loads from the subbasin scale to predict loads at the watershed and Puget Sound scale. Monitoring conducted at the subbasin scale generally measured contaminants relatively close to their source, although not within stormwater conveyance systems that are even closer.

However, after pollution has entered local waterways, there is considerable processing which occurs en route to the receiving water body. The bed of stream channels acts to filter water that passes through the alluvium (Grimm et al. 2005), and contaminant processing and sequestration is accelerated by a wide variety of macroorganisms (Fritioff and Greger 2003) and microorganisms (Bencala 2000) that thrive in healthy stream networks. In addition, legacy contaminated sediments within downstream channels can be mobilized during storm events and contribute to pollutant export (Hyun et al. 2010). These important factors are not addressed in this loading study because the unit-area loading from the subbasins are applied directly to estimate the total loading from the watersheds without accounting for contaminant processing or export that occurs in the downstream fluvial environment itself. This should be considered when interpreting the final results.

Various methods exist for extrapolating water quality data from monitored locations to unmonitored areas in order to generate watershed-wide loading estimates. The two most common are extrapolating land use-based export coefficients (unit-area loads, the method used in this study), and extrapolating land use-based concentrations to modeled flow volumes (concentration-based loads, the alternative method described in Appendix G that was previously used in the Phase 2 addendum). Unit-area loads are appropriate where loads scale by tributary area, whereas concentration-based loads are appropriate where loads scale by flow volume, which can vary within a watershed.

The primary assumption of the unit-area load approach we used in this study is that export coefficients (or unit-area loading rates) will remain constant despite variable rainfall patterns across the Puget Sound drainage. We also assumed that the land uses in the monitored subbasins are biogeochemically representative of the unmonitored basins to which we extrapolated the unit-area loading rates. An assessment of previous studies indicates that these assumptions are common (Tetra Tech 1995; Johnes 1996; Lin 2004; Bin Masood et al. 2008) and are even built into widely used watershed loading models such as PLOAD, an extension for BASINS (U.S. EPA 2001).

Most commercial, residential, and agricultural lands occur in the lowlands close to Puget Sound where rainfall variability is low. Therefore, extrapolating from these three land-cover categories using either unit-area loads or concentration times flow produces similar results. In contrast, forested lands span the full range of average annual rainfall and occur nearly exclusively at higher elevations where higher rainfall occurs. The unit-area loading rate method would break down in the forested areas if one assumes that pollutant export is “flow-limited”; or in other words, pollutant export is proportional to the amount of precipitation that falls. However, the data indicate that concentrations of most pollutants in runoff from the forested basins remain consistently low. In addition, there was little difference between storm-event and baseflow concentrations for many pollutants in the forested basins relative to the basins for the other land uses (see discussion in *Summary of Key Patterns* section below); this would suggest there is no strong relationship between flow and pollutant export.

Based on these considerations, it is likely that forested regions are actually “source limited”, and therefore the application of unit-area loading rates is justified in this analysis. For the loads of three parameters estimated for the Snohomish and Puyallup watersheds in Appendix G, the concentration-based method would estimate loads that are 20 to 50 percent higher than those developed from the unit area-based loads. Load estimates from forested lands constitute the biggest difference in load estimates at the watershed scale. This pattern likely holds at the Puget Sound scale, although Appendix G does not develop these estimates.

Finally, because data were collected from small streams, the concentrations and unit-area loads may not represent stormwater in areas adjacent to Puget Sound where conveyance systems discharge to marine waters or near marine waters. In these areas, conveyance system data may be more appropriate to quantify local loads. This report does not distinguish loads from these areas, and estimates are based on the Phase 3 instream data alone.

Other Sources of Bias (Overestimates and Underestimates)

While the study design was optimized to eliminate bias, several factors do introduce potential bias into the results. These factors may contribute to overestimates and underestimates at the watershed or Puget Sound scales.

The loads presented in the *Results* section may overestimate actual loads at the watershed or Puget Sound scale due to several factors:

- Instream processes may reduce the concentrations and loads reaching large rivers or Puget Sound. While these contaminants may still exist in the freshwater system in sediments, biota, or groundwater, the water delivered to downstream water bodies may have lower levels than characterized for small streams in this study.
- Forested lands were limited to areas below 2,200 feet in elevation. The selected subbasins are near population centers and may be subject to atmospheric deposition from local sources. Extrapolating from the four forested subbasins to all forested lands, even using the unit-area load method, may not characterize more remote forested regions.

The loads presented in *Results* may underestimate actual loads at the watershed or Puget Sound scale due to several factors:

- Subbasins selected to characterize commercial/industrial land covers averaged 40 percent land cover, and only one subbasin had >50 percent commercial/industrial land cover. Because concentrations and unit areas from other land uses were lower than those from the mixed commercial/industrial subbasins, commercial/industrial lands could produce even higher concentrations and unit-area loads.
- Subbasins selected to characterize residential land uses were almost exclusively low-density residential. Loads generated by medium- to high-density residential areas may be even higher

than those characterized based on low-density residential basins that also had significant forested lands.

- Loads from lands immediately adjacent to Puget Sound discharge directly through stormwater conveyance systems and not through small streams. Loads generated from these areas may be higher than those in this study, and stormwater conveyance data may be more appropriate.
- Several parameters were detected only during the October fall storm event. While not a true first-flush event, the results may be more characteristic of early-season storm events. Only one of the six storm events targeted this period, even though it produces a significant amount of the storm volume for the year.

Several factors could lead to overestimates or underestimates in the loads:

- Sample collection targeted the proportion of the hydrograph where the primary loads are delivered. Grab sampling may have missed the peak levels, which would underestimate the loads. However, if grab sampling captured peak levels and not average levels, the use of grab samples could overestimate the loads.
- Legacy contaminants may be remobilized during storms from existing contamination that is stored on the landscape or in sediment or biota. Levels captured in monitoring may overestimate true sources to the ecosystem. Because legacy contaminants may be associated with particles that are mostly delivered during several large storm events, monitored storms may not have captured these events and may underestimate legacy contaminants.
- Forested lands cover 83 percent of the Puget Sound watershed, much more than any other land use type. However, surface runoff was characterized by four subbasins just as for other land uses. Therefore, proportionally less forested land was monitoring than other land use types. Monitoring data may not have captured the full variability within forested land uses, which could lead to overestimates or underestimates.

Summary of Key Patterns

Undetected Parameters

One of the primary objectives of this study was to determine which of an extensive list of toxic contaminants are associated with surface runoff from various land-use types in the Puget Sound basin. To address this question, the collected samples from this study were analyzed for a wide range of contaminants. At the conclusion of this study, data were reported for 368 parameters; however, not all of these parameters were detected. Before focusing on the characteristics of the contaminants that were detected and are known to impact aquatic systems, it is important to first highlight those contaminants that were not found in any of the 126 samples collected.

Table 19 presents a list of the parameters that were not detected in any sample during this study. These results correlate well with another recent, similar Puget Sound-based study. For example, a study of contaminant loading in the Green River-Duwamish watershed in Washington evaluated many of the same parameters during baseflow and storm-event conditions from 2001 through 2003 (Herrera 2004). Selenium is the only parameter that was detected in the

Green/Duwamish study that was not detected in this study, and selenium was only detected in 1 of 114 samples collected for the Green/Duwamish study.

Storm-Event versus Baseflow Chemistry

Depending on the contaminant source, percent impervious cover, and fate and transport dynamics, toxic contaminants can either be preferentially exported to local waterways during baseflow or storm-event conditions. Parameter concentrations that are elevated in groundwater will contribute to elevated concentrations in baseflow and become diluted during storm events. When surface flow and interflow dominate during storm events, contaminants washed from the landscape will control the chemistry of local waterways. Consequently, by analyzing baseflow versus storm-event chemistry, inferences about contaminant source areas can be made.

Table 20 presents ratios of median storm-event to baseflow concentrations for 21 priority parameters. These storm-to-base ratios were computed separately for each land-use type in the study. Table 20 is formatted with horizontal bars indicating the relative degree of storm-event export. A long bar and high storm-to-base ratio indicate that the associated parameter has much higher concentrations during storm events relative to baseflow. Ratios that are less than one indicate the associated parameter concentration is elevated in baseflow relative to storm events; these values are highlighted in red in the table. If a priority parameter was not detected in any baseflow or storm-event samples, no ratio is provided in Table 20 for that parameter. It should be noted that parameters not detected in storm-event samples were also not detected in baseflow samples.

As is apparent from the ratios presented in Table 20, the commercial/industrial subbasins are characterized by increased storm-event export relative to the other land-use types. This is especially noticeable for TSS, total PBDEs, total PCBs, and total lead, where median concentrations in storm events exceed median baseflow concentrations by a factor ranging from 5.9 to 20. This pattern is indicative of what is observed in basins with a high percentage of impervious cover and has been observed in several studies in the region (Cullinan et al. 2007; Herrera 2007). Contaminants originating from sources within these basins undergo minimal processing during transport due to high transport velocities and have minimal opportunity for biofiltration (National Research Council 2008).

In addition, commercial/industrial basins tend to have more impervious and contaminant-generating surfaces than other land-use types, and the contaminants on these surfaces are more readily mobilized during storm events, which contributes to the pattern observed in Table 20. These areas might also have more contaminant sources, including air emissions from the facilities.

All the land-use types generally exhibited elevated metals concentrations during storm events, with the exception of arsenic. Dissolved arsenic concentrations were elevated in baseflow for all the land-use types, while total arsenic concentrations was elevated in baseflow in only the commercial/industrial and agricultural basins. In addition, concentrations of PAHs and other organic chemicals were also elevated during storm events, particularly in commercial/industrial land-use areas.

Storm-to-base ratios of nutrients did not exhibit consistent patterns across the four land-use types. In residential and agricultural subbasins, total phosphorus concentrations were greater during storm events than during baseflow (in addition, baseflow total phosphorus concentrations were higher than from any of the other land-use types during baseflow conditions). An unexpected result was that total phosphorus was not elevated during storm events in the commercial/industrial basins. Typically, total phosphorus behaves in a similar manner to TSS, but the storm-to-base ratio for total phosphorus in this study was 0.75 for the commercial/ industrial subbasins (Table 20). An analysis of storm-event and baseflow chemistry in densely developed areas within the Green-Duwamish watershed found that total phosphorus was approximately 40 percent greater in storm-event flow than baseflow (Herrera 2007), which is not consistent with this study.

In the commercial/industrial and residential subbasins, nitrate+nitrite nitrogen concentrations were higher in baseflow relative to storm events. However, nitrate+nitrite nitrogen concentrations were on average 4.7 times greater in storm-event flow than baseflow in agricultural subbasins (Table 20), indicating that runoff from fertilized fields or dairies may be contributing to elevated nitrate+nitrite nitrogen concentrations during storm events.

In the forested subbasins, differences between storm and baseflow concentrations were generally less than those observed in commercial/industrial and residential subbasins where storm-event concentrations tend to be much higher than baseflow concentrations. This difference is likely due to the lower impervious cover in forested basins than commercial/industrial or residential basins. In the forested subbasins, storm-to-base ratios only ranged from 0.77 to 3.50 (Table 20) and most parameters were slightly elevated in storm-event flow with the exception of dissolved arsenic, dissolved copper, and total PCBs that were elevated in baseflow.

The storm-event versus baseflow concentration analysis revealed the following findings and associated implications:

Finding	Implication
Commercial/industrial basins export proportionally more contaminants during storm events compared to baseflow than other land-use types.	Mitigation strategies in commercial/industrial basins should focus on storm events.
Nearly all metals (except arsenic) and trace organic chemicals concentrations are higher during storm events compared to baseflow for all land-use types.	Toxic metals and organic chemical mitigation strategies should focus on storm events.
Arsenic concentrations are higher in baseflow than storm events for all land-use types.	Arsenic primarily originates from groundwater across all land-use types.
Total phosphorus and ortho-phosphorus concentrations are higher during baseflow than during storm events in commercial/industrial basins (though agriculture had the highest baseflow concentrations). Nitrate+nitrite nitrogen concentrations are higher during baseflow than during storm events in commercial/industrial and residential basins.	Nutrient reduction strategies should address all hydrologic conditions in commercial/industrial, residential, and agricultural subbasins.
Forested subbasins exhibited relatively small differences between baseflow and storm-event flow concentrations.	Treating stormwater alone could be proportionally less effective at reducing contaminant export from forested basins than other land-use types, although specific geographically-based sources should be addressed.

Seasonality of Contaminant Export

Contaminant flushing dynamics are controlled by many factors, from rainfall intensity and volume, to contaminant mobility, uptake and biodegradation, proximity, and mass. Numerous studies have indicated that contaminant build up during dry periods leads to elevated concentrations in the first flows following an extended period with no precipitation (Han et al. 2006; Kayhanian and Stenstrom 2005; Lee et al. 2004; Soller et al. 2005). This phenomenon, known as a seasonal first flush, has been shown to contribute to contaminant concentrations that are between 1.2 and 20 times higher than storm-event concentrations later in the season (Lee et al. 2004). Although the current study was not explicitly designed to examine seasonal first-flush dynamics, the existing dataset can be examined to determine if some contaminants were detected with a greater frequency and at greater concentrations during early-season storms.

Appendix S reports detection frequencies and median concentrations for the 21 priority parameters during each of the six storm events sampled for this study. The six storm events were classified by season with storm 1 in the fall category, storms 2 through 4 in the winter storm category, and storms 5 and 6 in the spring storm category. Elevated concentrations and/or higher detection frequencies for specific parameters during storm 1 may be evidence of a seasonal pattern. However, this was only one event in the autumn. A more thorough investigation of the first flush would include more frequent sampling of the autumn and winter storm events; specifically sampling of the earliest autumn event and the most intense autumn event may have revealed a more pronounced flushing pattern. The following is an assessment of the autumn event, for the 21 priority parameters by land-use type.

In commercial/industrial subbasins, detection frequencies and concentrations were much higher for several parameters compared with the winter and spring storm events:

- Total cadmium
- Total PCBs
- Triclopyr
- Oil and grease

The oil and grease pattern was the most dramatic with 100 percent detects and a median concentration of 0.6 mg/L during storm 1, compared to subsequent events where the detection frequency did not exceed 50 percent and the median concentration did not exceed 0.3 mg/L.

Several parameters also had higher detection frequencies and concentrations in the fall storm compared with others in the residential subbasins:

- Dissolved arsenic
- Dissolved copper
- Dissolved lead
- Total PCBs
- Total PBDEs
- Triclopyr
- Oil and grease
- Lube oil (TPH-DOG)

In the residential subbasins, the pattern was most evident for total PCBs, triclopyr, oil and grease, and lube oil (TPH-DOG). It is interesting to note that total PCBs were higher during baseflow than storm events in the residential subbasins (Table 20), but there was a seasonal pattern of total PCBs. This observation suggests that the initial wash off of PCBs may be followed by persistent contamination of the streams from groundwater or benthic sediments.

Agricultural subbasins also exhibited a seasonal pattern in the storm data for:

- Dissolved cadmium
- Total and dissolved zinc
- Total PBDEs
- bis(2-Ethylhexyl) phthalate
- Triclopyr
- Oil and grease
- Lube Oil (TPH-DOG)

In these subbasins, total and dissolved zinc, bis(2-ethylhexyl) phthalate, triclopyr, oil and grease, and lube oil (TPH-DOG) were detected at higher frequencies and higher concentrations in the fall compared to other storms. Zinc concentrations in particular were approximately three times higher in storm 1 than in any of the other events.

In forested subbasins, the fall storm had higher frequencies of detection for:

- Total and dissolved arsenic
- Total and dissolved copper
- Total lead
- Total mercury
- Total zinc
- Total PCBs
- Total PBDEs

Although fall storm concentrations were generally not as high from the forested subbasins as the developed basins, total metals and PBDEs were higher in the fall storm than other events. It should be noted that oil and grease was detected in each of the developed land uses but not from forested subbasins.

In general, the higher incidence detection in the fall storm for a number of parameters suggests that stormwater management strategies should focus on early season storms where mitigating concentrations is appropriate. However, additional monitoring should verify this pattern as indicative of a seasonal or first-flush phenomenon. If the pattern is confirmed, stormwater monitoring designs should include fall flushing events to capture a wider range of contaminant concentrations, and future studies of parameters that are rarely detected in streams should focus on collecting data during fall flushing events.

Land-Use Patterns

This study showed a number of distinct patterns in pollutant concentrations that are related to land use. For example, the results from the PCA analysis that was performed on data from the storm-event sampling showed that forested monitoring locations were distinct from the remainder of the monitoring locations because they have particularly low concentrations of the following parameters: nitrate+nitrite nitrogen, total phosphorus, total mercury, total arsenic, total copper, and TSS. This pattern in the PCA results generally indicates most of the variance in the storm-event data is related to chemical differences between developed and undeveloped land.

The PCA analysis also showed a secondary pattern in the data that related to differences between the developed land uses. Specifically, the commercial/industrial monitoring locations were distinct from the monitoring locations for residential and agricultural land uses because they had particularly high concentrations of total PCBs, total zinc, total lead, and total PBDEs.

During baseflow conditions, the differences among the land uses were less pronounced, but generally showed the same patterns as the PCA analysis that was performed on data from storm-event sampling.

These trends are generally consistent with other studies in the region that have examined differences in pollutant concentrations across different land use types (Herrera 2004).

Management Implications

This study indicated that the majority of the total potential contaminant loading to Puget Sound is derived from very low-level concentrations in forested subbasins and from somewhat higher concentrations in residential subbasins. Total loading to Puget Sound is a concern for those contaminants that bioaccumulate or cycle within receiving waters and lead to persistent degraded conditions. Effective management strategies for controlling toxic loading to Puget Sound will be difficult to implement without their broad application across the areas represented by these land uses.

Traditional best management practices (BMPs) are often designed to treat relatively high concentrations (Schueler 1996; Ahearn and Tveten 2008), and source-control measures require that the contaminants be located in a manageable area of land or water. Low-impact development can provide a high level of treatment to lower concentrations of contaminants that are dispersed over a wider geographic area (Pennington et al. 2003) but generally does not apply to a forested setting. These factors indicate that the most effective measure that can be taken to reduce this low-level, widespread loading may be source prevention (e.g., emission controls, removing copper from brake pads or zinc from tires).

It is assumed that the majority of the forested area pollutant export is derived from atmospheric deposition. Because the pollutant export is too widespread and at too low a concentration to treat, the simplest method of reducing pollutant mass export is to reduce the atmospheric inputs through source prevention measures. However, contaminant loading to Puget Sound is not the only issue of concern. Some toxic contaminants do not readily bioaccumulate (e.g., metals) and thus low-level loading of these contaminants to receiving waters may be of less concern.

However, low-level concentrations of these same contaminants may affect instream organisms, including the endangered salmonid populations of the Pacific Northwest, in route to receiving waters (Hansen et al. 2002a; Hansen et al. 2002b; West et al. 2001). From this toxicity perspective, instream concentrations also must be addressed, not only low-level loading.

This study indicated that commercial/industrial subbasins export, in many cases, an order of magnitude higher concentration of organic chemicals than other land-use types. Commercial/industrial, agricultural, and residential land uses (in that order) are also associated with the highest concentrations of metals. These high contaminant concentrations may be adversely impacting sensitive organisms in streams and other water bodies that receive direct runoff from each land-use type (see Table 12). While effects on biota were not evaluated in this study, several contaminants exceeded water quality or human health criteria. Most of the exceedances occurred in streams draining commercial/industrial land uses.

Given the relatively large concentrations being exported from these areas and the relatively small geographic areas they occupy, effective management tools are generally available to control releases of contaminants. This points to the need to incorporate retrofit treatment in existing development and low-impact development strategies in new development of previously undeveloped lands. These are widely seen as the most effective structural and non-structural BMPs (Ahearn and Tveten 2008; Bedan and Clausen 2009; Selbig et al. 2008).

Comparisons to Other Studies

Commercial/Industrial

As was previously discussed, the results from this 2009-10 study indicate that the commercial/industrial subbasins were, in general, characterized by the highest concentrations of contaminants. Contaminant concentrations were, in most cases, higher in storm events than in baseflow. Consequently, storm events from commercial/industrial subbasins were characterized by high concentrations of most of the detected contaminants (see Table 10). This finding is consistent with other studies that have shown highly developed subbasins export higher contaminant concentrations than other land-use types (Basnyat et al. 1999; Cullinan et al. 2007; Herrera 2007; Lin 2004).

Residential and Agricultural

Contrary to this general pattern, the agricultural and residential subbasins in this study tended to export higher concentrations of nutrients than commercial/industrial subbasins. The agricultural subbasins also exported higher concentrations of arsenic, copper, and mercury (Table 10). The export of metals from agricultural basins was a result that is inconsistent with some studies (Sliva and Williams 2001) but consistent with the contaminant loading study in the nearby Green Duwamish watershed (Herrera 2007).

Of the four land-use categories, residential land use exhibited the highest nitrate+nitrite nitrogen concentrations in baseflow and the highest TSS concentrations during storm events (Table 10). The former result is unexpected as agricultural, not residential, land uses are usually associated with the highest levels of nitrogen in groundwater (Dubrovsky and Hamilton 2010), while the latter result is consistent with what has been observed across the nation (National Research Council 2008). It may be the high percentage of residences with septic tanks contributed to elevated nitrate+nitrite nitrogen concentrations in baseflow, but further study would be required to identify the source.

When compared with the other land-use categories, the agricultural subbasins exported the highest concentrations of total phosphorus in both baseflow and storm events (Table 10). Nationwide, the trend is for urban and agricultural areas to export roughly equivalent concentrations of total phosphorus (Dubrovsky and Hamilton 2010), which highlights an important pattern in the data from this study. In general, the agricultural monitoring locations in this study exported more and higher concentrations of contaminants than expected based on previous studies, while the residential monitoring locations exported fewer and lower concentrations of contaminants than expected.

For example, the agricultural subbasins in this study exported the highest concentrations of mercury and copper when compared with other land uses. This finding was not consistent with some previous studies (Sliva and Williams 2001); however, one of the two agricultural basins monitored in the *Green-Duwamish Watershed Study* (Herrera 2007) did export comparably high levels of mercury and copper. This indicates that select agricultural basins may act as important source areas for metals export.

The residential subbasins in this study exported very little petroleum products, organic chemicals, and metals relative to the commercial/industrial subbasins. This may be due to a relatively low housing density in the residential subbasins studied that do not capture potential sources in higher intensities of residential land use.

These finding have important implications for the comparisons between the Puget Sound scale load estimates from this study and the Phase 2 study (see Tables 15, 16, and 17). The Phase 2 study found that residential land-use types had the greatest influence on total contaminant loading to Puget Sound. For a number of parameters, however, the relative proportion of modeled runoff from residential land use on overall loading was reduced because concentrations for residential land use in Phase 3 were considerably lower than in Phase 2.

As an example, runoff from residential land was estimated to have a total copper median concentration of 4 µg/L in residential subbasins in the Phase 2 study based on literature compilations. However, the Phase 3 study found total copper levels averaged, 2.2 µg/L during storm events and 0.88 µg/L during baseflow (Table 10). This pattern was also found for lead, mercury, zinc, total PCBs, PAHs, bis(2-ethylhexyl) phthalate, total DDT, and oil and grease. Oil and grease was an extreme case where the concentration used in the Phase 2 loading estimates was 3,000 µg/L compared to 200 µg/L in this study, which is an order of magnitude difference. Two factors may have contributed to this decrease. First, the Phase 1 and Phase 2 concentration estimates were based on compilations of both stream and conveyance system data for residential land uses, and these concentrations varied widely across the cited studies. Second, the Phase 3 residential subbasins included relative low-intensity residential land covers. The result of these differences was that residential land use contributed proportionally much less contaminant loading in this study relative to the Phase 2 study.

Forested

Surface runoff from forested areas produced the largest load in both phases, but because the relative contribution of contaminant loading from residential subbasins decreased in this study relative to the Phase 2 study, the relative contribution from forested subbasins increased. As noted in the *Results* section, forested land use contributed the greatest total loading of the 21 priority parameters whenever they were detected in the forested subbasins. This calculation result likely has multiple explanations.

For those of the 21 priority parameters that were detected at frequencies less than 50 percent in forested subbasins (i.e., total zinc, total PBDEs, PAHs, bis(2-ethylhexyl) phthalate, triclopyr, nonylphenol, total DDT, oil and grease, and lube oil [TPH-DOG]), the associated median concentration values are considered estimates. This means there is the potential for a high degree of error associated with these values, and this error is magnified when the concentrations are converted to total loading (using flow and land-use area). Total forested land area in the Puyallup and Snohomish watersheds was calculated to be on average 141 times higher than commercial/industrial area, 7 times higher than residential land area, and 29 times higher than agricultural land area. This means, for example, that an equivalent concentration error in commercial/industrial and forested land uses became 141 times greater for forested land use after converting the concentrations to total loadings.

However, error from a low detection frequency does not explain why those frequently detected parameters were still found to be exported primarily from forested subbasins. Another possible explanation is that the forested subbasins sampled were not representative of forested land use as a whole. As noted above, the forested land-use area (83 percent of the total Puget Sound watershed) far exceeds the area of the other land-use types within the two study watersheds. Therefore, the population of candidate forested subbasins was proportionally under-sampled versus the other land-use types with fewer candidate subbasins, which increased the likelihood that the four forested subbasins were not representative of forested land use as a whole in the Snohomish and Puyallup watersheds.

Additionally, to avoid ice and snow conditions that would interfere with sampling for this study, only forested subbasins below 2,200 feet in elevation were selected. This effectively biased the monitoring location selection to low elevation subbasins. The lower elevation subbasins and associated sampling sites may have exhibited higher contaminant concentrations due to their proximity to more populated areas and a greater number of roadways. If it is the case that the high elevation subbasins export lower levels of toxic contaminants than the low elevation subbasins, then the result would be an overestimate of contaminant concentrations from forested land use as a whole. Although when calculating areal loading, lower concentrations at higher elevations would likely be offset by increased flow driven by higher precipitation rates.

Loading Comparisons to Green-Duwamish Water Study and National Studies

As an additional check on the representativeness of this dataset, the unit-area loading rate results were compared with results from the *Green-Duwamish Watershed Study* (Herrera 2007) and to literature values based on national data (Tables 21 and 22). The total unit-area loading rates for this study were generated by summing the baseflow and storm-event loading rates for each parameter across all the land-use types. Data from other studies were not available for all of the 21 priority parameters; consequently, the parameter list was shortened for this comparison. In general, unit-area loading rates from this study were more likely to be lower than those from the *Green-Duwamish Watershed Study* or other published studies. Major differences include the following:

- Total Suspended Solids (TSS)
  - ◻ For all land-use types, TSS loading in this study was two to three times lower than TSS loading from the *Green-Duwamish Watershed Study*.
  - ◻ Compared with literature values, this study produced TSS unit-area loading that was considerably lower (8 to 17 times) for agricultural and commercial/industrial land uses, while at the same time being much higher (5 to 20 times) for forest and residential land use.
- Nitrate+Nitrite Nitrogen
  - ◻ Nitrate+nitrite nitrogen values were generally higher in this study than those from literature values and lower than those from the *Green-Duwamish Watershed Study.* The one exception was for commercial/industrial land uses where this study exhibited the lowest nitrate+nitrite nitrogen of all the datasets.
  - ◻ Compared to the *Green-Duwamish Watershed Study*, unit-area loading of nitrate+nitrite nitrogen from forested and agricultural land uses was lower in this study by factors of 4 and 3, respectively.
- Total Phosphorus
  - ◻ The unit-area loading of total phosphorus was higher than literature values but comparable to the *Green-Duwamish Watershed Study* for all land uses but commercial/industrial.
  - ◻ Total phosphorus loading for commercial/industrial was one-half the values from the *Green-Duwamish Watershed Study* and one-third the literature values.
- Metals
  - ◻ Unit-area loading of metals for commercial/industrial and residential land uses was lower in this study than in the *Green-Duwamish Watershed Study* or in the national literature by factors of 1.25 to 6.
  - ◻ Metals unit-area loading rates from this study were between 1.2 to 3.3 times higher for forested subbasins and agricultural subbasins versus the *Green-Duwamish Watershed Study* with the exception of dissolved mercury which for forested subbasins was approximately equivalent between the two studies.
  - ◻ When compared with the national literature, total copper unit-area loading from residential and agricultural land uses were lower in this study, while total zinc unit-area loading was lower for agricultural land uses and higher for forested land uses.

The comparison of metals unit-area loading between this study and the *Green-Duwamish Watershed Study* highlights the fact that toxic substances like metals were elevated for forested and agricultural land uses and low for residential and commercial/industrial land uses relative to other studies. This may partially explain why total loading from forested land uses were much higher than total loading from residential land uses. This is counter to the findings in the Phase 2 study, which relied in part on data from the *Green-Duwamish Watershed Study*.

Comparisons to Puget Sound Ocean Exchange Study and Other Regional Studies

Simultaneous with this Phase 3 study of toxic chemicals in surface runoff, Ecology conducted another Phase 3 study to characterize toxic chemicals in marine waters and from ocean exchange (Gries and Osterberg 2011). This study, hereafter referred to as the *Puget Sound Ocean Exchange Study* (PSOES), involved sample collection in five rivers at their point of discharge to Puget Sound. The Snohomish River and Puyallup River were sampled in connection with this effort in July, October, and December of 2009. During each event, depth and width integrated samples were collected during various flow conditions. These samples were analyzed for a similar suite of toxic chemicals to those analyzed for this Phase 3 study.

In addition to the PSOES study, another study of regional significance was conducted from 1996 to 1998 as part of the USGS National Water Quality Assessment. The NAWQA study (USGS 2003) consisted of targeted baseflow and storm-event sampling in the Skokomish, Nooksack, Green, and Thornton Creek watersheds. A wide variety of parameters were analyzed in this NAWQA study, and the experimental design was amenable to comparison to this Phase 3 study.

Table 22 presents the results from the two aforementioned studies along with results from the *Green-Duwamish Watershed Study* (Herrera 2004) and this study. Concentrations (as opposed to loads) are reported by land use for a subset of parameters that were analyzed in both the NAWQA study and this study. Total suspended solids were comparable among the studies with the exception that agricultural areas in this study tended to export lower concentrations relative to the other studies. A land use-based comparison cannot be made to the PSOES study, but it is of interest to note that total suspended solids at the mouth of the Puyallup River were higher than those from any of the specific land uses in the other studies. This may be unique to the glacial influence in the Puyallup River watershed (Gries and Osterberg 2011).

Land use-based nutrient concentrations were comparable between the NAWQA study and *Green-Duwamish Watershed Study*, while commercial land use had noticeably lower concentrations in this study compared to these other studies. Based on data from the PSOES study, nutrient concentrations were also lower at the mouths of the Snohomish River and Puyallup River relative to concentrations measured for the majority of the individual land uses in the other studies, an indication that nutrient uptake during riverine transport may be reducing concentrations at the river mouths. Chlorpyrifos was the only organic chemical that was analyzed in all the studies presented in Table 22. The NAWQA study indicated that Thornton Creek (a medium-density residential basin) exported the highest concentration of this parameter in comparison to the other studies. In the *Green-Duwamish Watershed Study*, Chlorpyrifos was not detected in any of the basins, but the reporting limits for organic chemicals were much higher for the *Green-Duwamish Watershed Study* relative to those for the PSOES study or this study.

There was little difference between Chlorpyrifos concentrations measured at the mouths of the Snohomish River and Puyallup River through the PSOES study and those measured in the upland tributaries through this study; however, it is difficult to draw any conclusive inferences from this comparison due to the high percentage of non-detect values (3 to 13 percent, Appendix K).

The remainder of the organic chemicals in Table 22 were not analyzed in the PSOES study so further comparisons can only be made across the other studies. These comparisons show 2,4-D concentrations were elevated in the commercial/industrial and agricultural basins for the *Green-Duwamish Watershed Study* relative to this study and the NAWQA study. Dicamba, MCPA, and triclopyr were either not detected or were not detected with adequate frequency to calculate a median value in the NAWQA study and the *Green-Duwamish Watershed Study*. Median values are reported for these chemicals in this study, but the percent detections were very low (ranging from 0 to 50 percent; Appendix K). Taken together, these results indicate that comparisons of organic chemicals across these studies are complicated by the fact that these parameters are not commonly analyzed or have highly variable detection limits depending upon the laboratory.

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Conclusions

This report summarizes results from the Phase 3 study of toxics in surface runoff in the Puget Sound basin. The objectives of this study were to (1) refine previous estimates of contaminant load contributions to Puget Sound from surface runoff by monitoring contaminant concentrations and discharge in small streams from four land-use categories (commercial/industrial, residential, agricultural, and forest) and (2) calculate the relative contributions of toxic chemicals from the four land-use types.

From August 2009 through July 2010, samples were collected during six storm conditions and two baseflow conditions from 16 streams in the Puyallup and Snohomish watersheds. Each stream received surface runoff primarily originating from one of the four land uses. Samples were analyzed for conventional water quality parameters, heavy metals, and an extensive list of organic compounds. The specific analyses performed on these data included:

- Computation of summary statistics.
- Principal component analysis.
- Computation of loading estimates at the subbasin scale.
- Computation of loading estimates at the watershed scale.
- Computation of loading estimates at the Puget Sound-basin scale.

Based on these analyses, major conclusions from this study are presented below.

- Despite some limitations on the accuracy of the compiled data, this study provided a high quality dataset for generating improved toxic chemical load estimates in surface runoff in the Puget Sound ecosystem. Unlike the previous Phase 1 and Phase 2 studies, the data from this study were obtained from actual field sampling in representative subbasins for each land use using analytical methods that provided very low detection limits. The data were also subject to a rigorous quality assurance review process to ensure they are of a known and acceptable quality.
- Whenever possible, potential sources of error in the loading estimates were quantified based on analyses of compiled quality assurance data from the study. These data generally show that uncertainty in the loading estimates that stems from flow measurement error ranges from approximately 12 to 50 percent. Potential uncertainty in the water quality data from sampling and analysis error averaged 14 percent for all parameters but PCBs and PBDEs. Errors in congeners averaged 40 and 29 percent, respectively, although 52 percent of results were very close to the reporting limit. Overall variability in the loading estimates that stems from uncertainty in the water quality data was also quantified by reporting the 25th and 75th percentile load estimates that were derived using the 25th and 75th percentile concentrations for each parameter. The error reflected in the range between these values is typically several orders of magnitude. Despite this large error, the resultant data from this study are, in the majority of cases, consistent with previous studies.
- Consistent with other regional studies (e.g., Herrera 2004, 2007), concentrations of many parameters (e.g., metals) were higher during storm events in comparison to baseflow for each of the land-use types. This pattern was especially evident in the data collected from the

commercial/industrial and residential subbasins. Dissolved arsenic was an exception and also tended to be elevated during baseflow across all the land-use types.

- Although this study was not explicitly designed to examine seasonal first-flush dynamics, results from the fall storm indicated higher detection frequencies and concentrations than in winter or spring storm events. In particular, oil and grease, TPH (lube oil), and triclopyr were detected more frequently and at higher concentrations in samples collected during the fall storm relative to subsequent storm events. This pattern was generally observed for each of these parameters in the data from all the land-use types except forests.

- This study did not specifically evaluate adverse impacts to sensitive organisms in streams and other water bodies that receive direct runoff from each land-use type. However, stormwater runoff, particularly from commercial/industrial subbasins, did not meet water quality criteria or human health criteria for several parameters. These include dissolved copper, lead, and zinc; total mercury; bis(2-ethylhexyl) phthalate; and carcinogenic PAHs. However, no numeric criteria have been developed for most parameters analyzed in this study, and the lack of exceedances does not necessarily mean that the levels are safe for aquatic life or human health.

- This study indicated that commercial/industrial subbasins export, in many cases, an order of magnitude higher concentration of organic chemicals than other land-use types. Commercial/industrial, agricultural, and residential (in that order) land uses have substantially elevated levels of metals concentrations and unit loadings as compared to forested lands.

- This study indicated that the majority of the total contaminant loading to Puget Sound is derived from very low-level concentrations in forested subbasins and from somewhat higher concentrations in residential subbasins. Total loading to Puget Sound is a concern for those contaminants that bioaccumulate or cycle within receiving waters and lead to persistent degraded conditions.

- Total contaminant load to Puget Sound is not the only scale of importance. Given that the highest contaminant concentrations and unit-area loads were found in stormwater from the most highly developed land uses, controls may be needed to address contaminant levels that could be found in small streams in the urban corridor.

- While the study was designed to minimize bias, several factors may have produced overestimates or underestimates of loads at various scales. Factors possibly leading to overestimates include instream processes and selection of forested basins close to population centers. Factors possibly leading to underestimates include land cover heterogeneity particularly for commercial/industrial, residential characterized low-density only, use of stream data to characterize lands discharging through conveyance systems, and undersampling fall storms. Other factors could produce either overestimates or underestimates, including use of grab samples, legacy contaminants, and the much smaller proportion of forested lands in the Puget Sound watershed characterized by the four forested subbasins.

- While instream data were used to estimate loads by different land uses and at different spatial scales, these data may not represent stormwater that discharges to marine waters or near marine waters. Conveyance system data may be more appropriate; however, this study did not distinguish loads in these areas.

- Approximately 139 parameters out of the 368 evaluated were not detected in any of the collected samples despite the very low detection limits that were achieved for this study. Many of these same parameters were also not detected in other regional studies (e.g., Herrera 2007) of toxics loading in surface runoff. These parameters are unlikely to be detected in any future instream monitoring given reporting limits that can be achieved with existing analytical methods.

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Recommendations

Based on these study conclusions, the following recommendations are offered:

Management Needs

- Using the data obtained from this study, management actions should be developed to target specific toxic chemicals at the appropriate scale. For example, this study indicated that the majority of the total chemical loading to Puget Sound is derived from very low-level concentrations in forested subbasins and from somewhat higher concentrations in residential subbasins. Low-level loading to Puget Sound is a concern for those toxic chemicals that bioaccumulate or cycle within receiving waters and lead to persistent degraded conditions or are known to impact marine organisms at low concentrations (Puget Sound Partnership 2006).

  To be effective, management strategies for controlling toxic chemical loadings to Puget Sound must be broadly applied across forest and other land uses. Given that it may be difficult to reduce the low concentrations in runoff from these areas using conventional stormwater treatment practices (Schueler 1996), source prevention (e.g., emission controls, removing toxics from consumer products) may be the most effective control measure for parameters where Puget Sound-scale loads are of concern.

- Targeted management actions should be identified for specific land-use types with high unit-area loading rates of toxic chemicals (e.g., commercial/industrial) to reduce their associated acute and chronic toxicity in adjacent streams and other water bodies. Given the relatively high concentrations in runoff from these areas and the relatively small geographic areas they occupy, effective treatment options are generally available for reducing the export of toxic chemicals from these areas (Barrett 2005; Davis et al. 2009; Dietz 2007; Geosyntec and Wright Water 2008). This would include retrofitting treatment systems in existing development (USGS 2010) and low-impact development techniques in new development of previously undeveloped lands (Pennington et al. 2003).

Data and Analytical Needs

- Additional monitoring of toxic chemicals in surface runoff should be performed to address data gaps that were identified through this study. This would include further characterizing any seasonal first-flush dynamics for toxic chemicals in surface runoff, toxic chemical transport on the water surface and/or within the alluvium where the well-mixed assumption may not hold, and toxic chemical transport in association with large events.
- The study relied on the use of multiple grab samples to optimize resources. However, future studies should consider in-situ equipment to quantify within-storm variations in contaminant concentration and the associated loads.
- A sample size power analysis should evaluate the extensive dataset compiled in this study and quantify sampling program needs to further reduce uncertainty for specific parameters of interest.

- Supplemental sampling could be conducted for parameters that exhibited large variability among different subbasins within a given land use. More forested basins may be necessary to adequately characterize those land-use contributions for contaminants that persist or bioaccumulate, for example.
- Given that the residential sites selected in the stratified random-study design were entirely low-density residential, future studies should consider quantifying the full spectrum of residential land-cover intensity.
- If the total load of a given parameter to Puget Sound needs more precise quantification due to potential impacts, then additional characterization of forested lands may be warranted. Sampling sites were limited to forested lands below 2,200 feet in elevation to optimize sampling logistics and to avoid complications of snowmelt. Future studies could further stratify the forested lands by elevation or other factors.
- In addition, because stream and river processes may affect the delivery of contaminant loads generated by forested or other land covers, an understanding of how these processes affect particular parameters of concern may be warranted. These processes may mitigate loads delivered to Puget Sound but could be responsible for retaining contaminants in sensitive freshwater bodies where biota and human impacts are still possible.
- The hydrologic monitoring data were not evaluated in detail, but several patterns suggest land cover influences. Understanding patterns between hydrologic responses and pollutant loads could inform future stormwater management.
- Decisions about parameters to include in future studies in the region should consider the fact that many of the parameters identified in Appendix E will likely not be found unless substantially lower analytical detection limits are employed or unless sampling occurs closer to the point of generation where dilution is minimal. Reducing the parameter list could lead to potential cost savings in future monitoring efforts without compromising scientific rigor.
- Stormwater conveyance system data currently being collected by permittees should be compiled and analyzed in a Puget Sound context. For some areas, conveyance system data may be more appropriate to characterize loads. Future load estimates should consider this dataset.

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Glossary, Acronyms, and Abbreviations

Glossary

Alluvium: A general term for all sediment deposits resulting from the operation of modern rivers. The sediments laid down in river beds and flood plains. Often specifically refers to recent stream deposits.

Anthropogenic: Human-caused.

Areal flow: Surface water discharge per unit of watershed area, in units of length per time, for example inches per day.

Baseflow: Groundwater discharge. The component of total streamflow that originates from direct groundwater discharges to a stream.

Basin: A drainage area or watershed in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Benthic: Bottom-dwelling organisms.

Bioaccumulate: Build up in the food chain.

Box model: A computer prediction tool to simulate the movement of water and pollutants within a water body.

Congener: In chemistry, congeners are related chemicals. For example, polychlorinated biphenyls (PCBs) are a group of 209 related chemicals that are called congeners.

Conventional pollutants: Non-toxic pollutants. In this study, conventionals are hardness, nutrients, total suspended solids, and field parameters.

First flush: The initial runoff during a rain event flows over the ground and often carries more pollutants with it than runoff that occurs later in the storm.

Fluvial: Relating to or happening in a river.

Grab sample: A discrete sample from a single point in the water column or sediment surface.

Groundwater: Water in the subsurface that saturates the rocks and sediment in which it occurs. The upper surface of groundwater saturation is commonly termed the water table.

Hydrologic: Water in the atmosphere, on the surface of the earth and underground. Includes processes such as precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transpiration.

Loading: The input of pollutants into a water body.

Marine water (seawater): Salt water.

Metals: Elements, such as cadmium, chromium, cobalt, copper, lead mercury, nickel, and zinc, which are of environmental concern because they do not degrade over time. Although many are necessary nutrients, they are sometimes magnified in the food chain, and they can be toxic to life in high enough concentrations. They are also referred to as heavy metals.

Noisy data: Poor quality hydrologic data (i.e., data spikes).

Nonpoint source: Unconfined and diffuse sources of contamination. Pollution that enters water from dispersed land-based or water-based activities. This includes, but is not limited to, atmospheric deposition, surface-water runoff from agricultural lands, urban areas, or forest lands, subsurface or underground sources, or discharges from boats or marine vessels not otherwise regulated under the National Pollutant Discharge Elimination System program.

Organics: Natural or synthetic compounds that contain carbon and hydrogen bonds. A few examples of organics in this study include oil and grease, PCBs, and PBDEs.

Parameter: An analyte or grouping of analytes.

Puget Sound: In this study, Puget Sound includes all of Puget Sound, Hood Canal, and the Straits of Georgia and Juan de Fuca within Washington State.

Puget Sound Box Model: A computerized tool for predicting contaminant movement within the Puget Sound ecosystem.

Sill: A relatively shallow area of the seabed.

Storm event: A distinct period of rainfall defined by a minimum precipitation depth (0.25 inches in 24 hours in this study) and a minimum antecedent dry period (12 hours with less than 0.01 inches of precipitation in this study).

Stormwater: The portion of precipitation that does not naturally percolate into the ground or evaporate but instead runs off roads, pavement, and roofs during rainfall or snow melt. Stormwater can also come from hard or saturated grass surfaces such as lawns, pastures, and playfields, and from gravel roads and parking lots.

Surface runoff: In this study, surface runoff is broadly defined to include stormwater, nonpoint source overland flow, and groundwater discharge to surface waters that flow to Puget Sound.

Thalweg: The primary flow path and the deepest part of the stream channel.

Total suspended solids (TSS): The suspended particulate matter in a water sample as retained by a filter.

Unit area: A defined area (e.g., square kilometers).

Water column: A conceptual tube of water extending vertically from the top of the sediment layer to the surface of the water.

Water quality: The chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.

Watershed: A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Acronyms and Abbreviations

BMP	Best management practice
BNA	Base/neutral/acid extractable compound
$CaCO_3$	Calcium carbonate
DDT	Dichlorodiphenyltrichloroethane
DOG	Dissolved oil and grease
Ecology	Washington State Department of Ecology
E&E	Ecology and Environment, Inc.
e.g.	For example
EPA	U.S. Environmental Protection Agency
et al.	and others
GC/ECD	Gas chromatography/electron capture detector
GC/MS	Gas chromatography/mass spectrometry
GIS	Geographic Information System software
Herrera	Herrera Environmental Consultants, Inc.
HPAH	High molecular weight polycyclic aromatic hydrocarbons
HRGC/HRMS	High resolution gas chromatography/high resolution mass spectrometry
i.e.	In other words
LPAH	Low molecular weight polycyclic aromatic hydrocarbons
MCPA	2-methyl-4-chlorophenoxyacetic acid
MEL	Manchester Environmental Laboratory
MQO	Measurement Quality Objective
MRL	Method reporting limit
n	Number
NAWQA	National Water Quality Assessment
PAH	Polycyclic aromatic hydrocarbon
PBDE	Polybrominated diphenyl ethers
PCA	Principal component analysis
PCB	Polychlorinated biphenyl
PSOES	Puget Sound Ocean Exchange Study
QA	Quality assurance

QAPP	Quality Assurance Project Plan
QC	Quality control
RPD	Relative percent difference
SM	Standard method
TP	Total phosphorus
TPH	Total petroleum hydrocarbon
TPH-DOG	Total petroleum hydrocarbons, extract of oil and grease (lube oil)
TSS	Total suspended solids
USGS	U.S. Geological Survey
WRIA	Water Resource Inventory Area

Units of Measurement

cfs	cubic feet per second
$g/km^2/yr$	grams per square kilometer per year
$kg/ km^2/yr$	kilograms per square kilometer per year
$mg/km^2/yr$	milligrams per square kilometer per year
g/km	grams per kilometer
g/yr	grams per year
kg/yr	kilograms per year
MT/yr	metric tons per year
mg/L	milligrams per liter (parts per million)
ng/L	nanograms per liter (parts per trillion)
pg/L	picograms per liter (parts per quadrillion)
µg/L	micrograms per liter (parts per billion)

Figures

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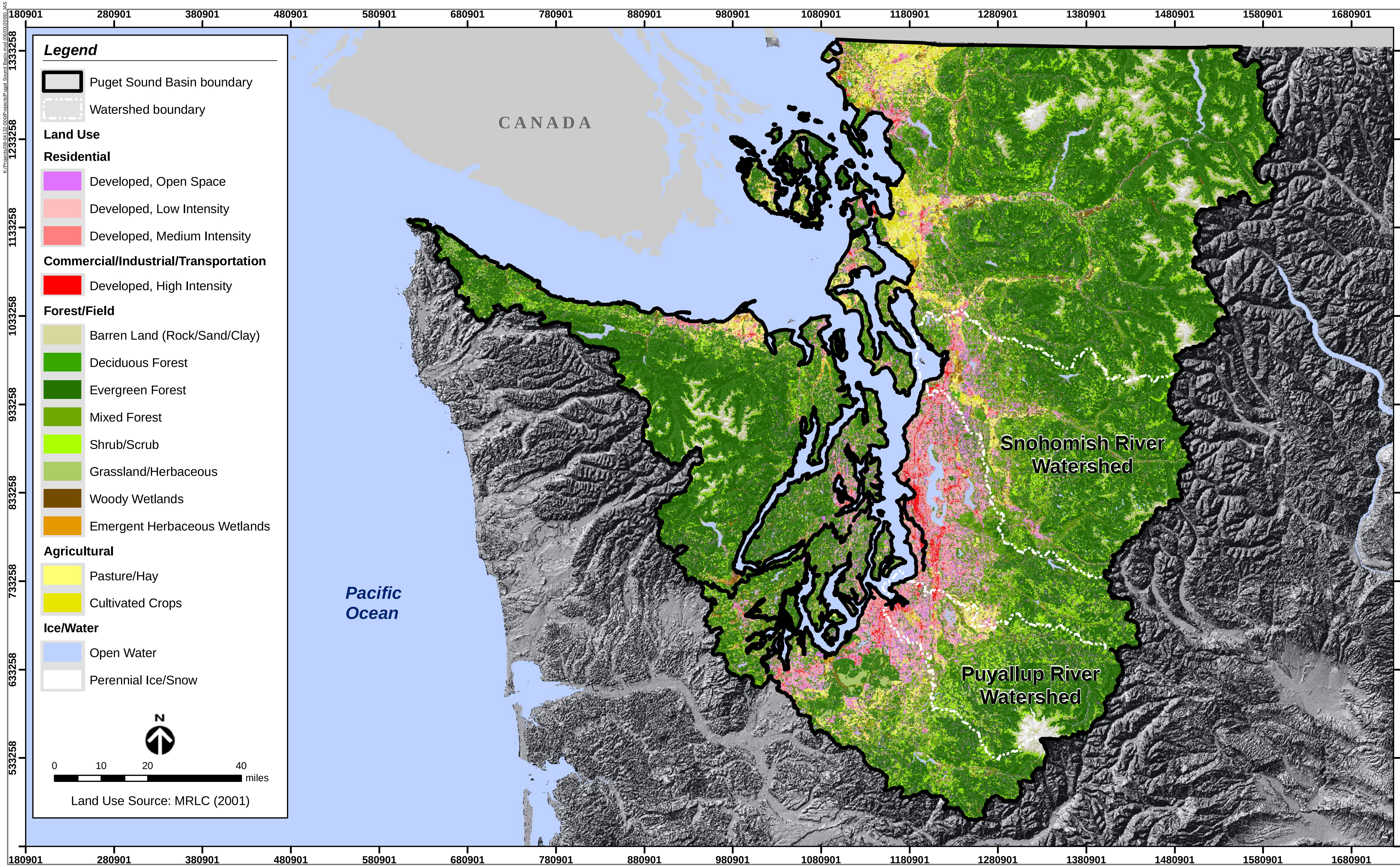

Figure 1. Regional map showing the Puget Sound Basin, Snohomish River Watershed, and Puyallup River Watershed.

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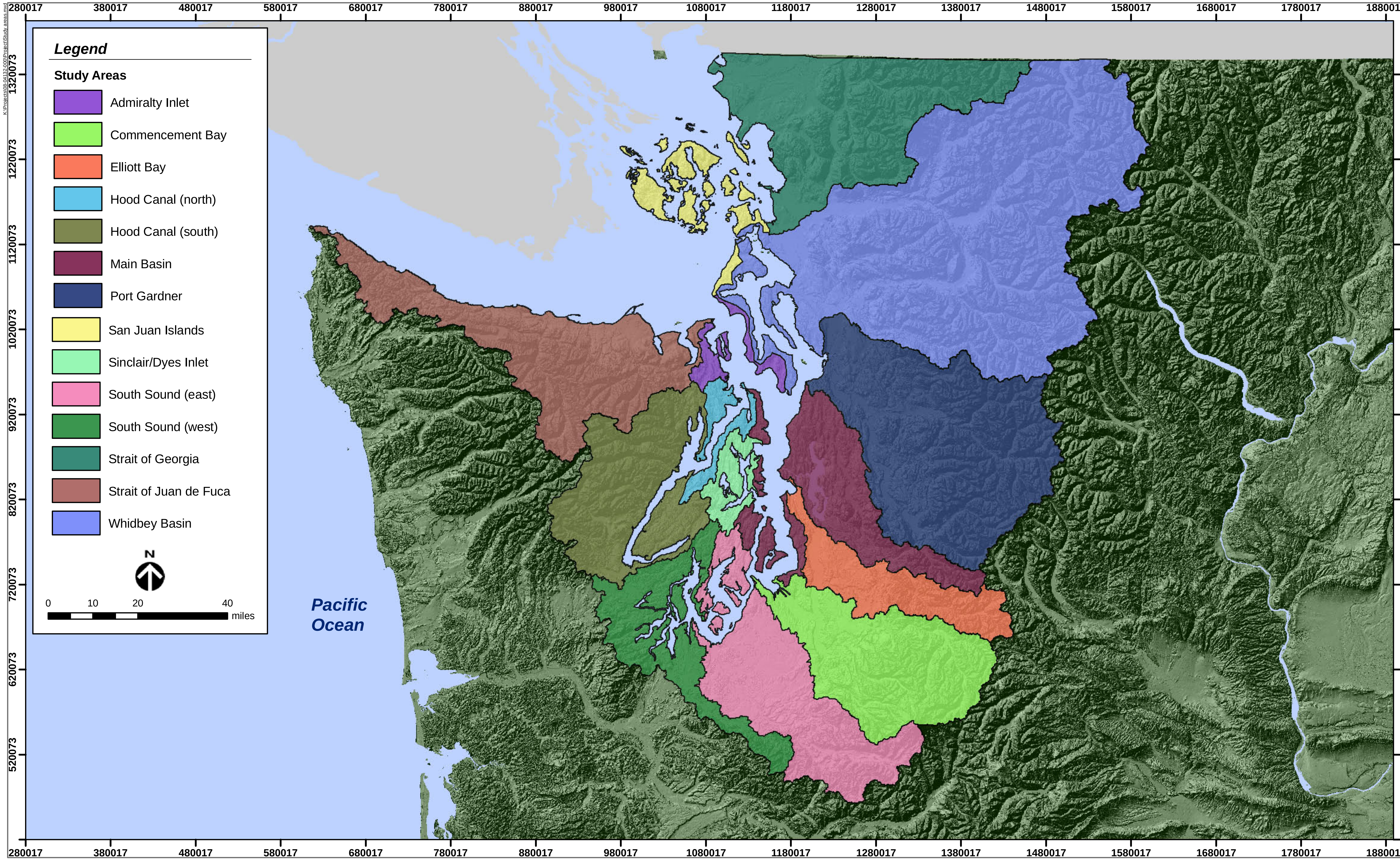

Figure 2. Fourteen study areas that provide input to the Puget Sound Box Model.

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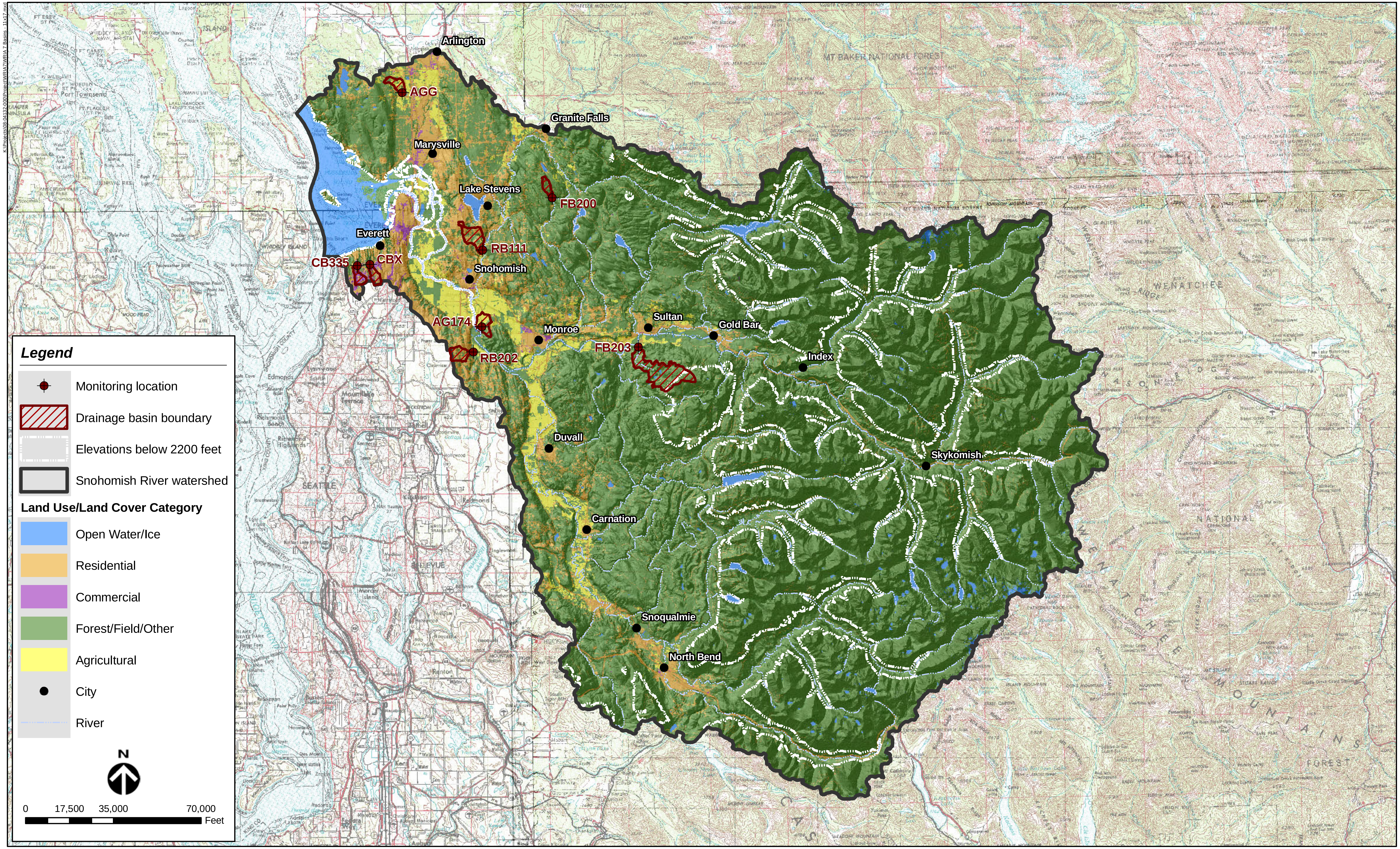

Figure 3. Individual monitoring locations and their corresponding drainage basins within the Snohomish River Watershed.

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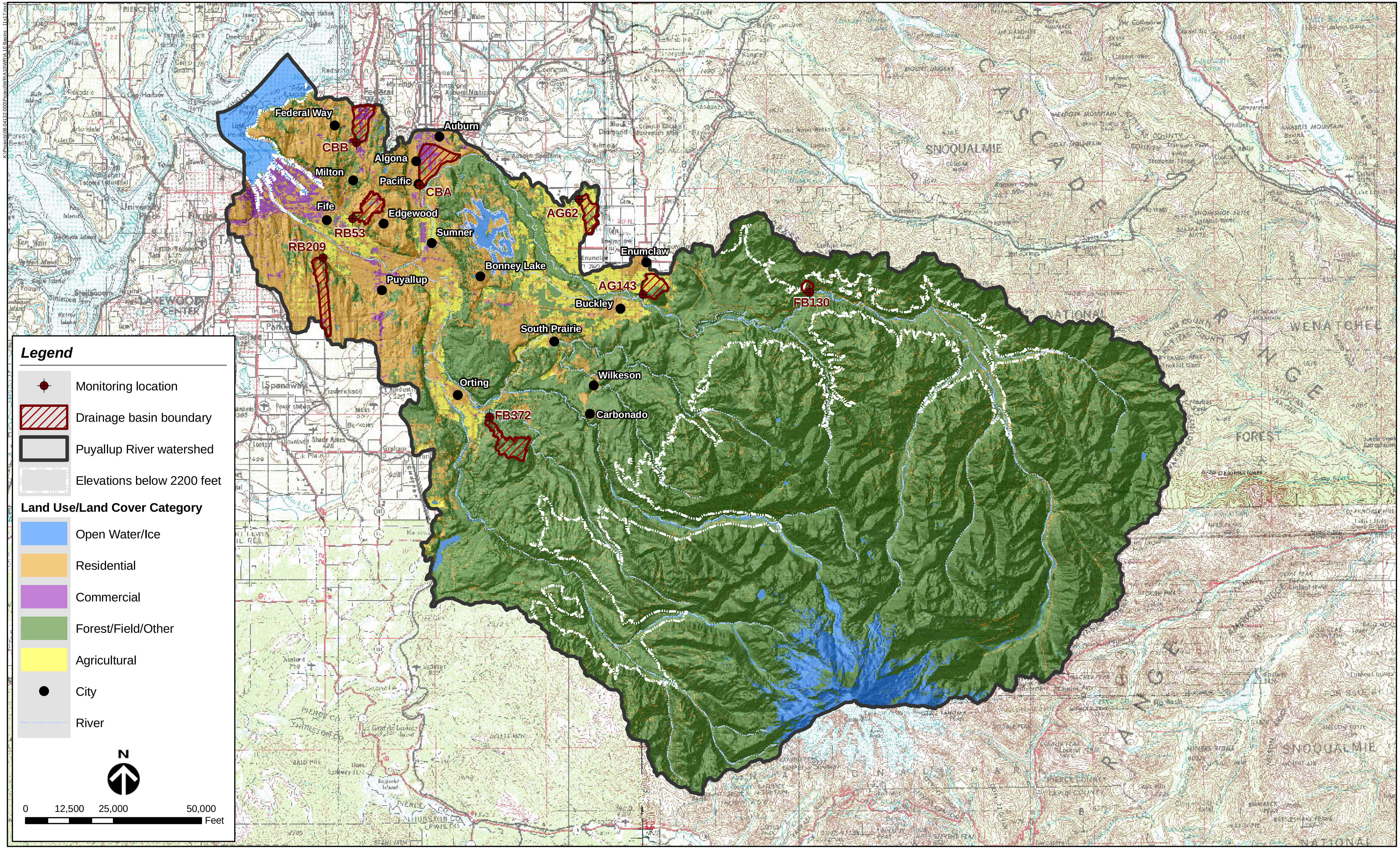

Figure 4. Individual monitoring locations and their corresponding drainage basins within the Puyallup River Watershed.

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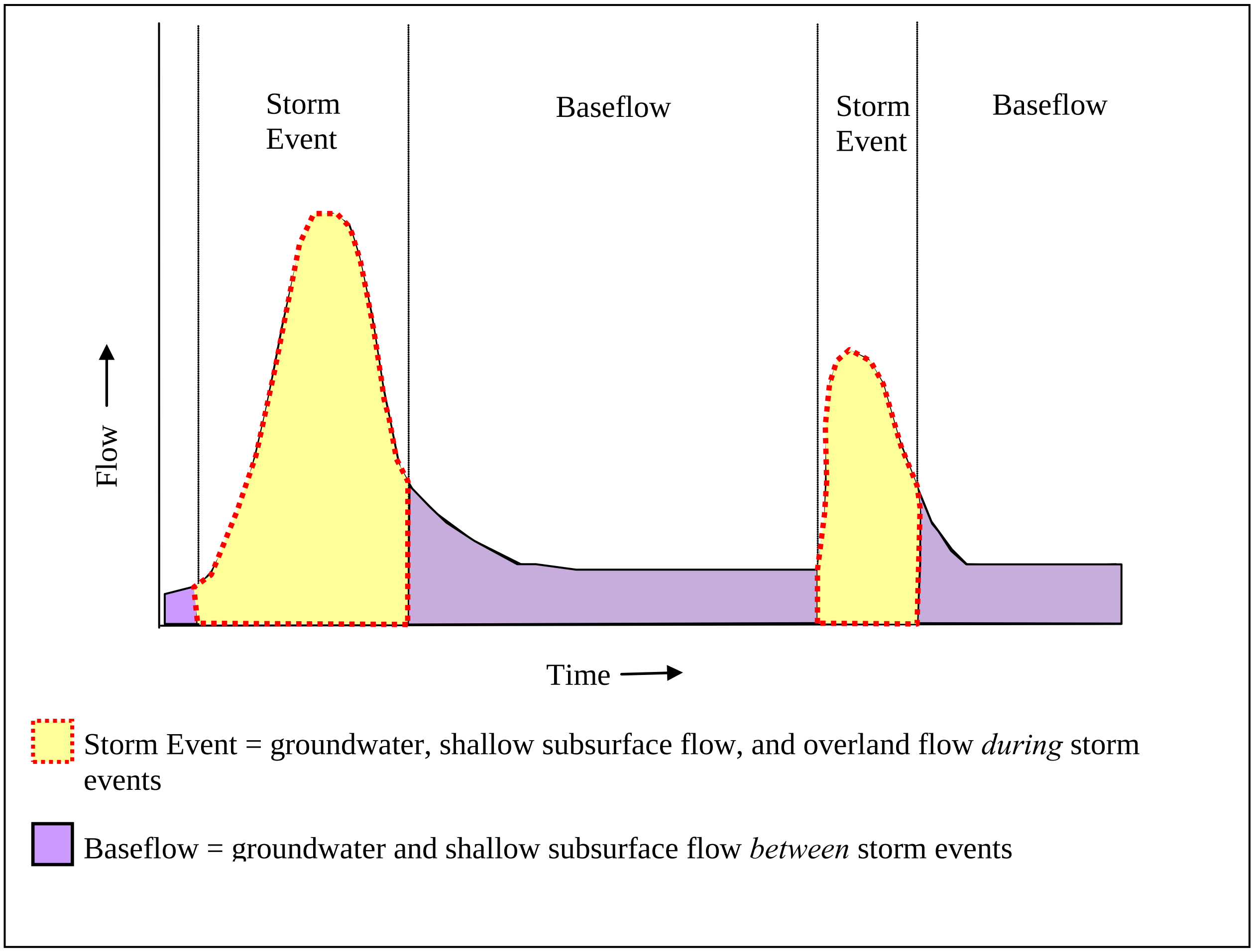

Figure 5. Hydrograph components delineated for computing loading estimates.

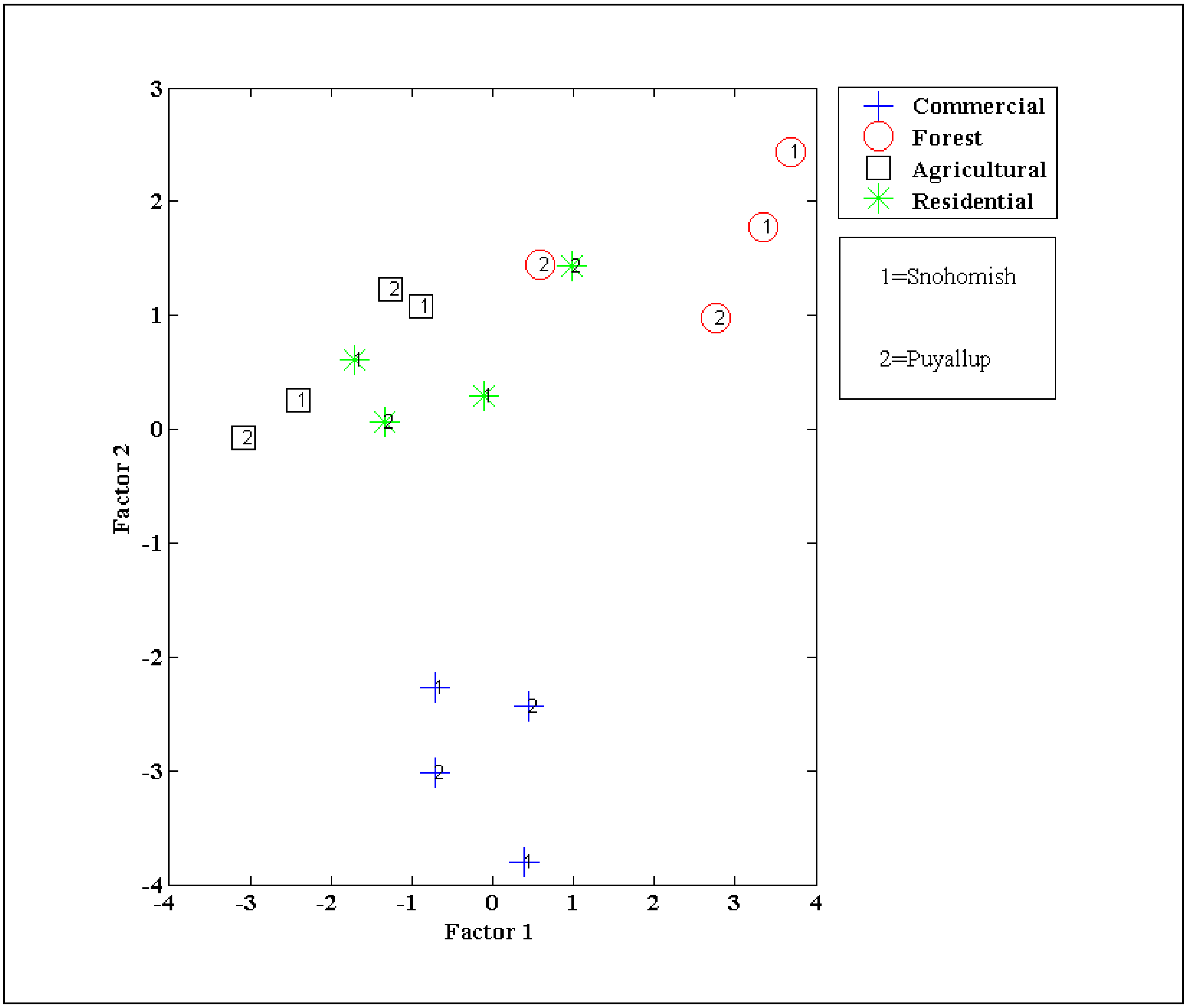

Figure 6. Results of the principal component analysis on data from storm-event sampling: mapping of monitoring locations (based on median concentrations) in the principal component space.

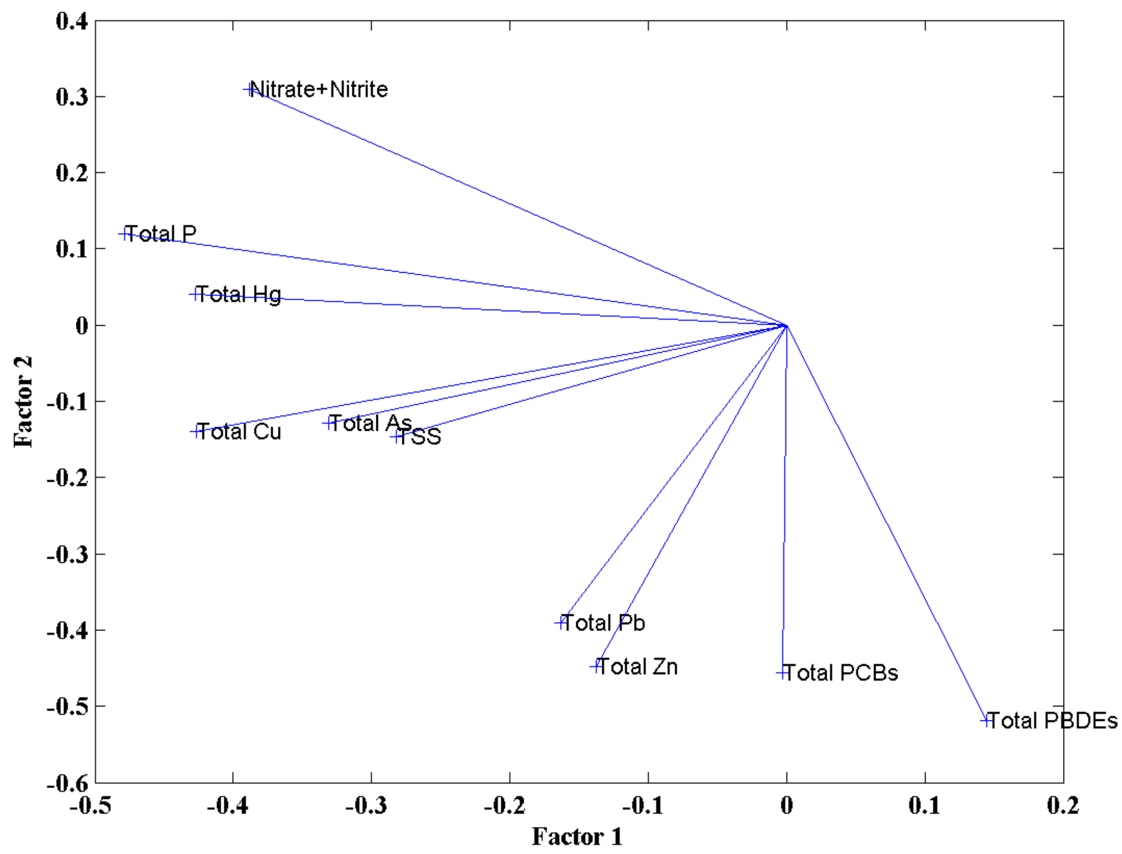

Figure 7. Results of the principal component analysis on data from storm-event sampling: mapping of monitoring parameters in the principal component space.

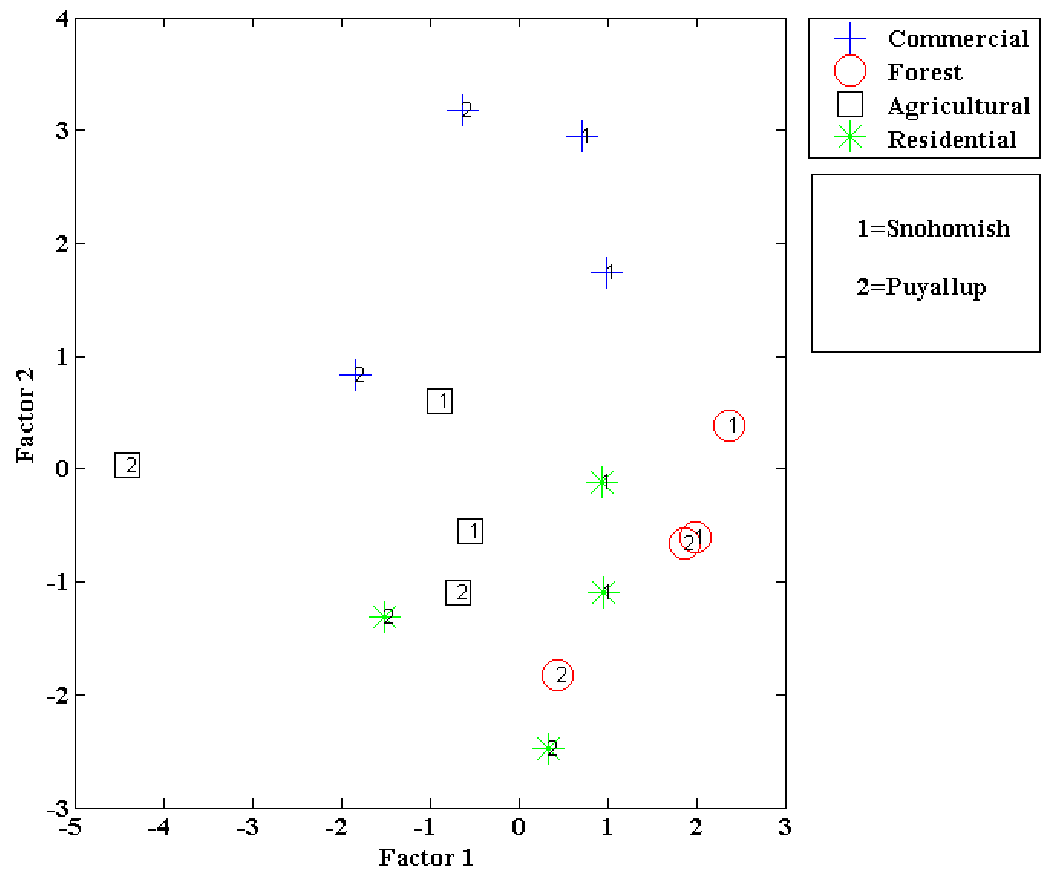

Figure 8. Results of the principal component analysis on data from baseflow sampling: mapping of monitoring locations (based on median concentrations) in the principal component space.

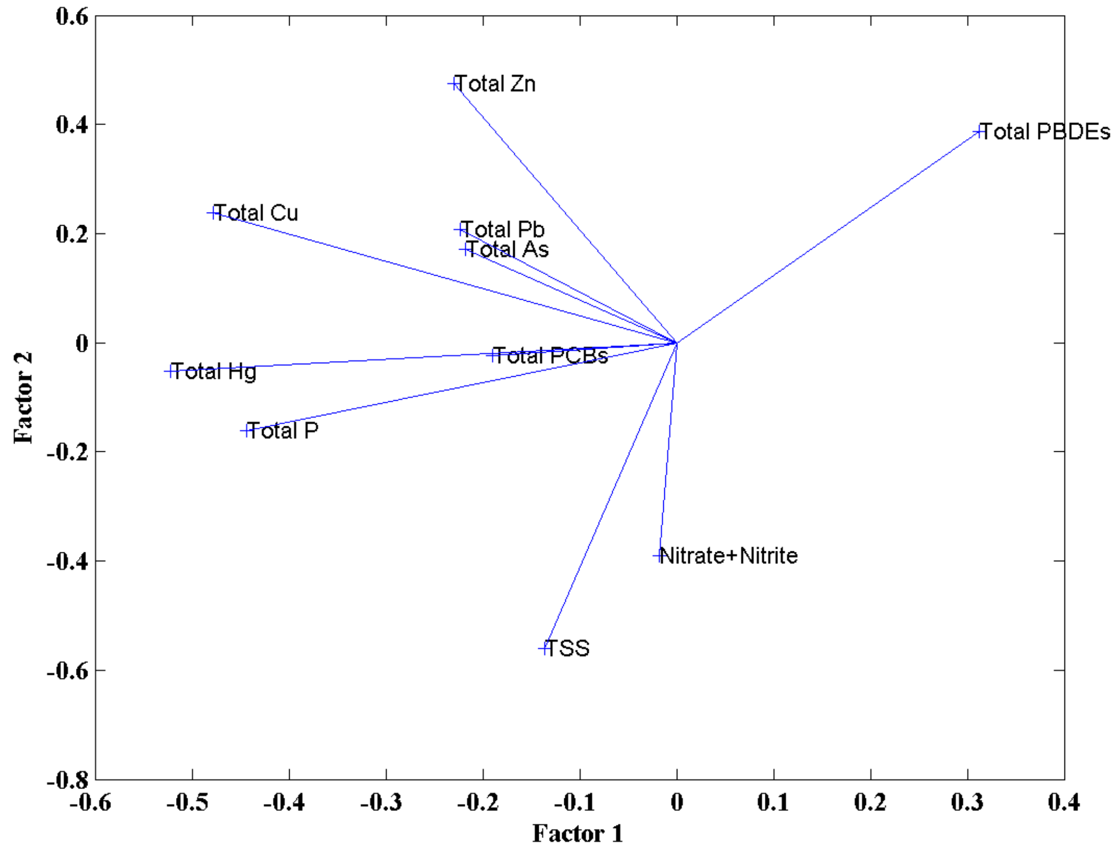

Figure 9. Results of the principal component analysis on data from baseflow sampling: mapping of monitoring parameters in the principal component space.

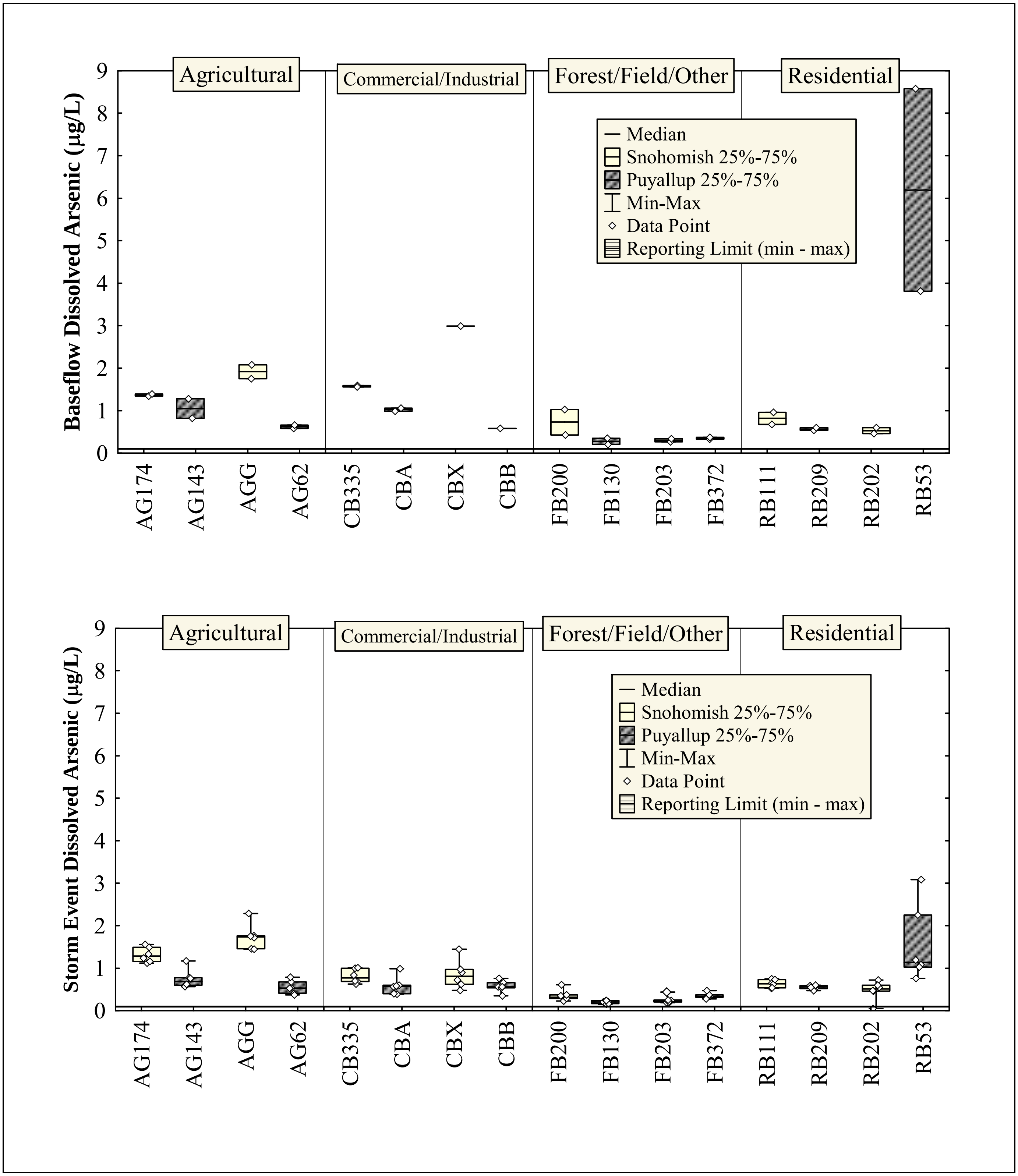

Figure 10. Baseflow and storm-event dissolved arsenic concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

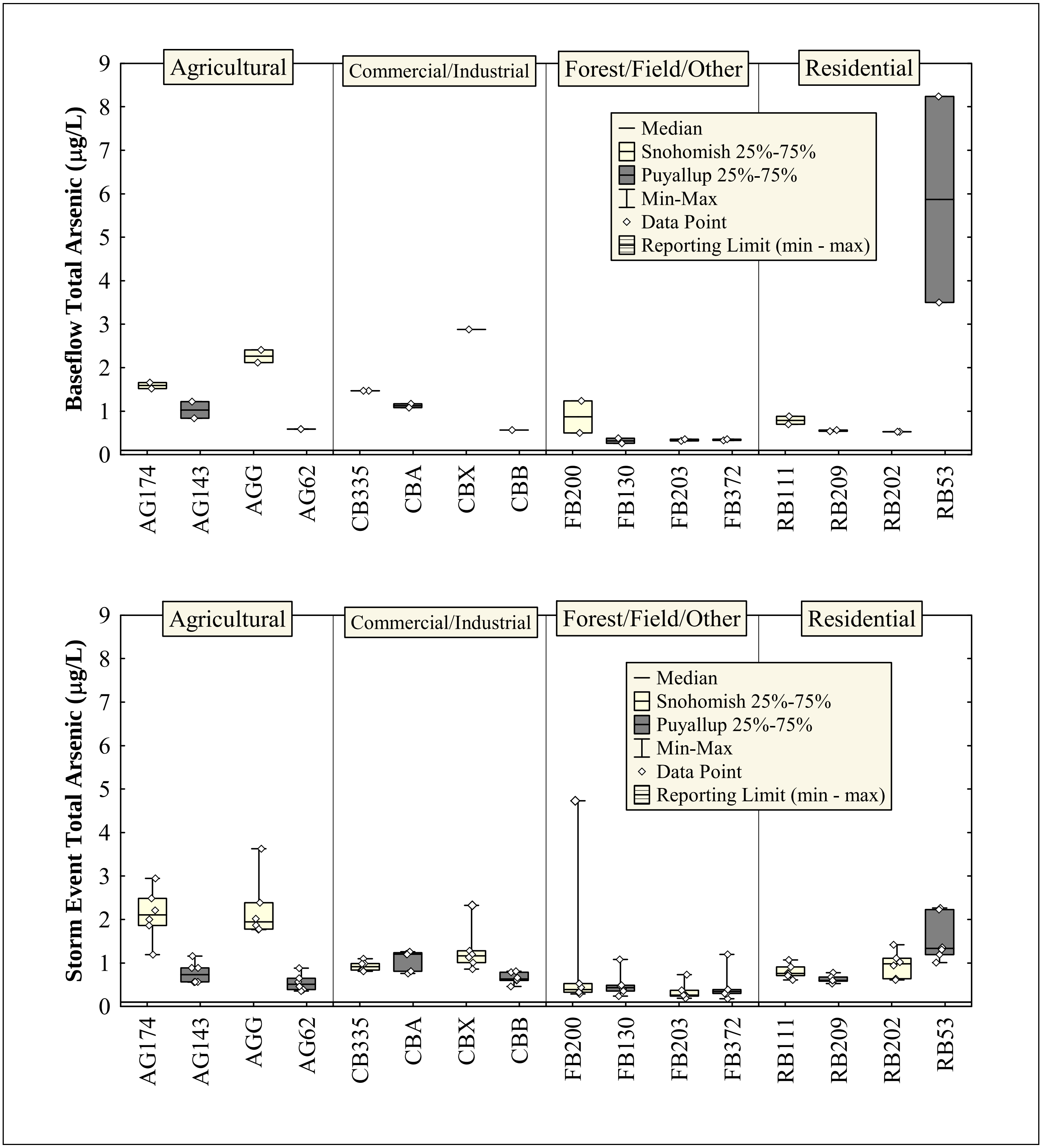

Figure 11. Baseflow and storm-event total arsenic concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

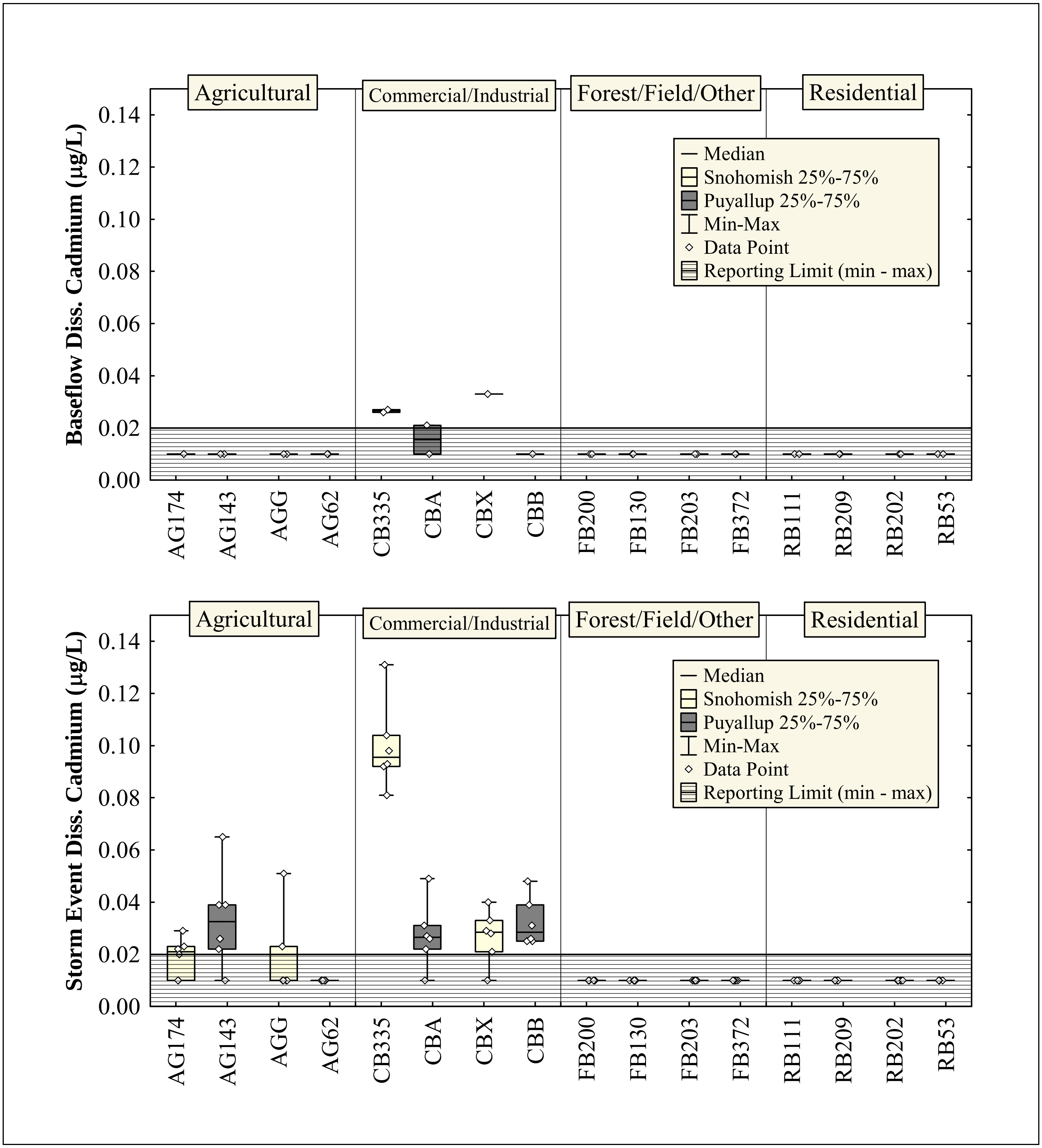

Figure 12. Baseflow and storm-event dissolved cadmium concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

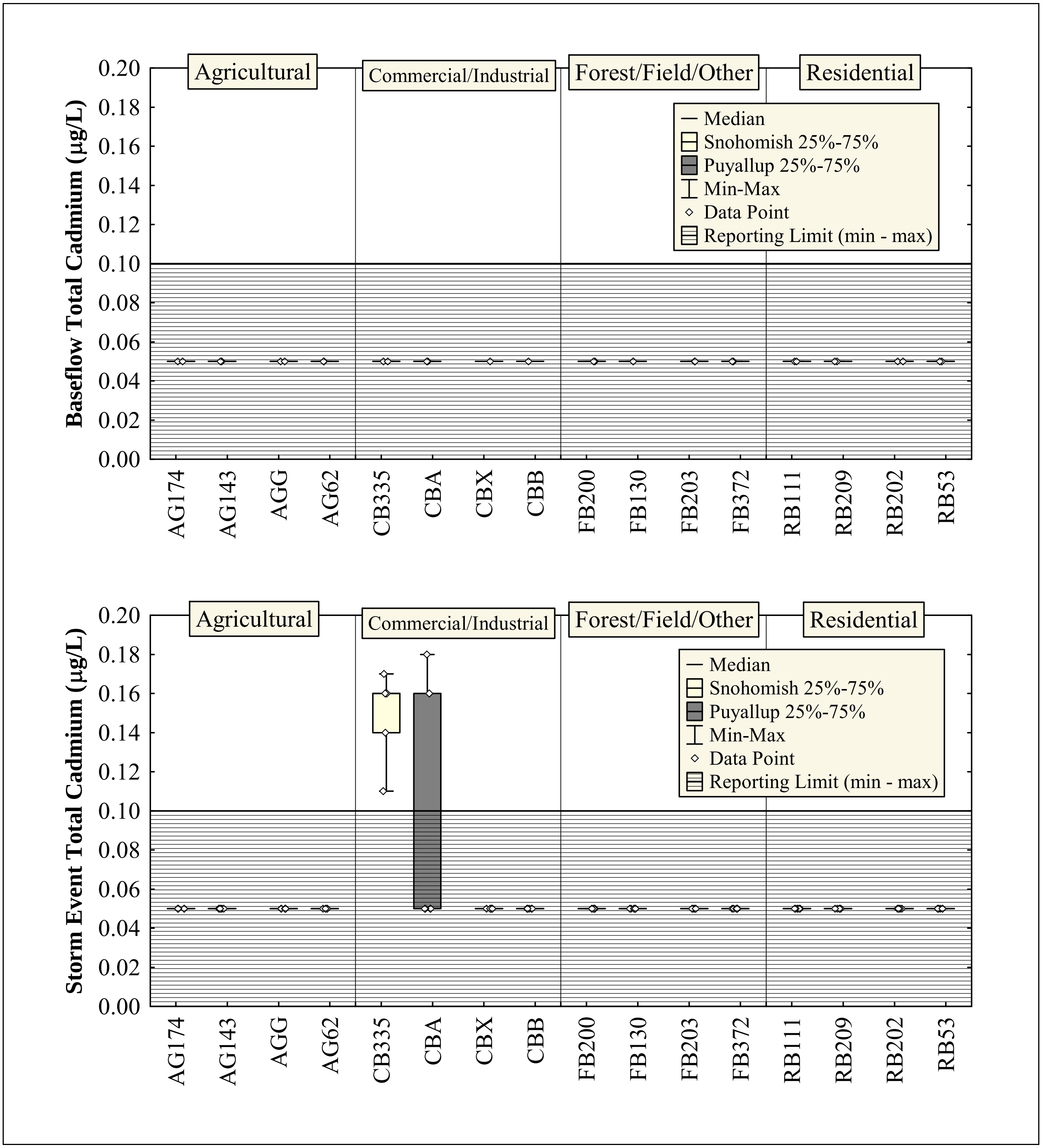

Figure 13. Baseflow and storm-event total cadmium concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

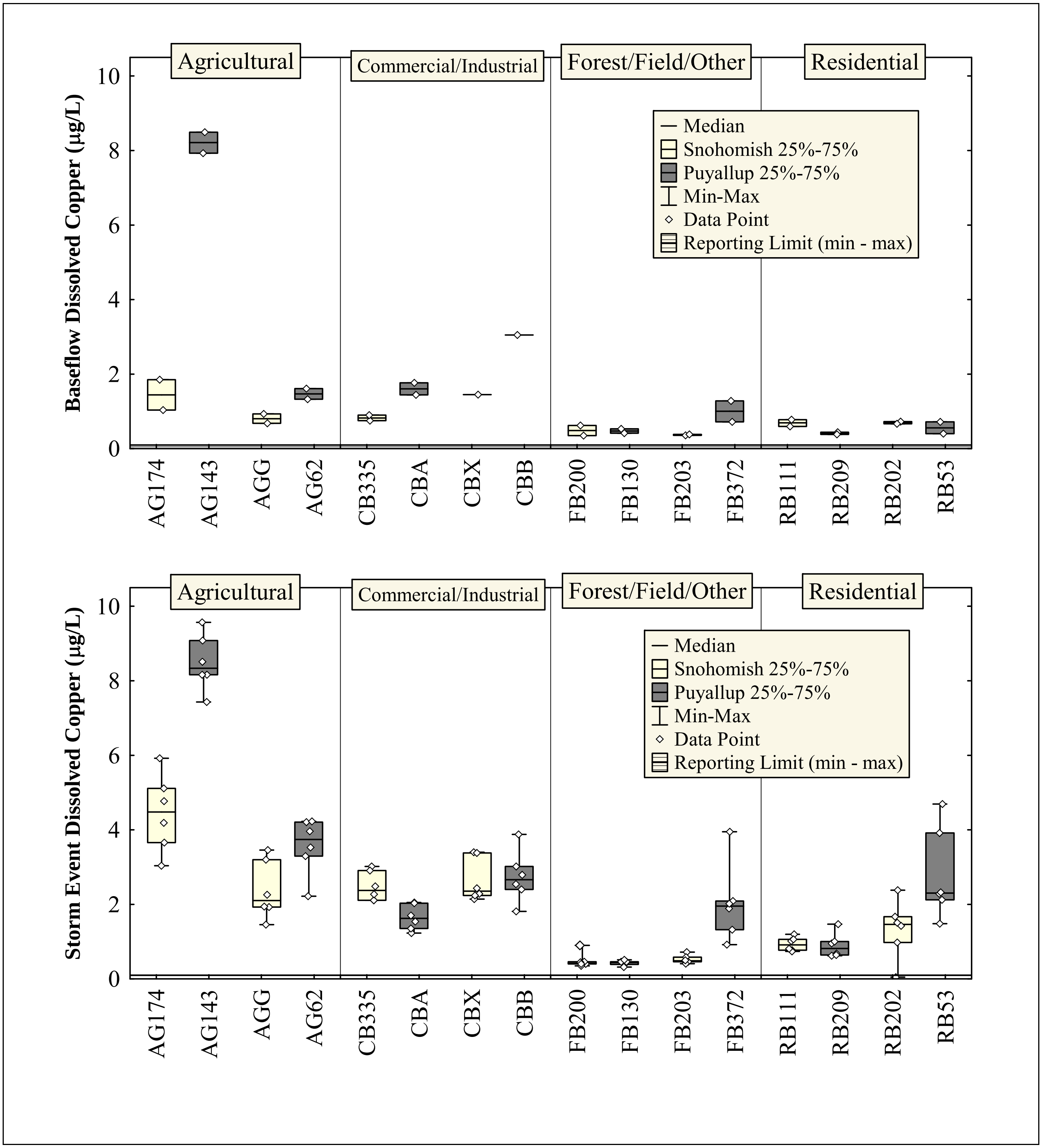

Figure 14. Baseflow and storm-event dissolved copper concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

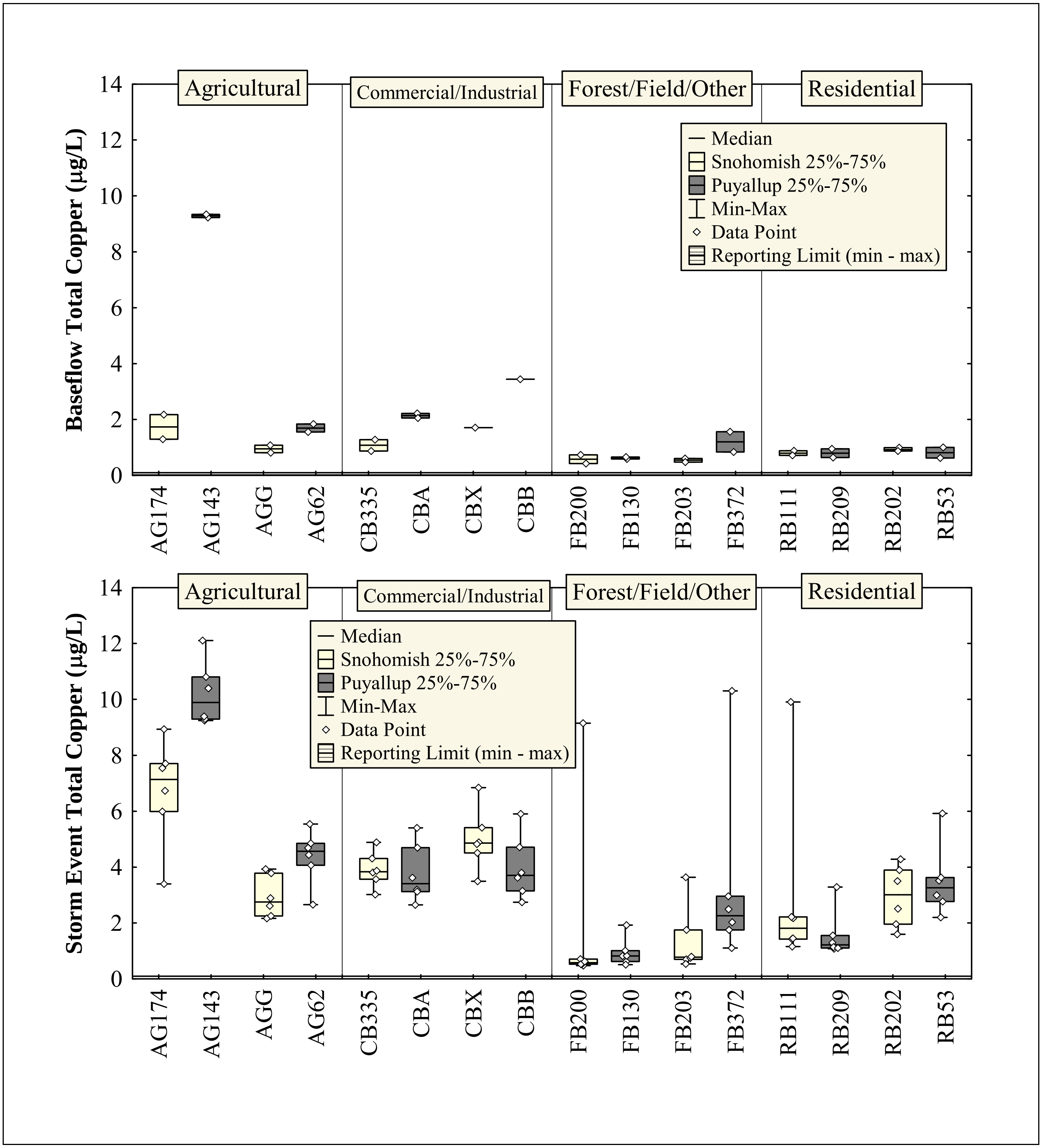

Figure 15. Baseflow and storm-event total copper concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

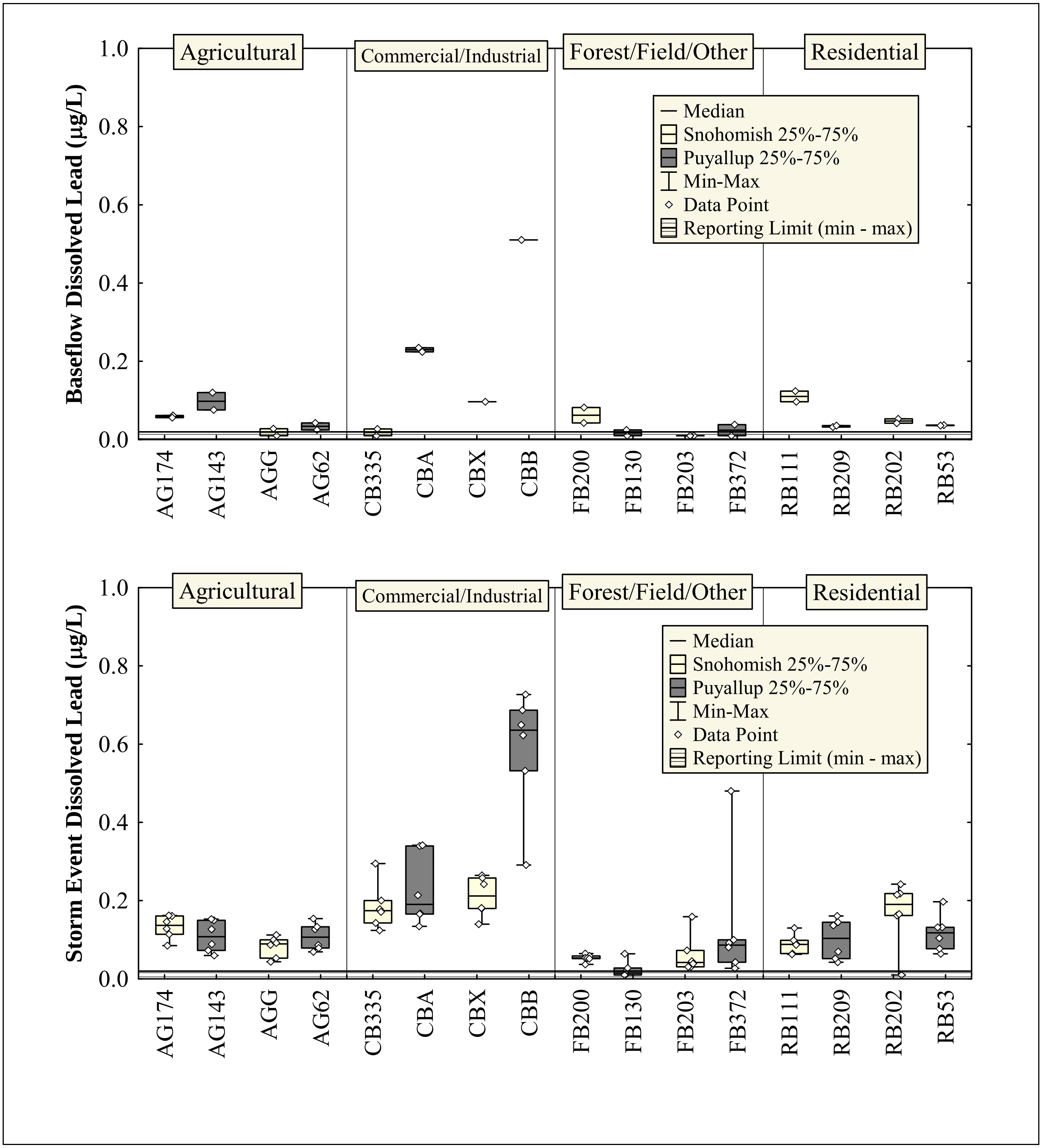

Figure 16. Baseflow and storm-event dissolved lead concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

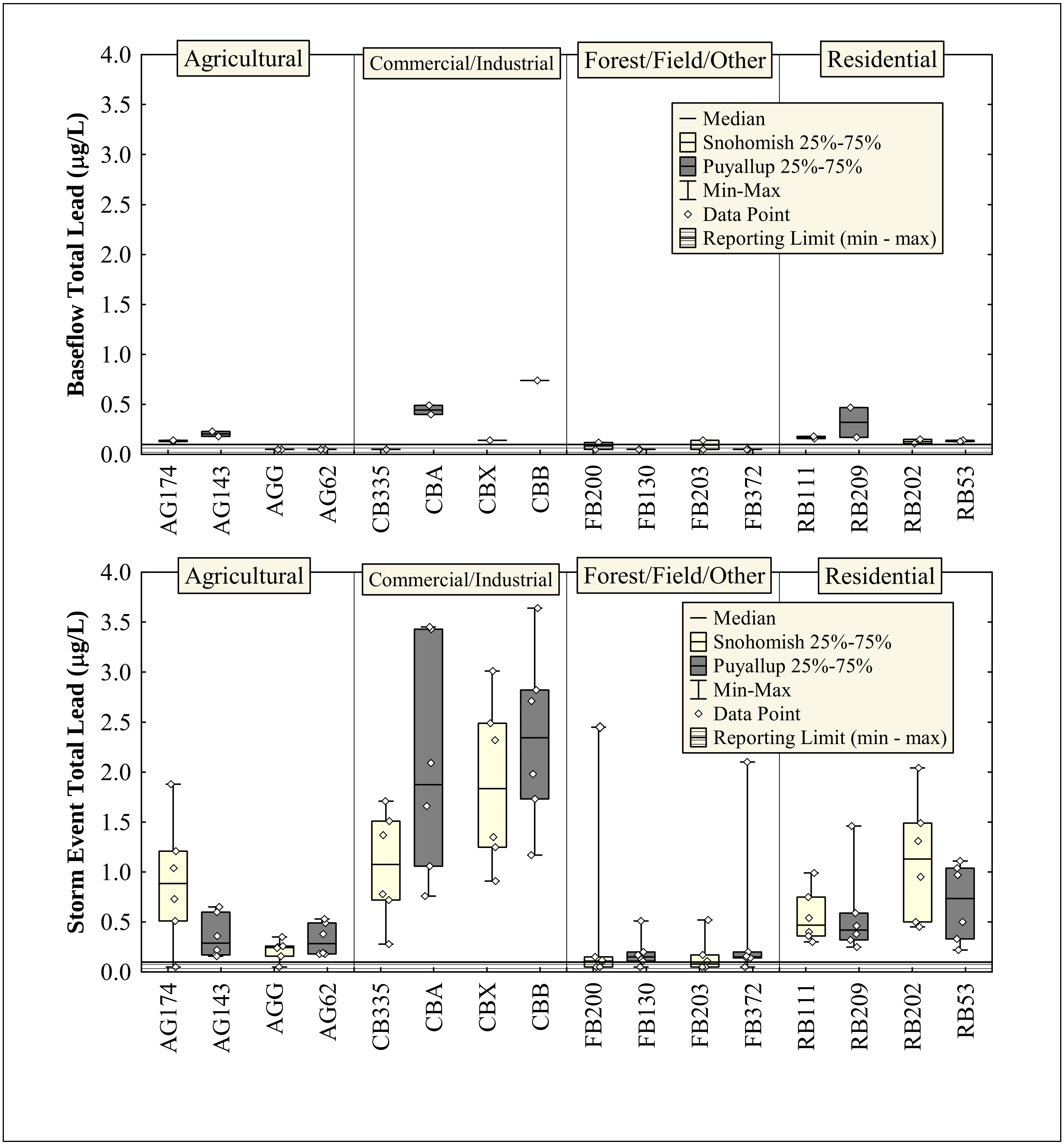

Figure 17. Baseflow and storm-event total lead concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

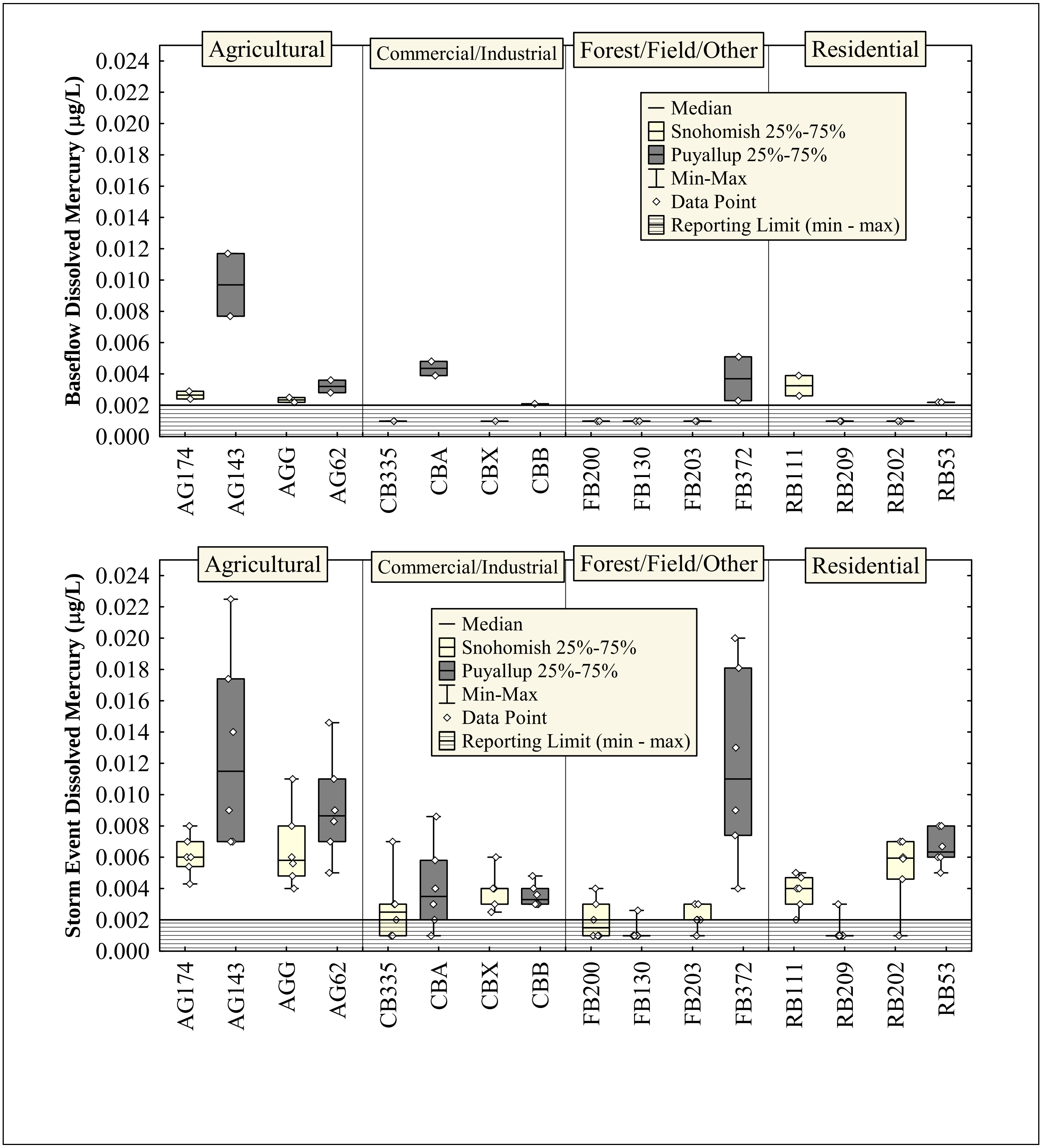

Figure 18. Baseflow and storm-event dissolved mercury concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

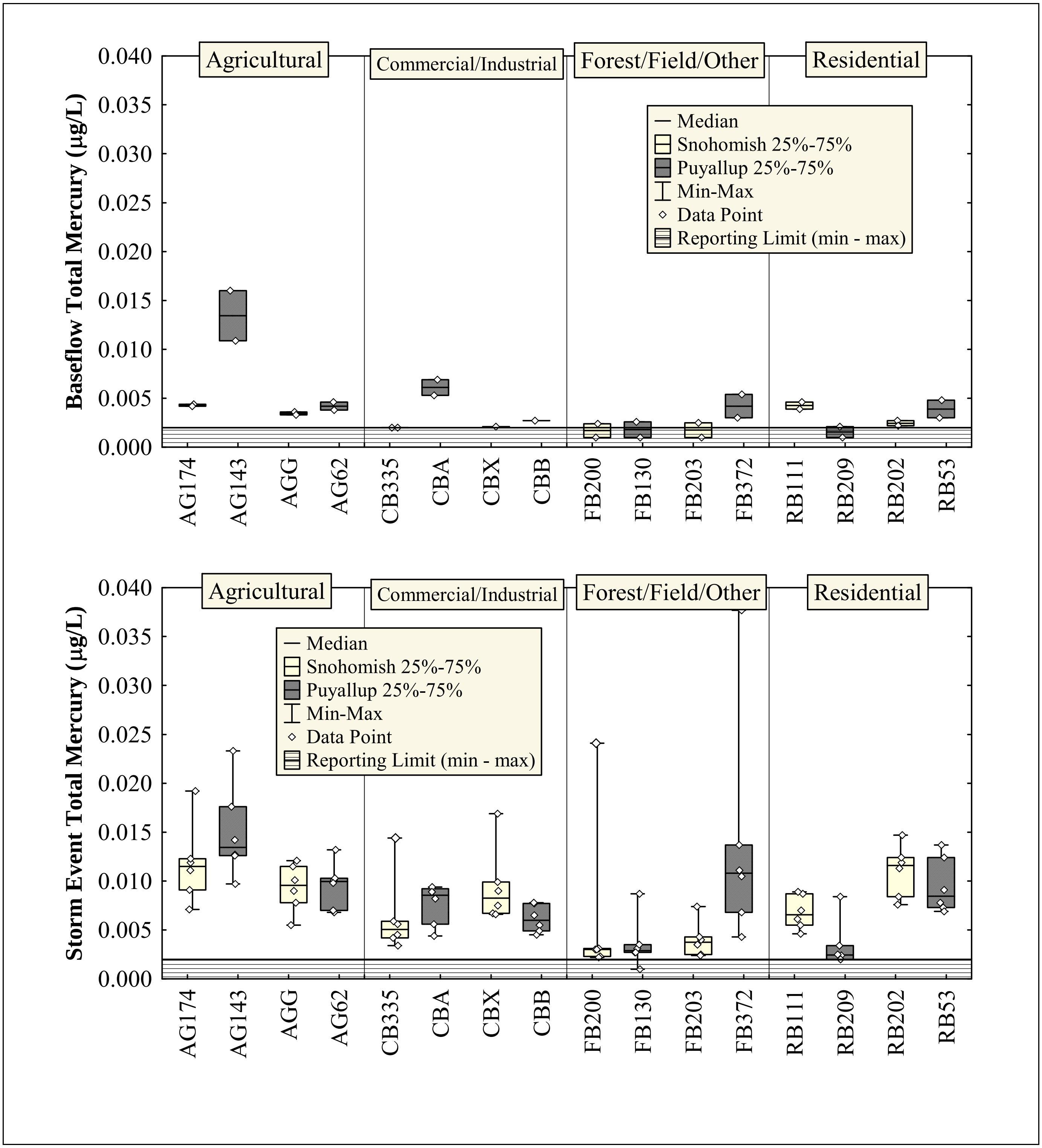

Figure 19. Baseflow and storm-event total mercury concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

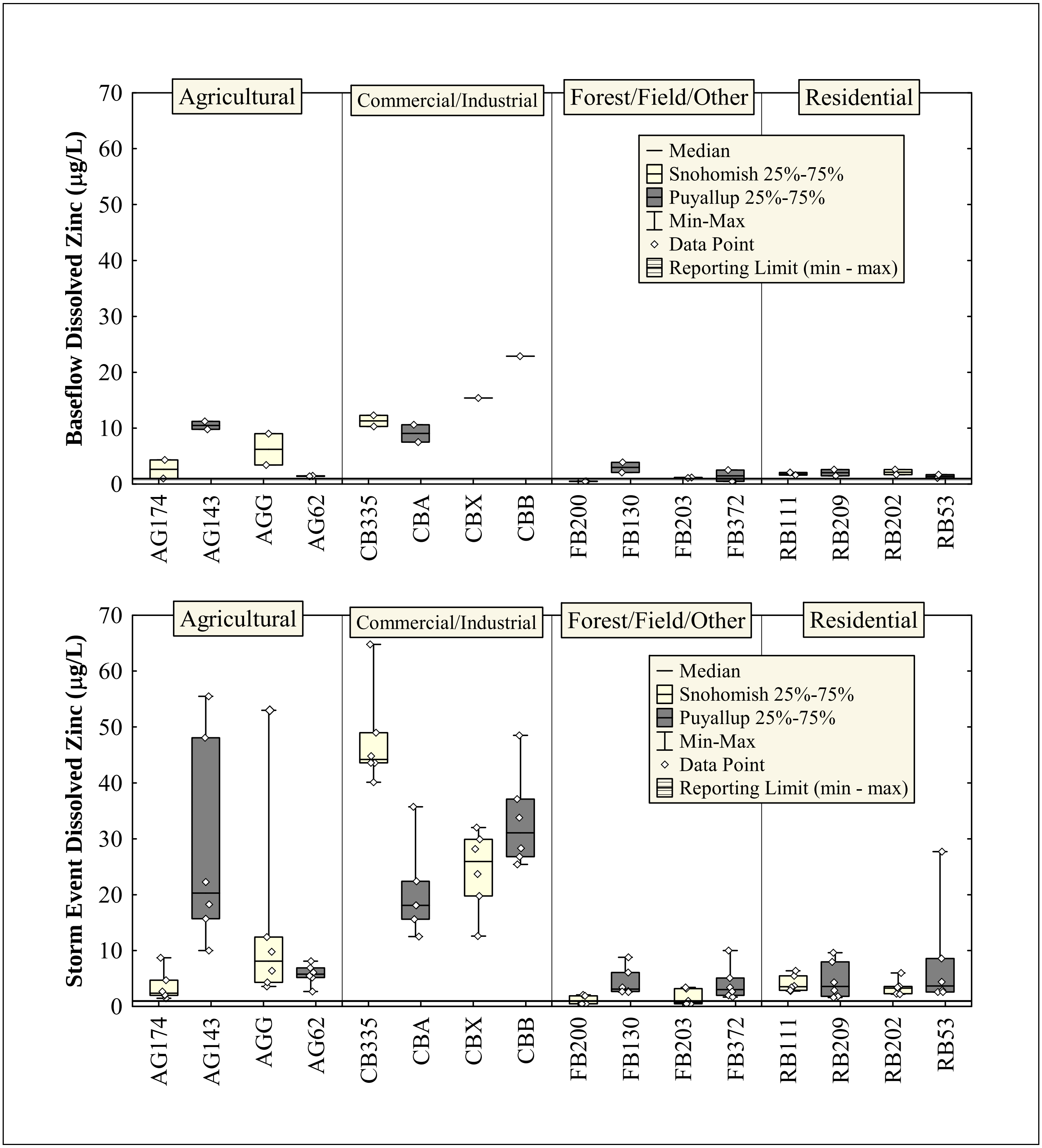

Figure 20. Baseflow and storm-event dissolved zinc concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

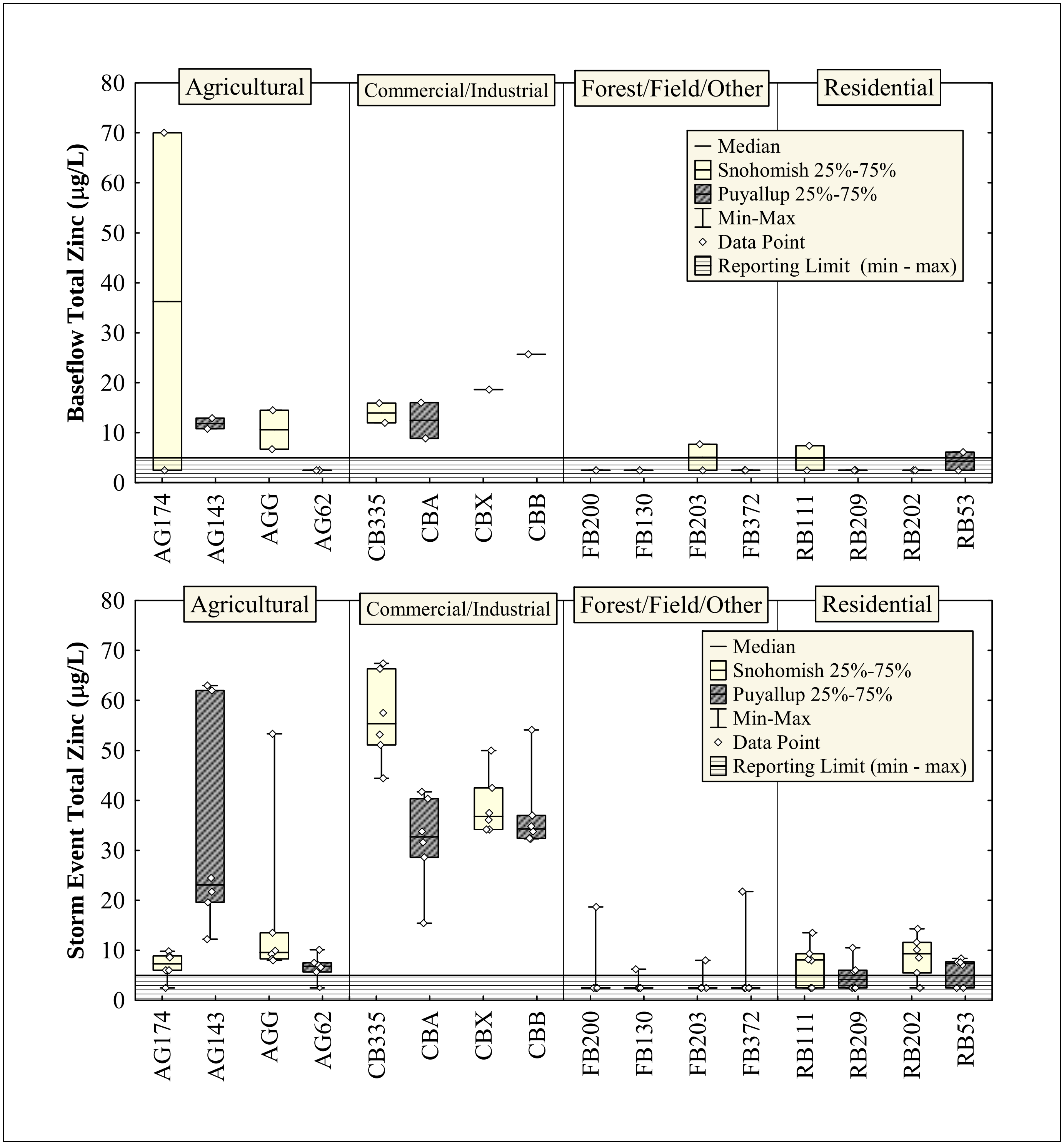

Figure 21. Baseflow and storm-event total zinc concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

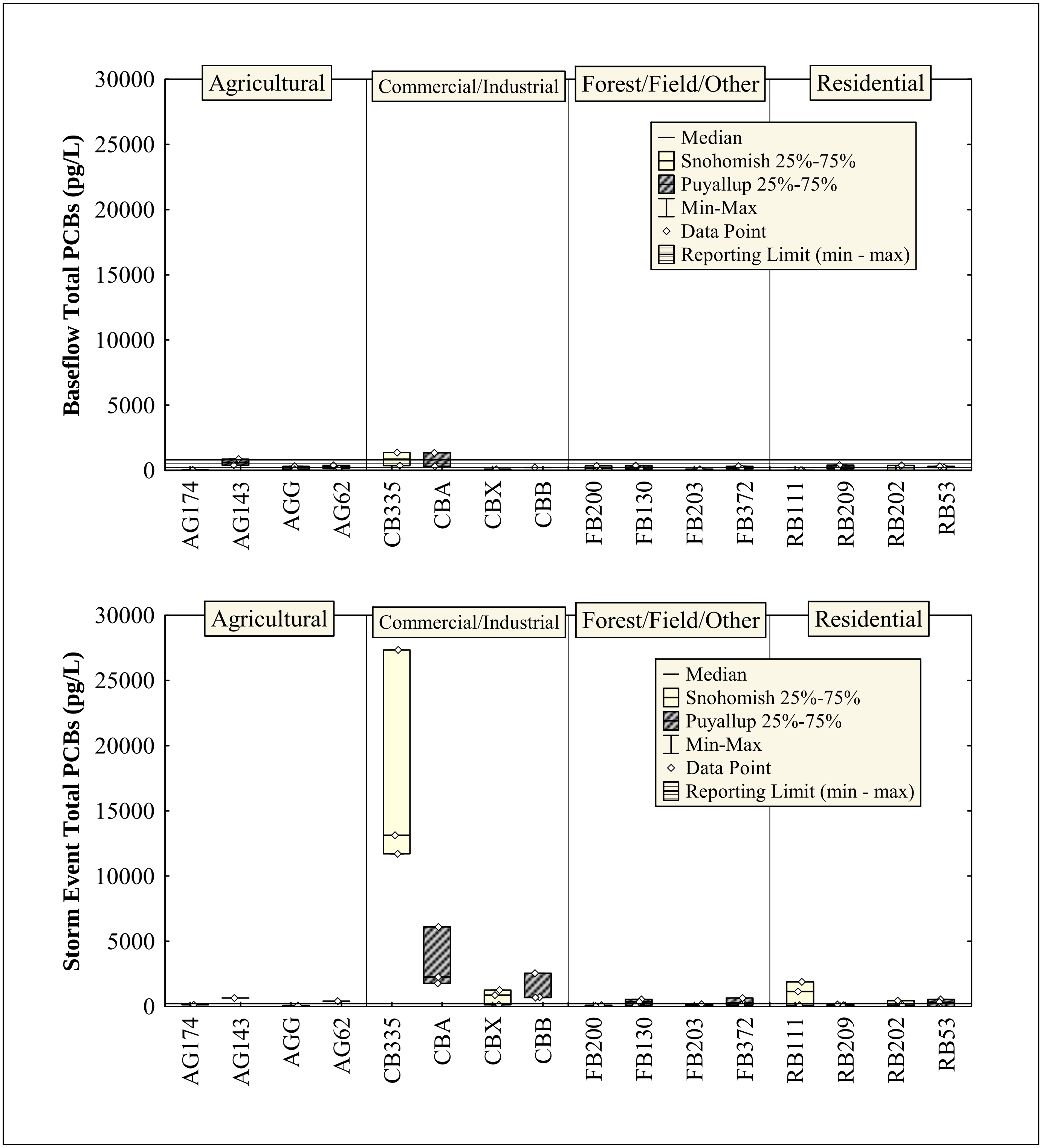

Figure 22. Baseflow and storm-event total polychlorinated biphenyls (PCBs) concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

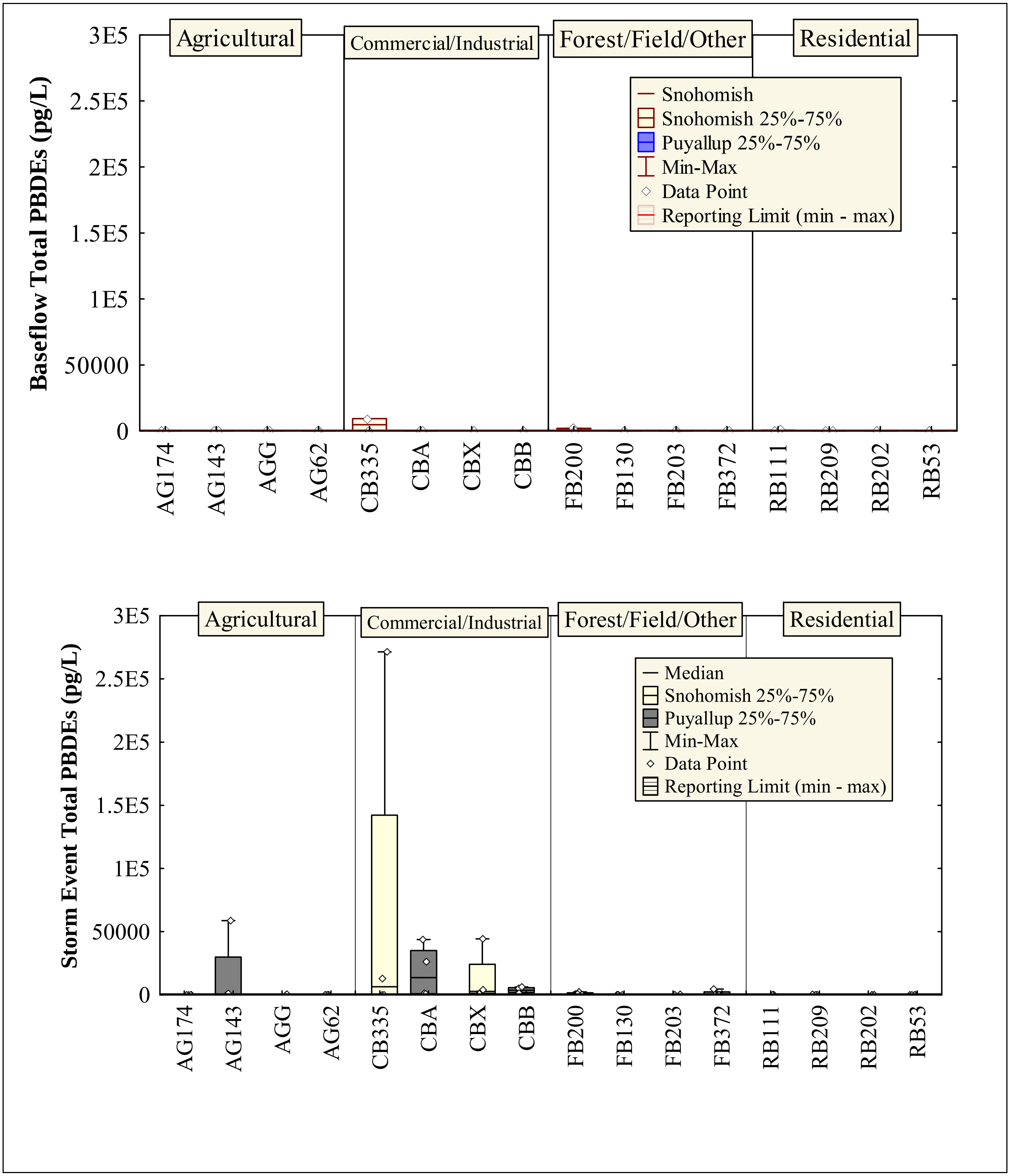

Figure 23. Baseflow and storm-event total polybrominated diphenyl ethers (PBDEs) concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

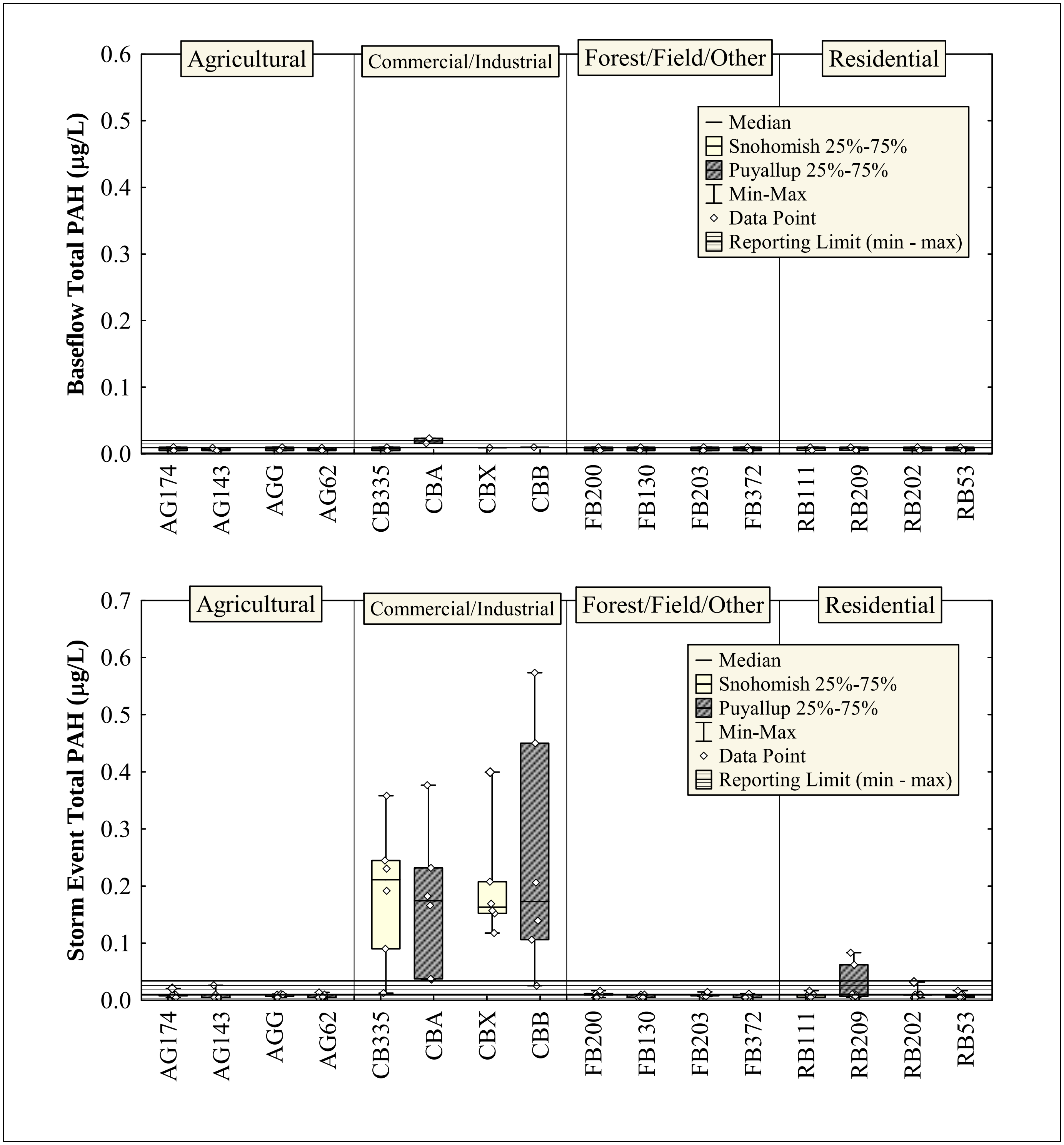

Figure 24. Baseflow and storm-event total polycyclic aromatic hydrocarbons (PAHs) concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

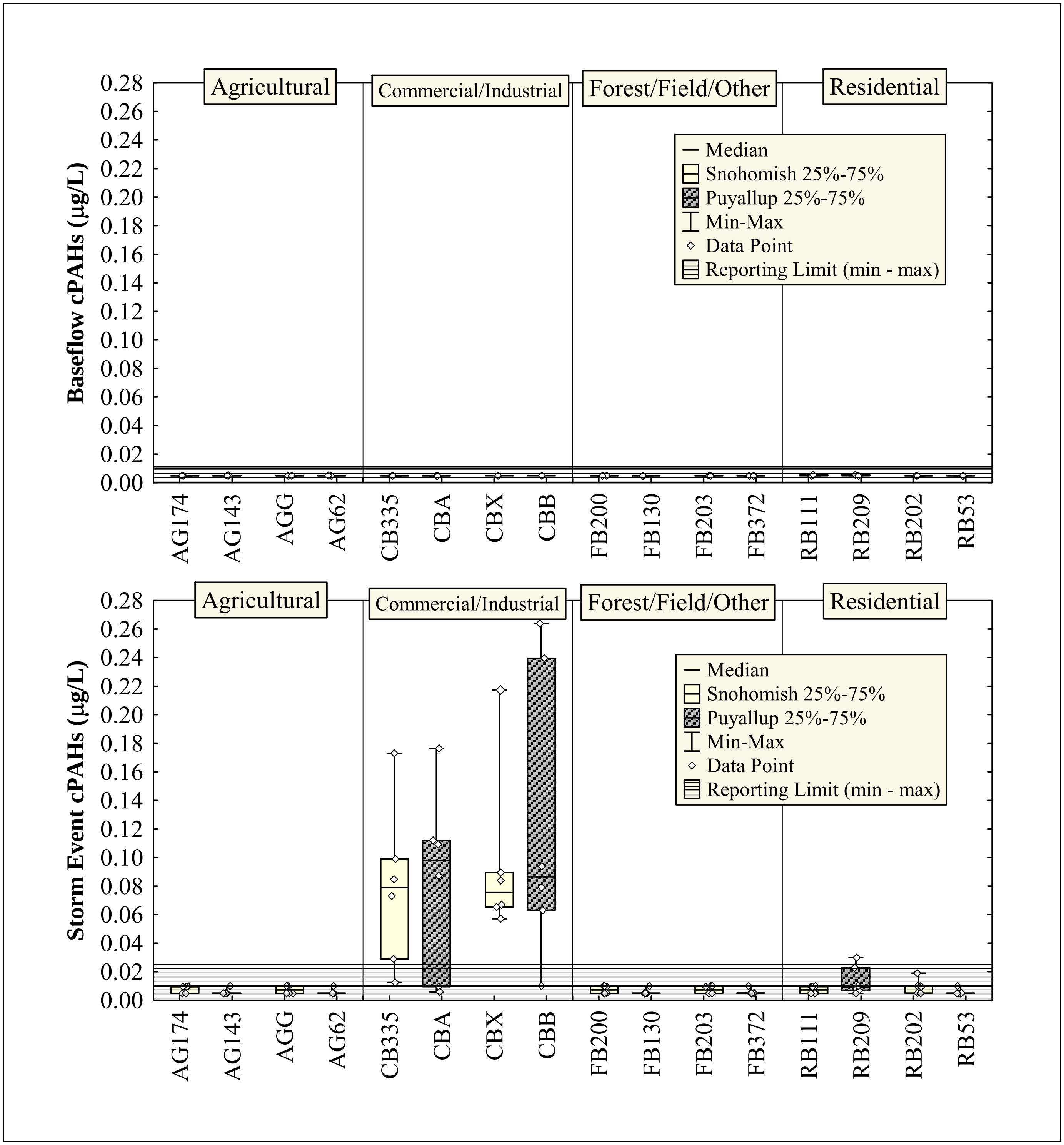

Figure 25. Baseflow and storm-event carcinogenic polycyclic aromatic hydrocarbons (cPAHs) concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

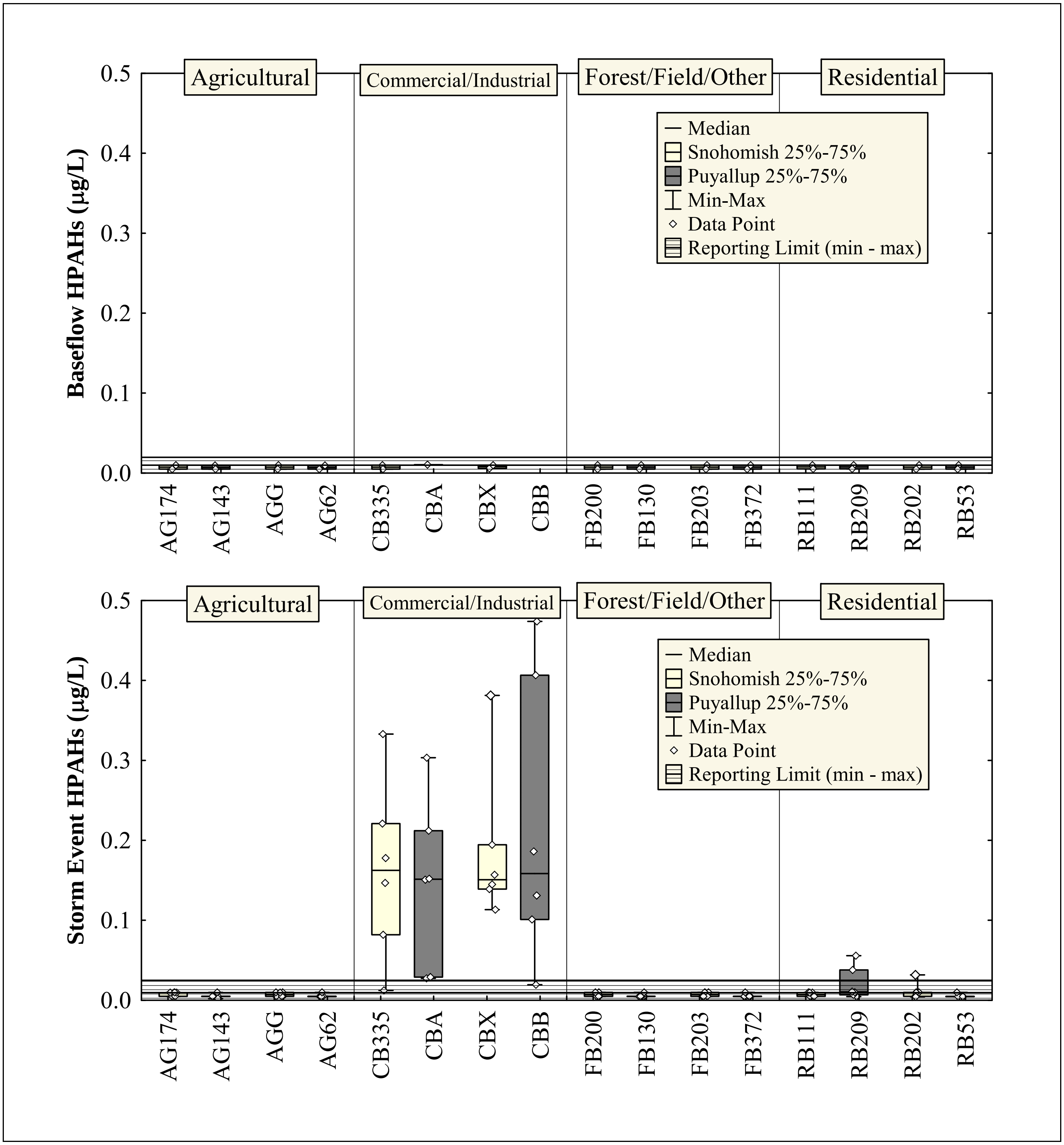

Figure 26. Baseflow and storm-event high molecular weight polycyclic aromatic hydrocarbons (HPAHs) concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

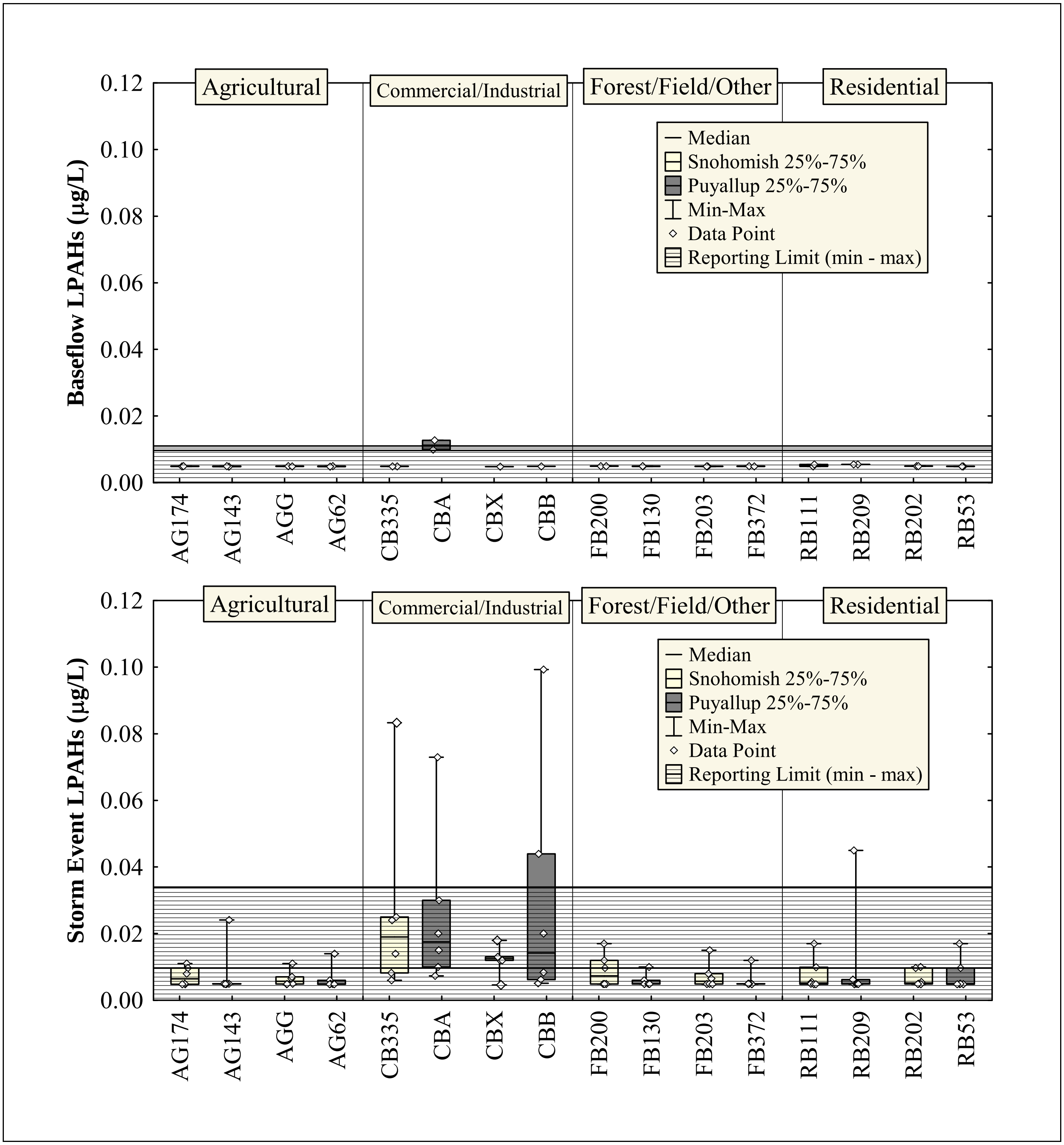

Figure 27. Baseflow and storm-event low molecular weight polycyclic aromatic hydrocarbons (LPAHs) concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

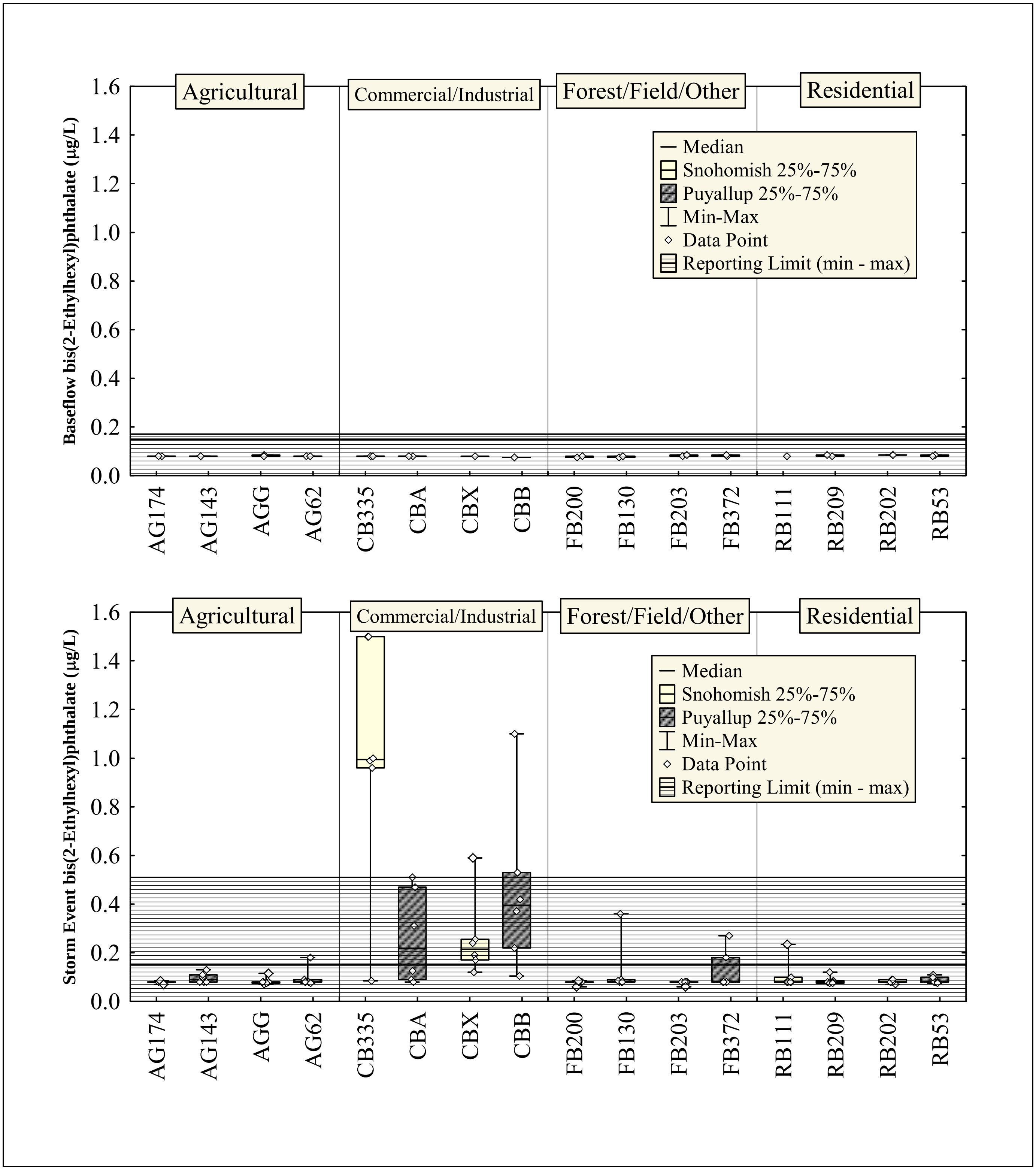

Figure 28. Baseflow and storm-event bis(2-ethylhexyl) phthalate concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

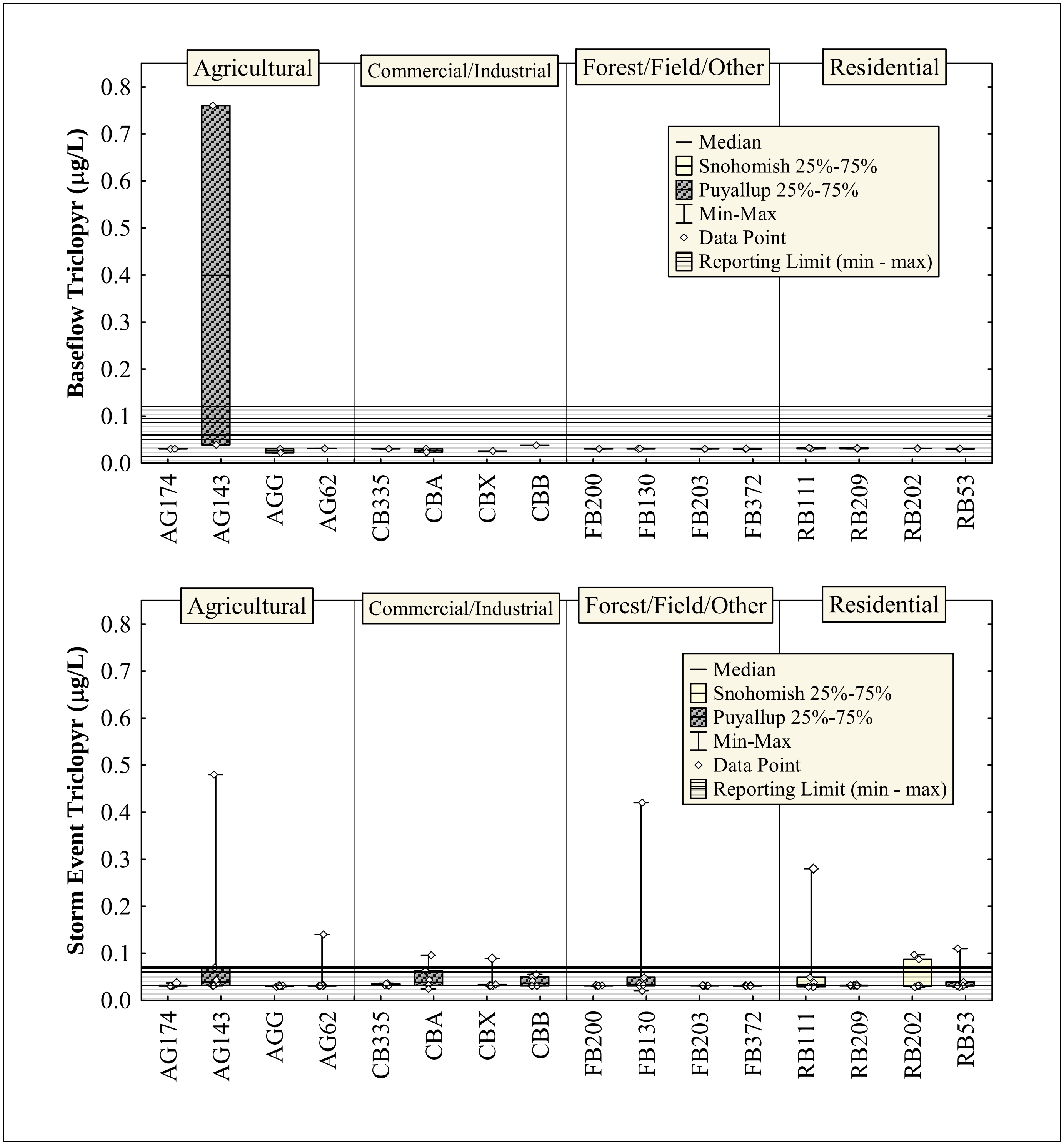

Figure 29. Baseflow and storm-event triclopyr concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

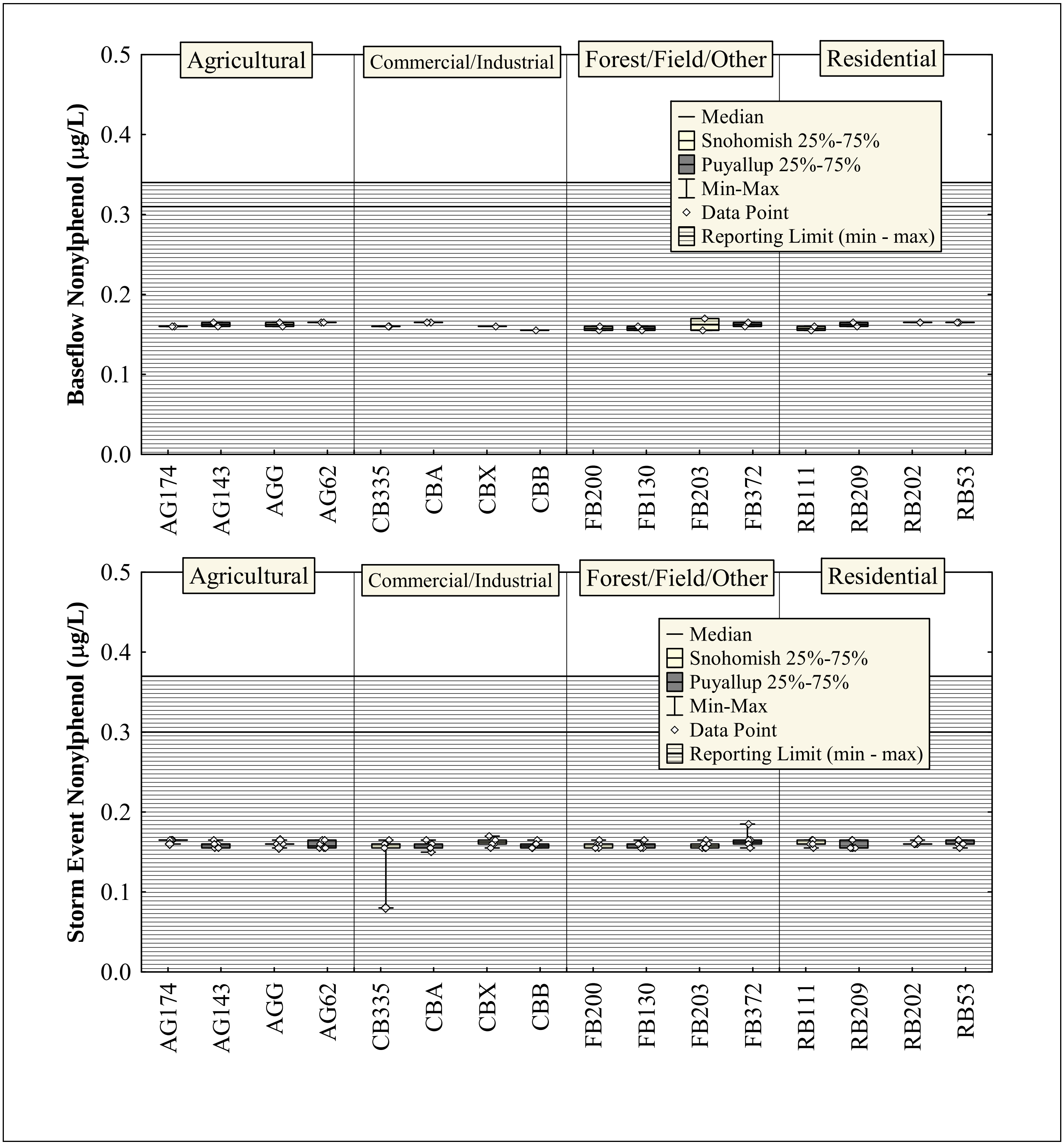

Figure 30. Baseflow and storm-event nonylphenol concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

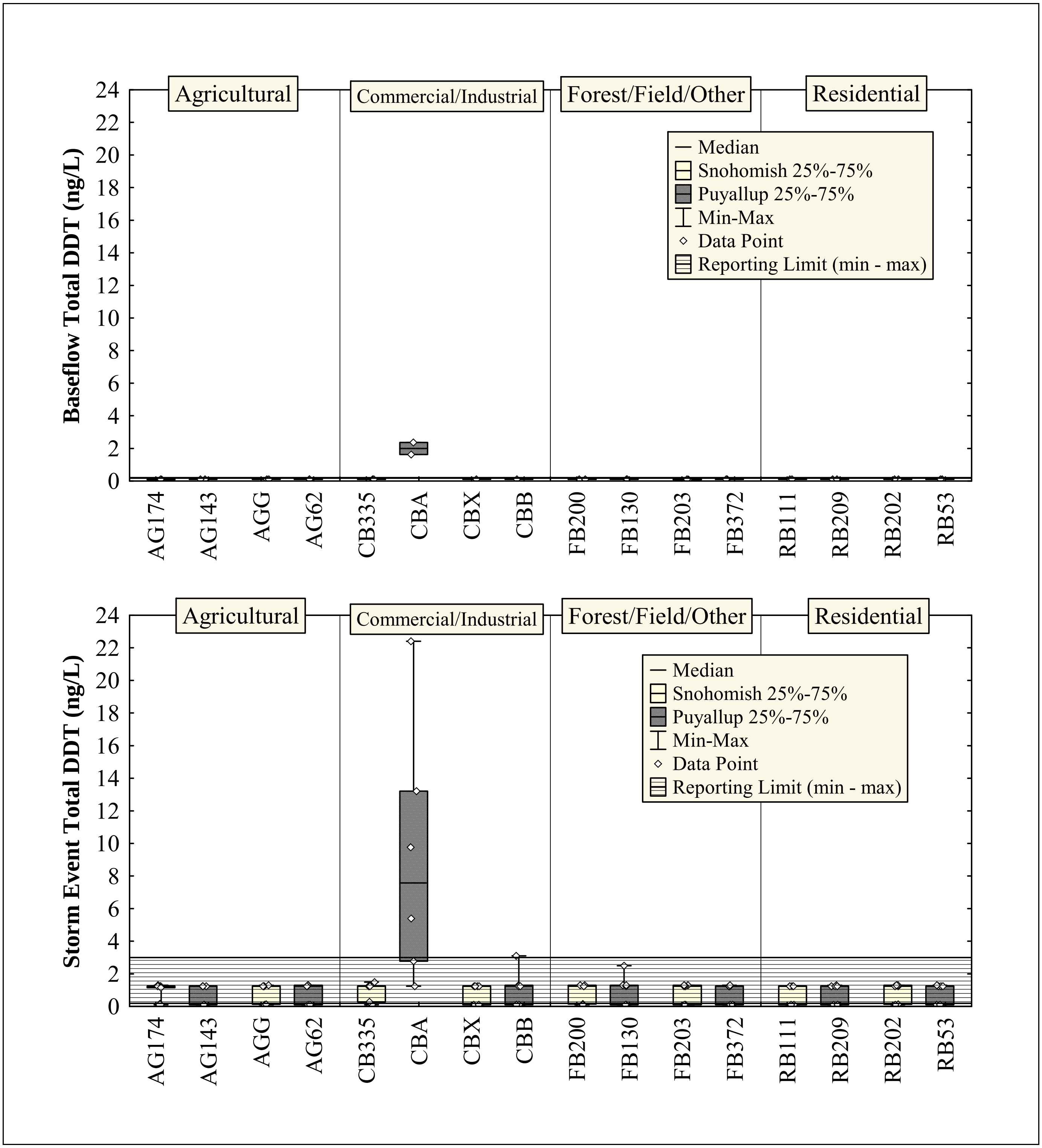

Figure 31. Baseflow and storm-event total dichlorodiphenyltrichloroethane (DDT) concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

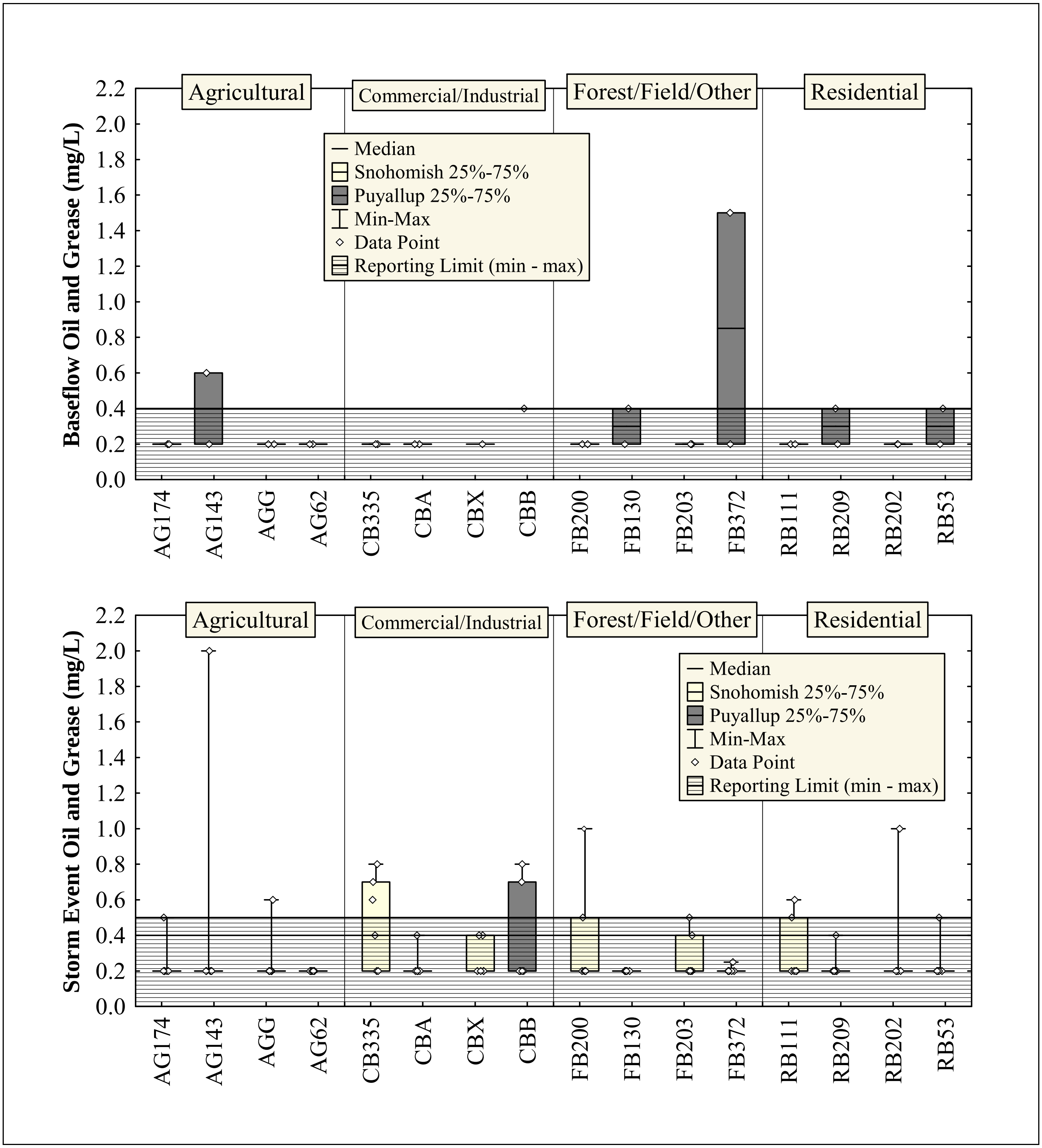

Figure 32. Baseflow and storm-event oil and grease concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

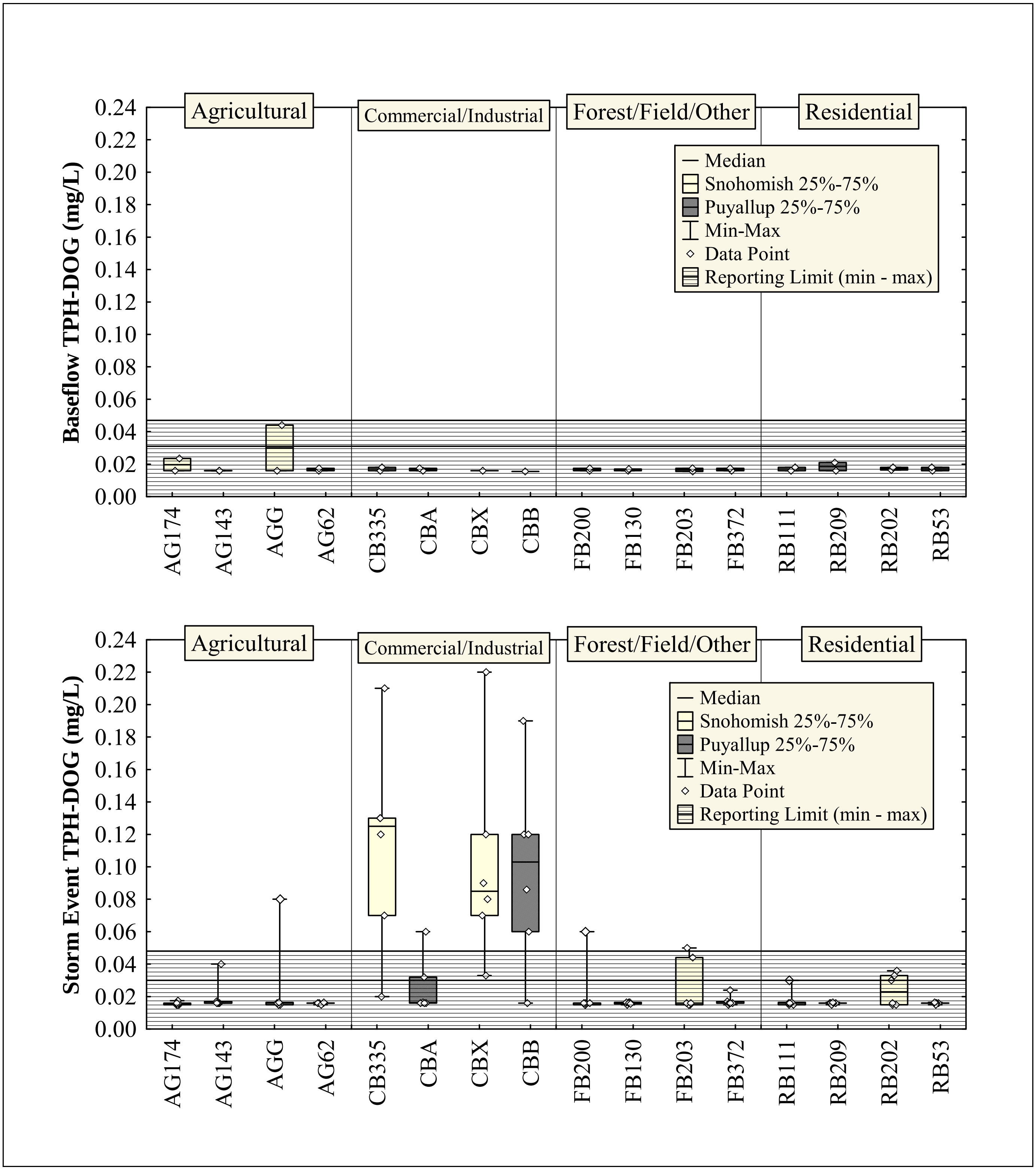

Figure 33. Baseflow and storm-event lube oil (TPH-DOG) concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

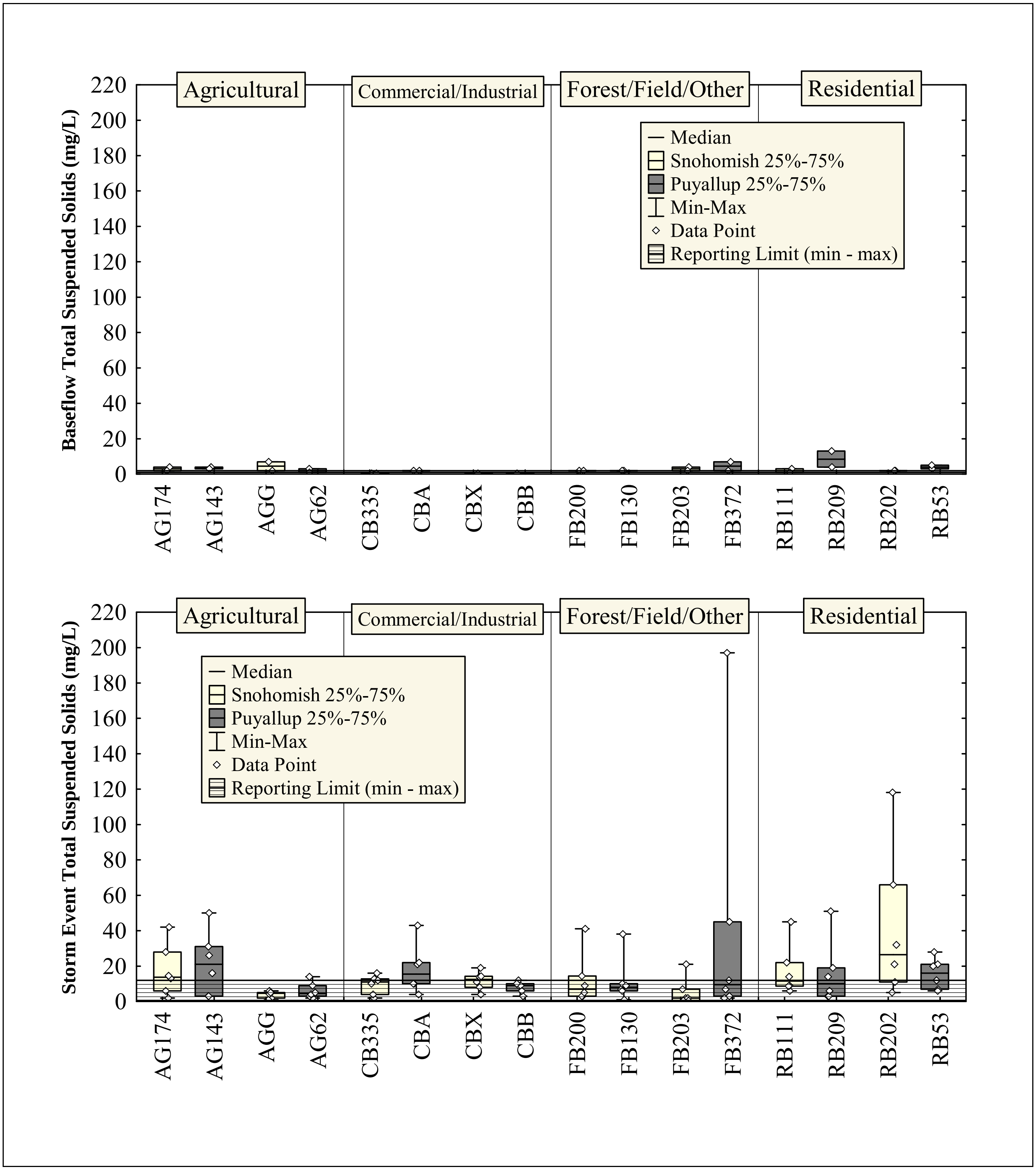

Figure 34. Baseflow and storm-event total suspended solids (TSS) concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

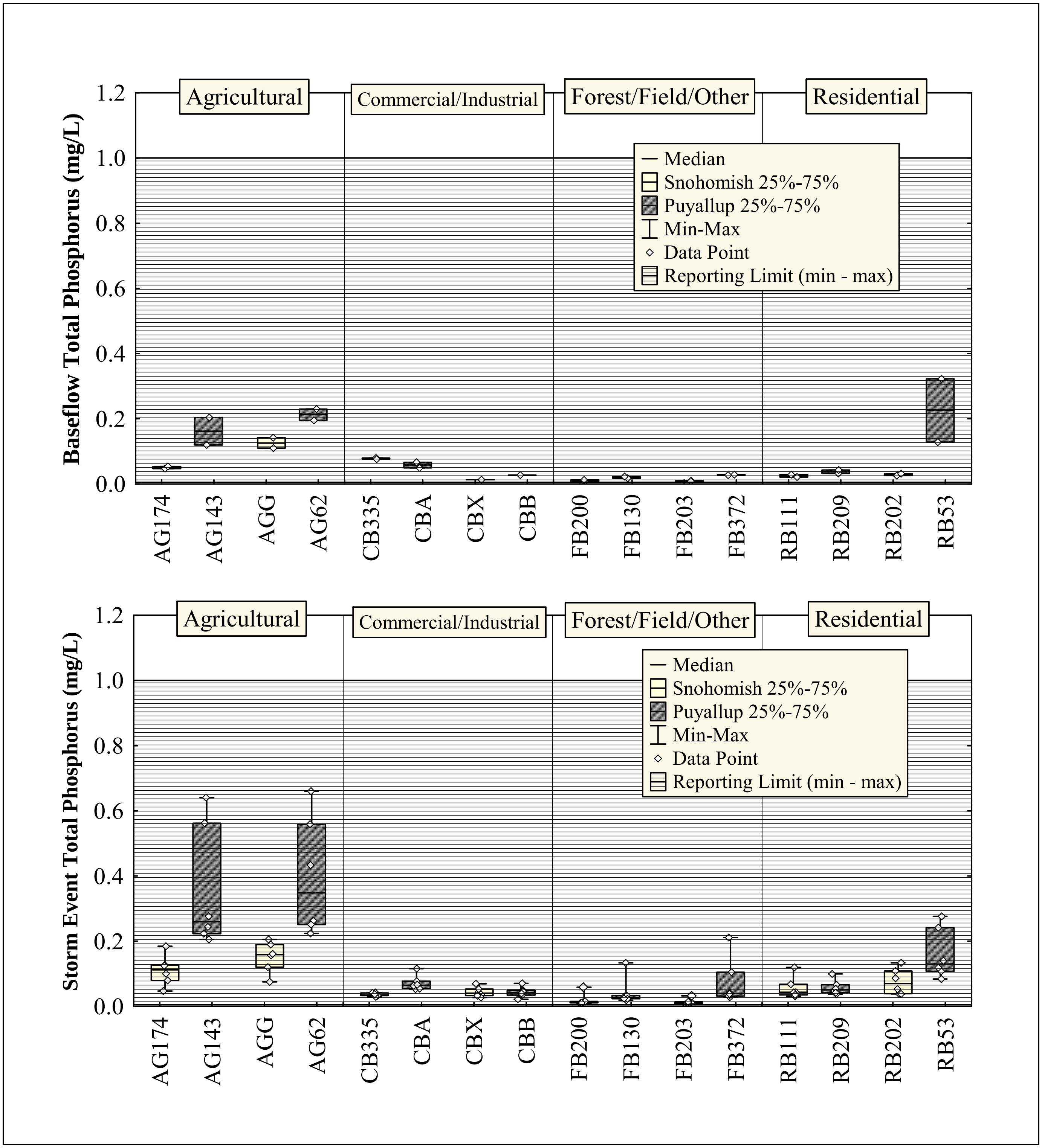

Figure 35. Baseflow and storm-event total phosphorus concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

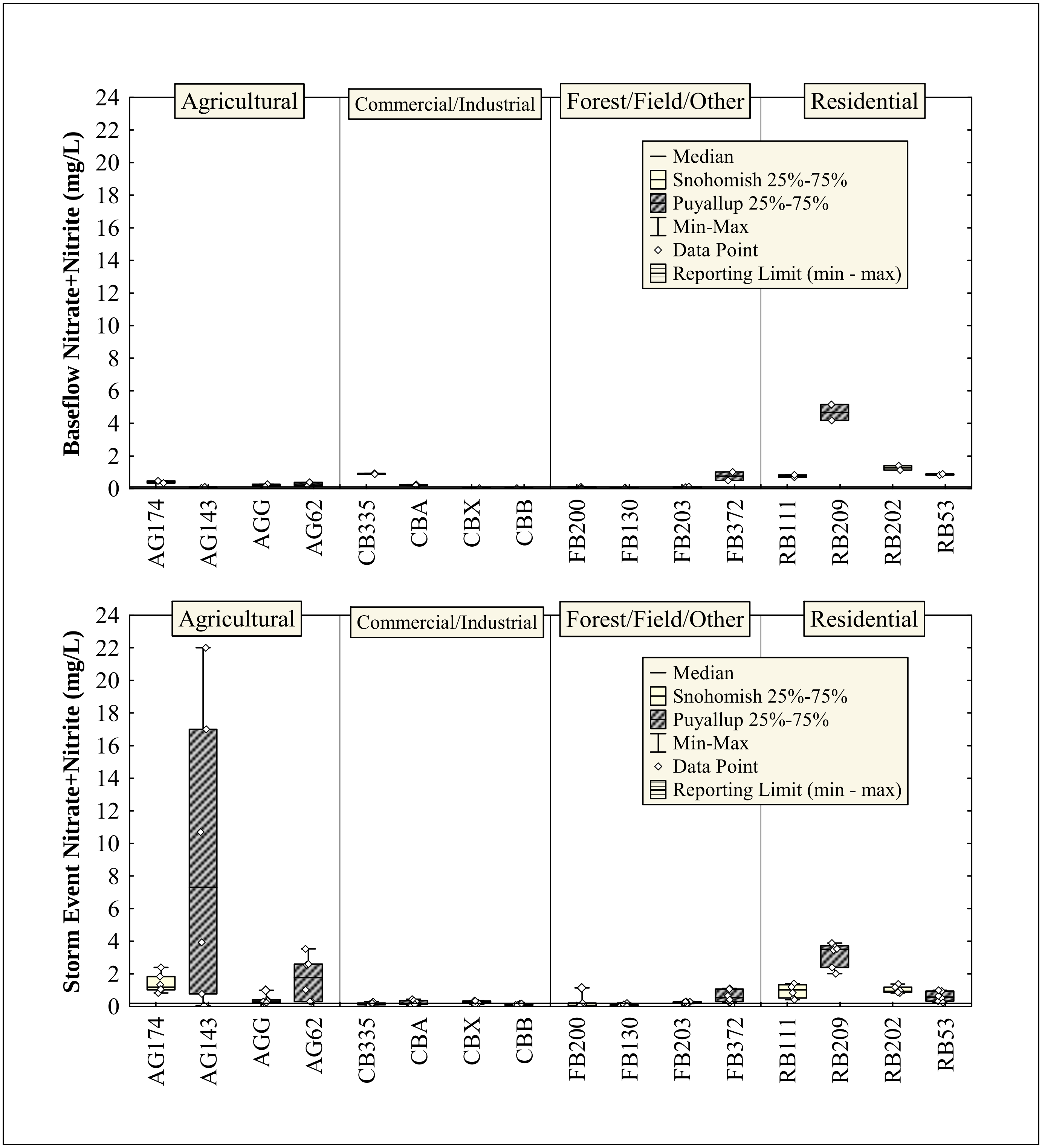

Figure 36. Baseflow and storm-event nitrate+nitrite nitrogen concentration box plots for the Phase 3 study of toxics in surface runoff to Puget Sound.

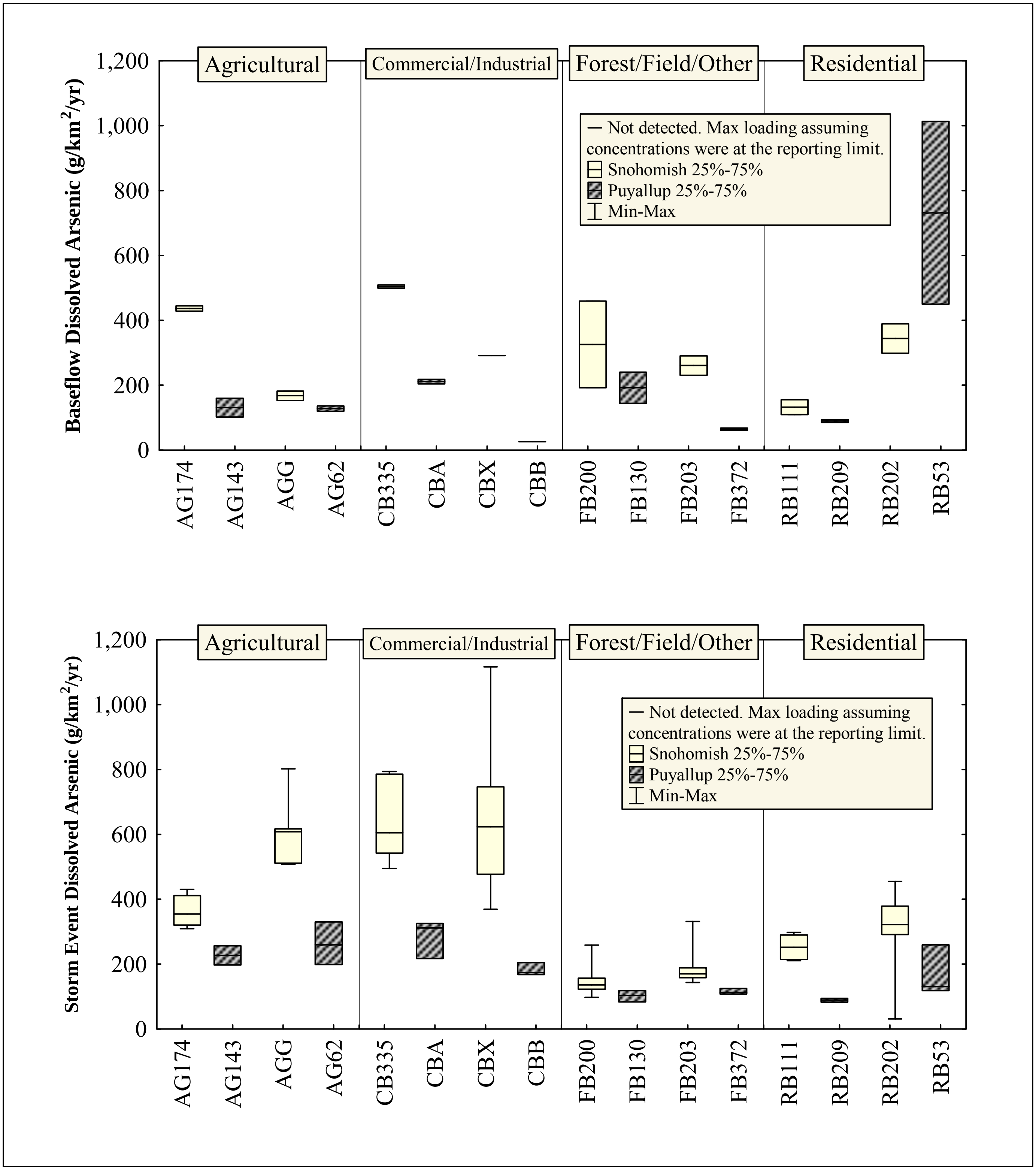

Figure 37. Baseflow and storm-event unit-area chemical loading box plots for dissolved arsenic for the Phase 3 study of toxics in surface runoff to Puget Sound.

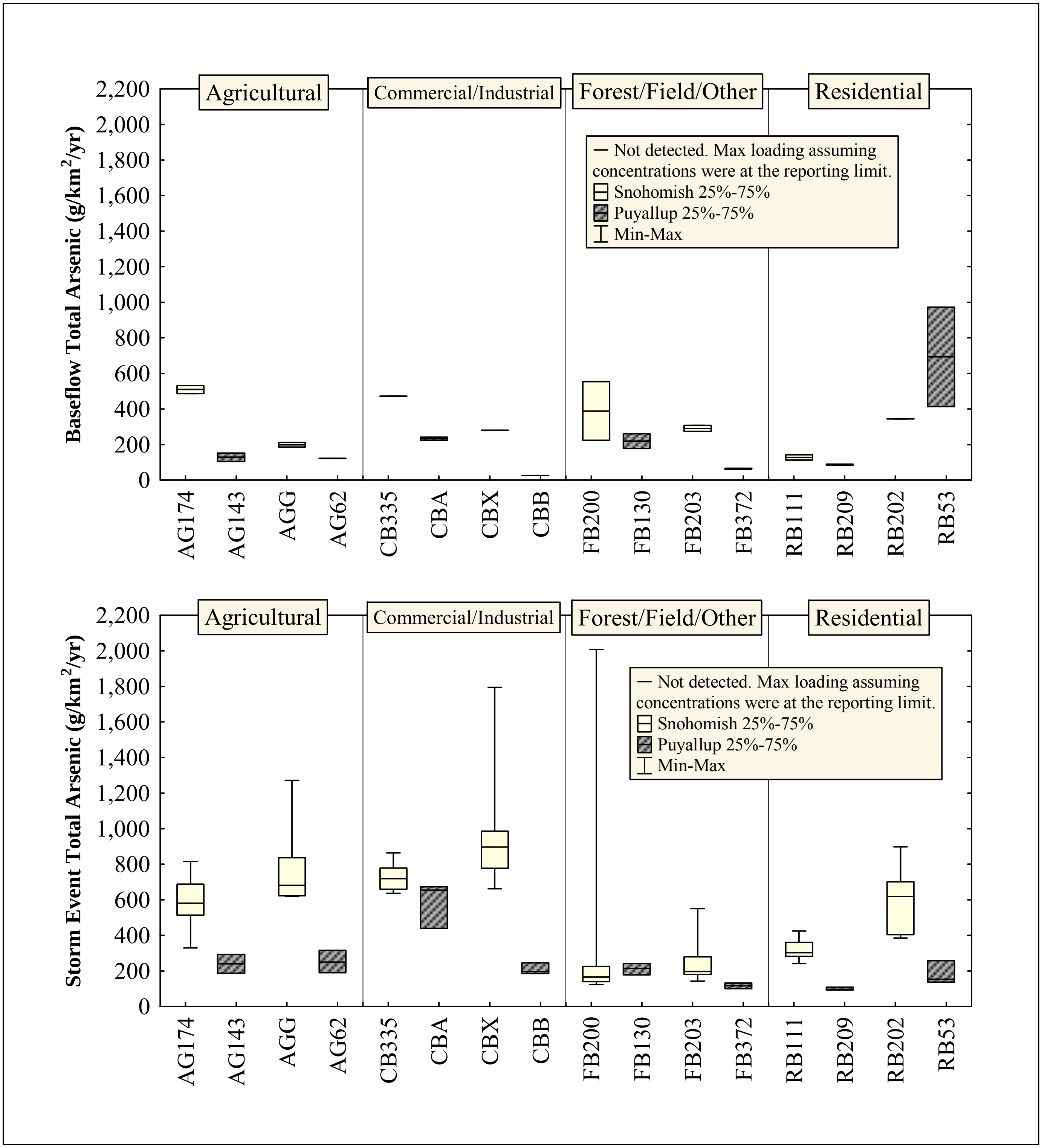

Figure 38. Baseflow and storm-event unit-area chemical loading box plots for total arsenic for the Phase 3 study of toxics in surface runoff to Puget Sound.

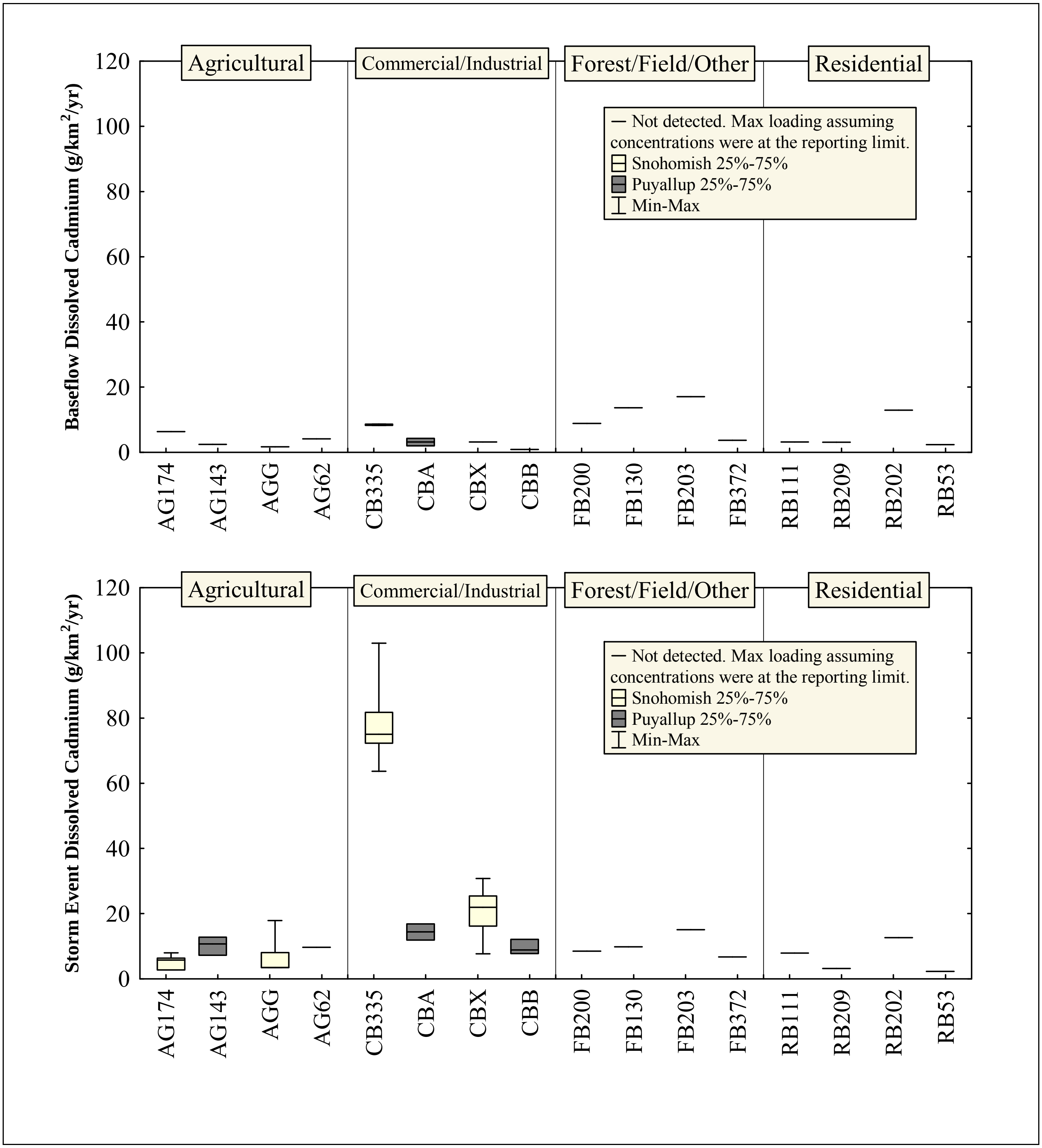

Figure 39. Baseflow and storm-event unit-area chemical loading box plots for dissolved cadmium for the Phase 3 study of toxics in surface runoff to Puget Sound.

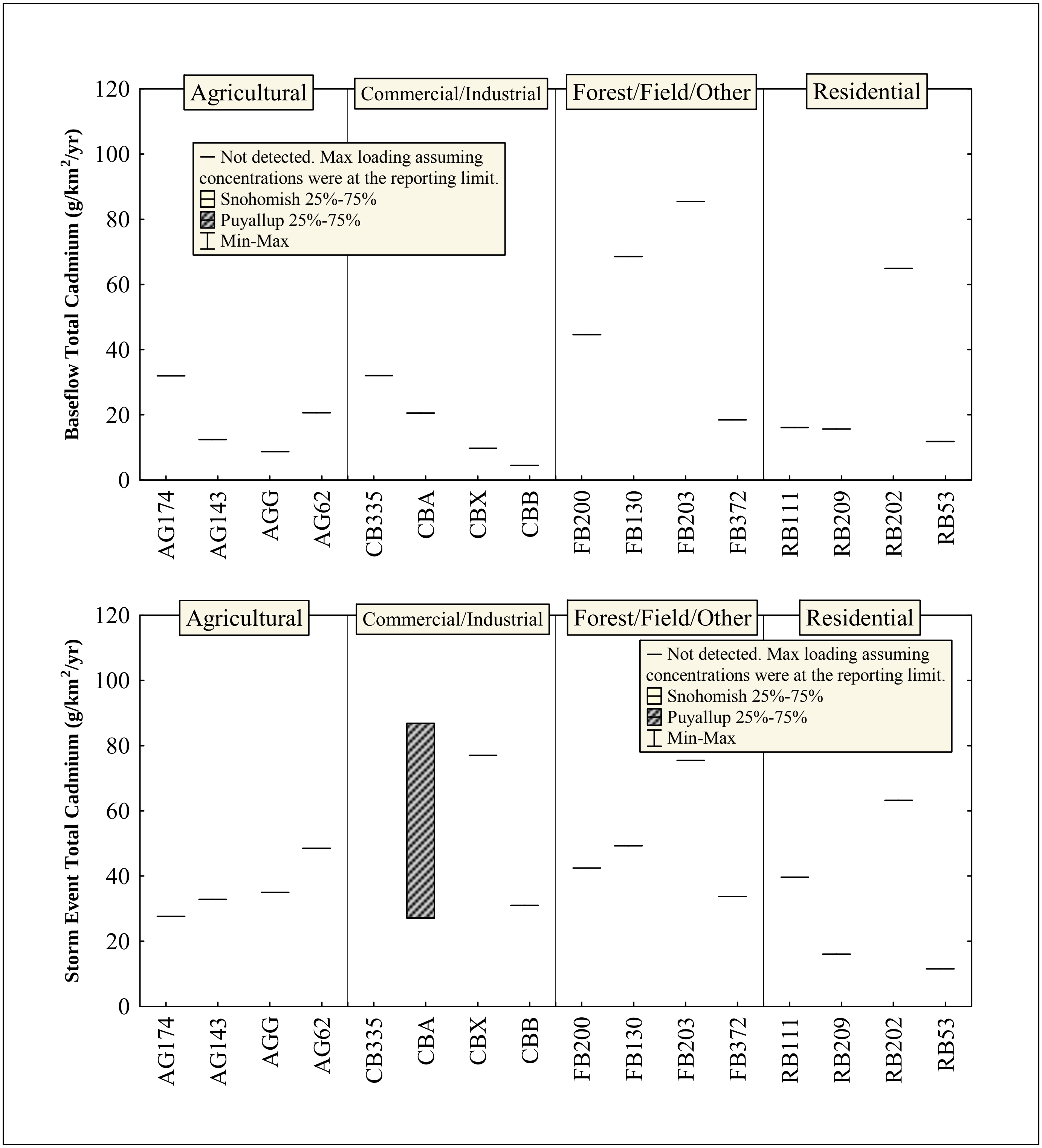

Figure 40. Baseflow and storm-event unit-area chemical loading box plots for total cadmium for the Phase 3 study of toxics in surface runoff to Puget Sound.

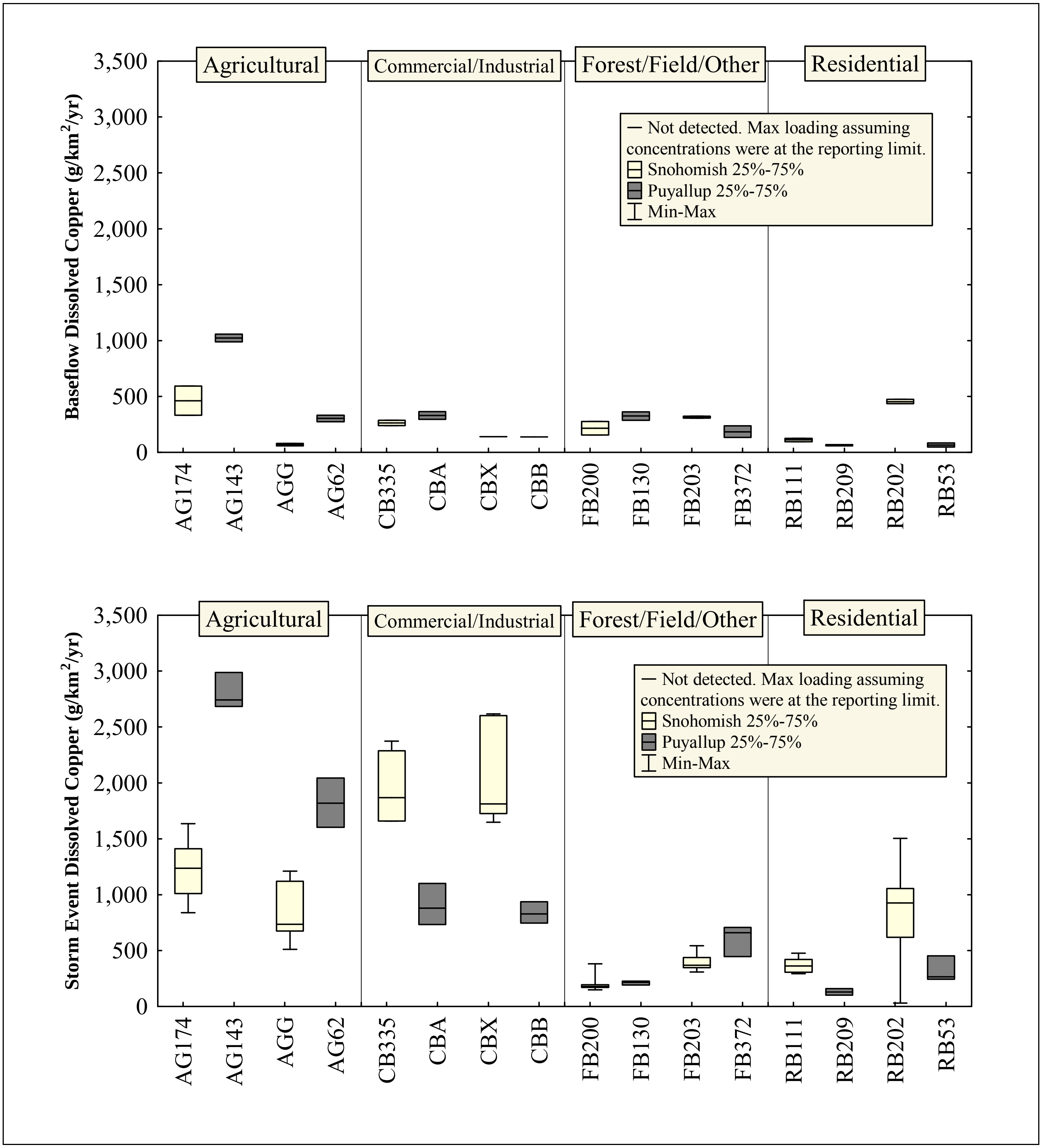

Figure 41. Baseflow and storm-event unit-area chemical loading box plots for dissolved copper for the Phase 3 study of toxics in surface runoff to Puget Sound.

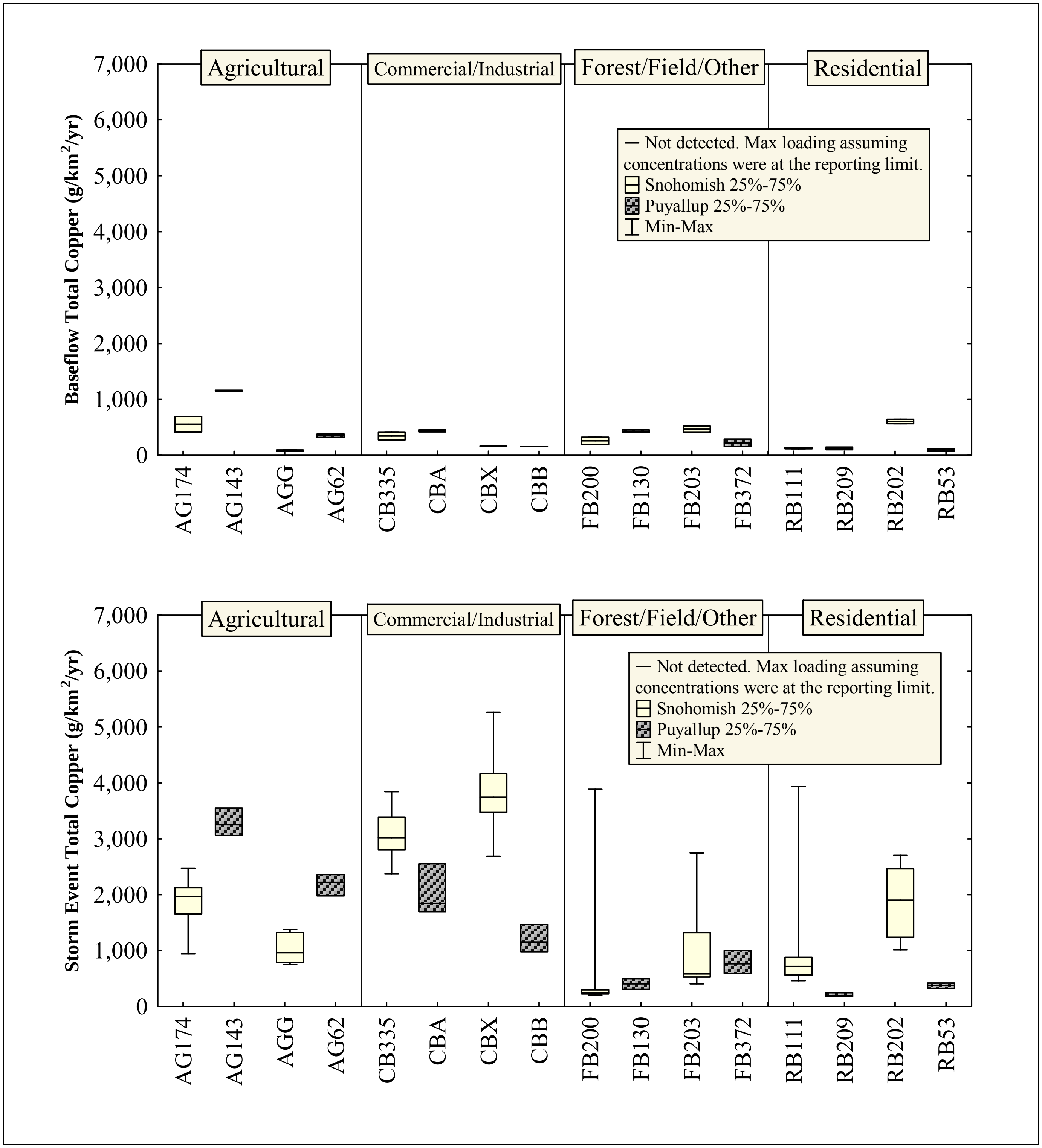

Figure 42. Baseflow and storm-event unit-area chemical loading box plots for total copper for the Phase 3 study of toxics in surface runoff to Puget Sound.

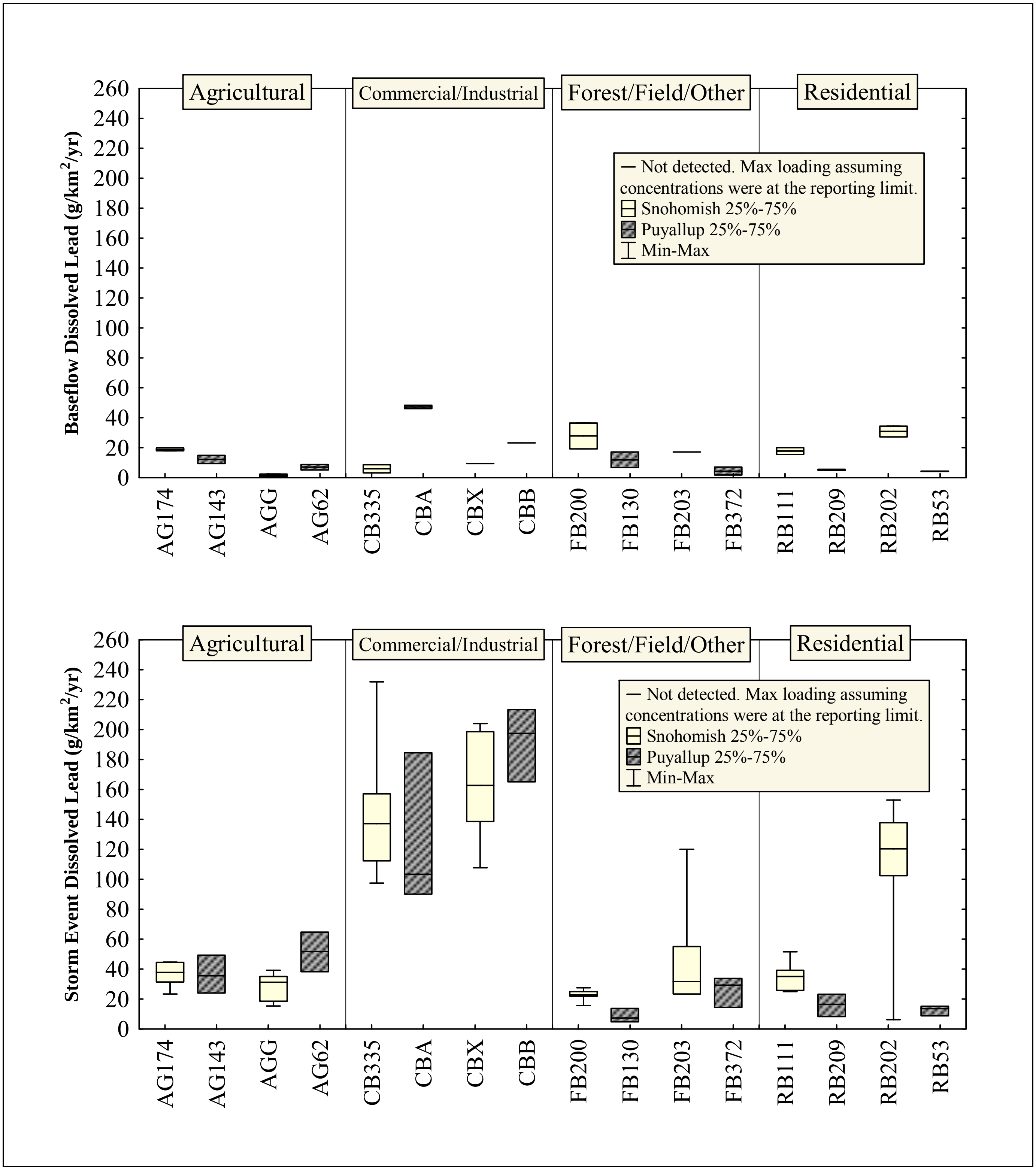

Figure 43. Baseflow and storm-event unit-area chemical loading box plots for dissolved lead for the Phase 3 study of toxics in surface runoff to Puget Sound.

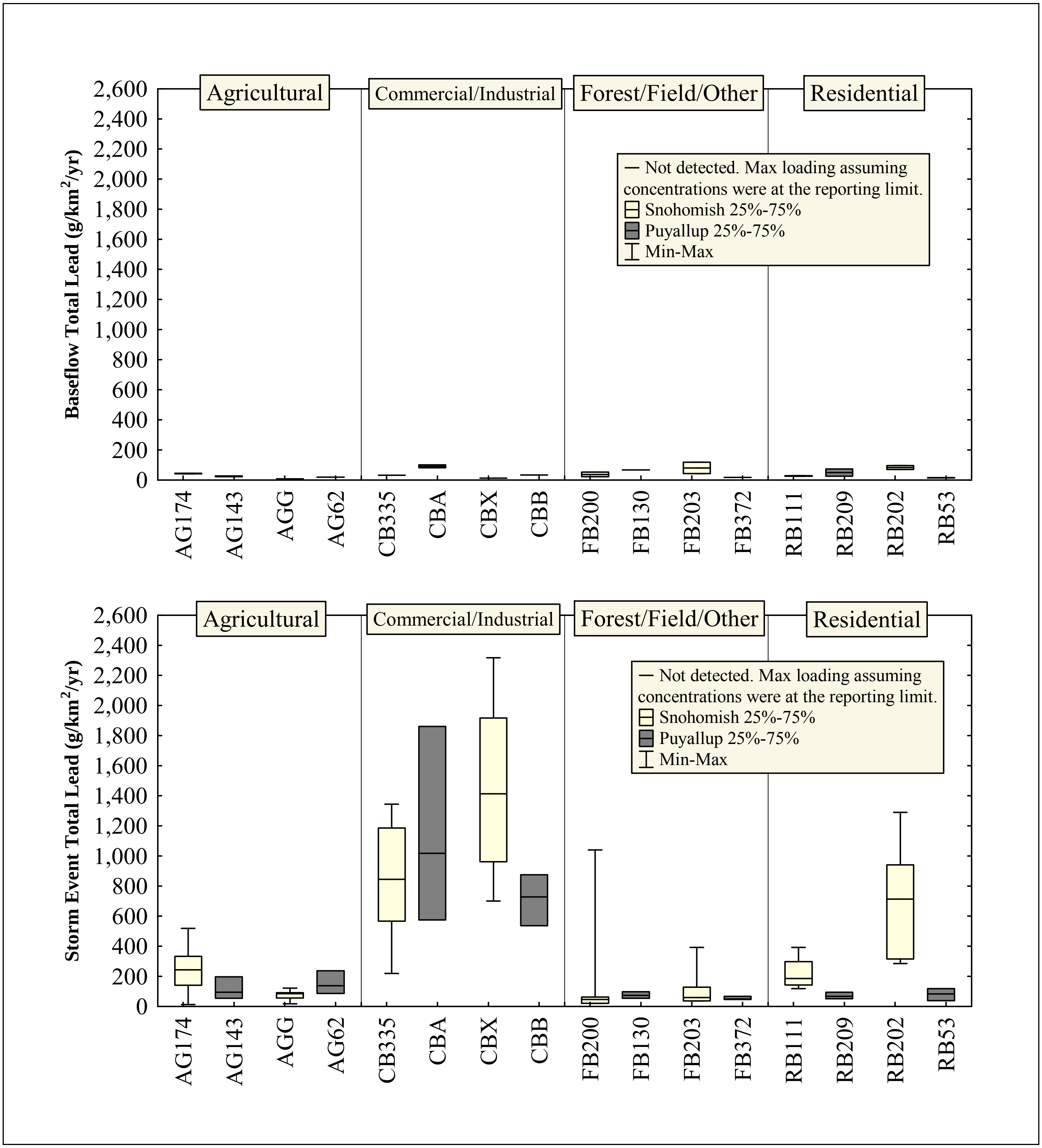

Figure 44. Baseflow and storm-event unit-area chemical loading box plots for total lead for the Phase 3 study of toxics in surface runoff to Puget Sound.

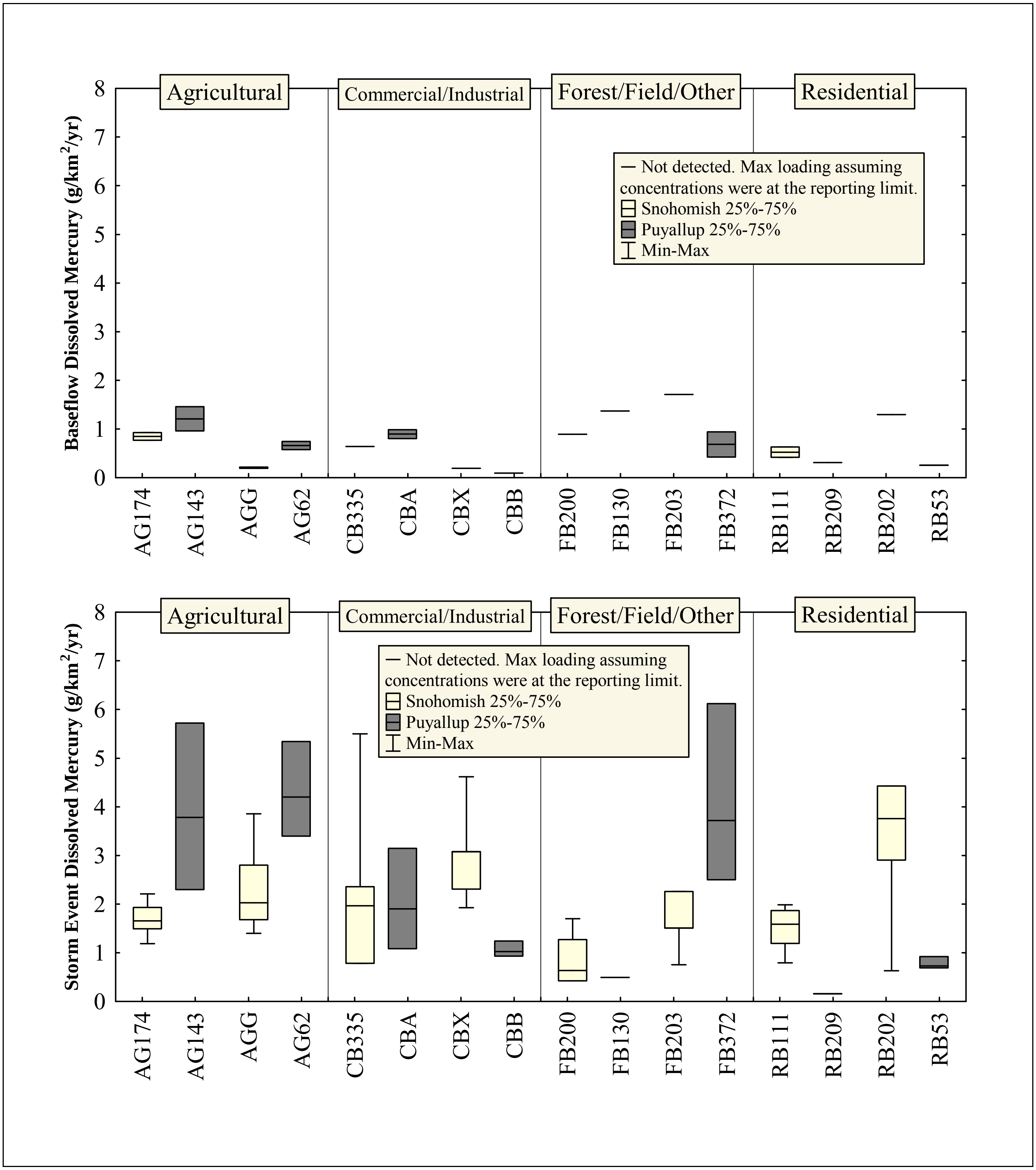

Figure 45. Baseflow and storm-event unit-area chemical loading box plots for dissolved mercury for the Phase 3 study of toxics in surface runoff to Puget Sound.

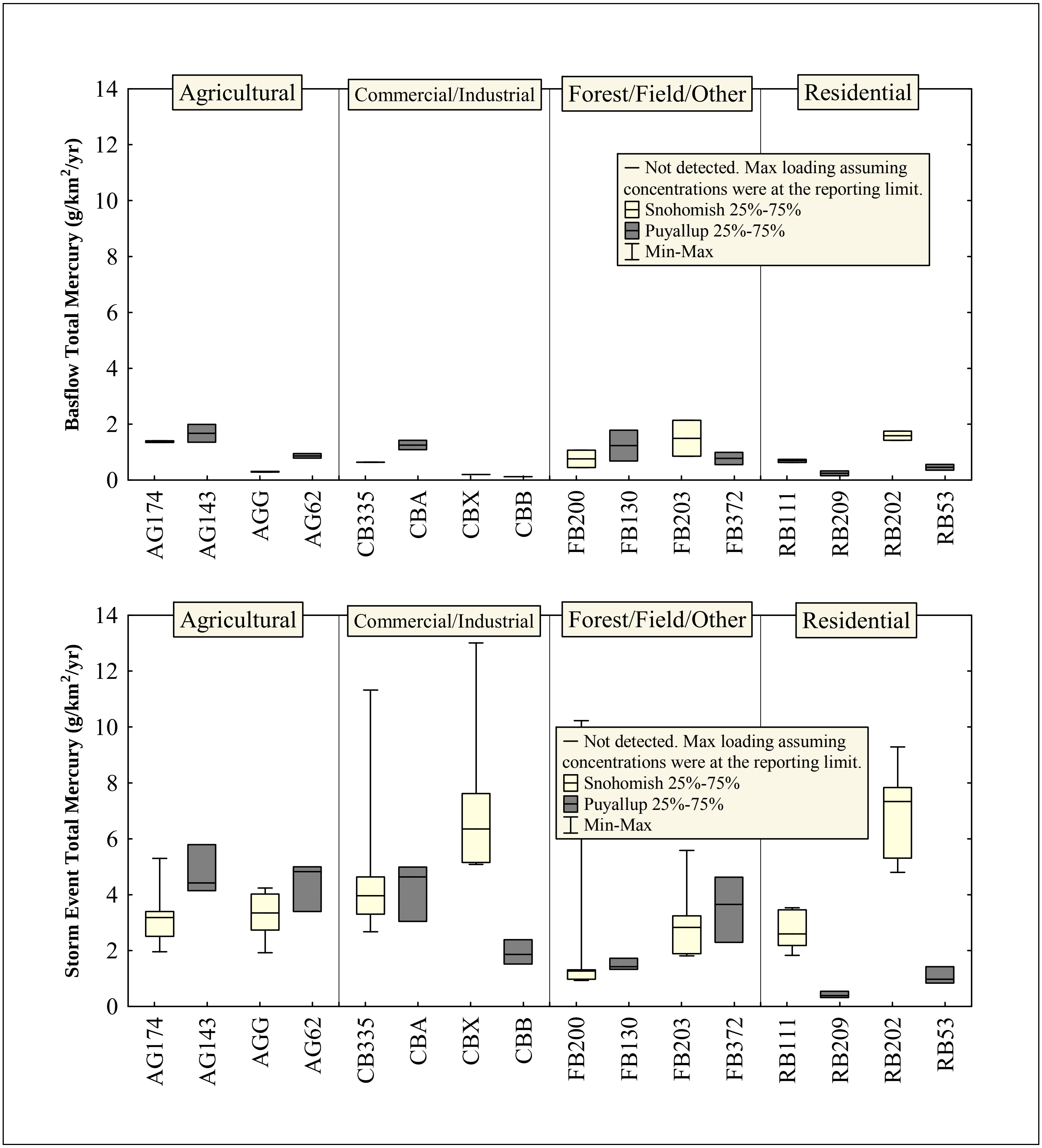

Figure 46. Baseflow and storm-event unit-area chemical loading box plots for total mercury for the Phase 3 study of toxics in surface runoff to Puget Sound.

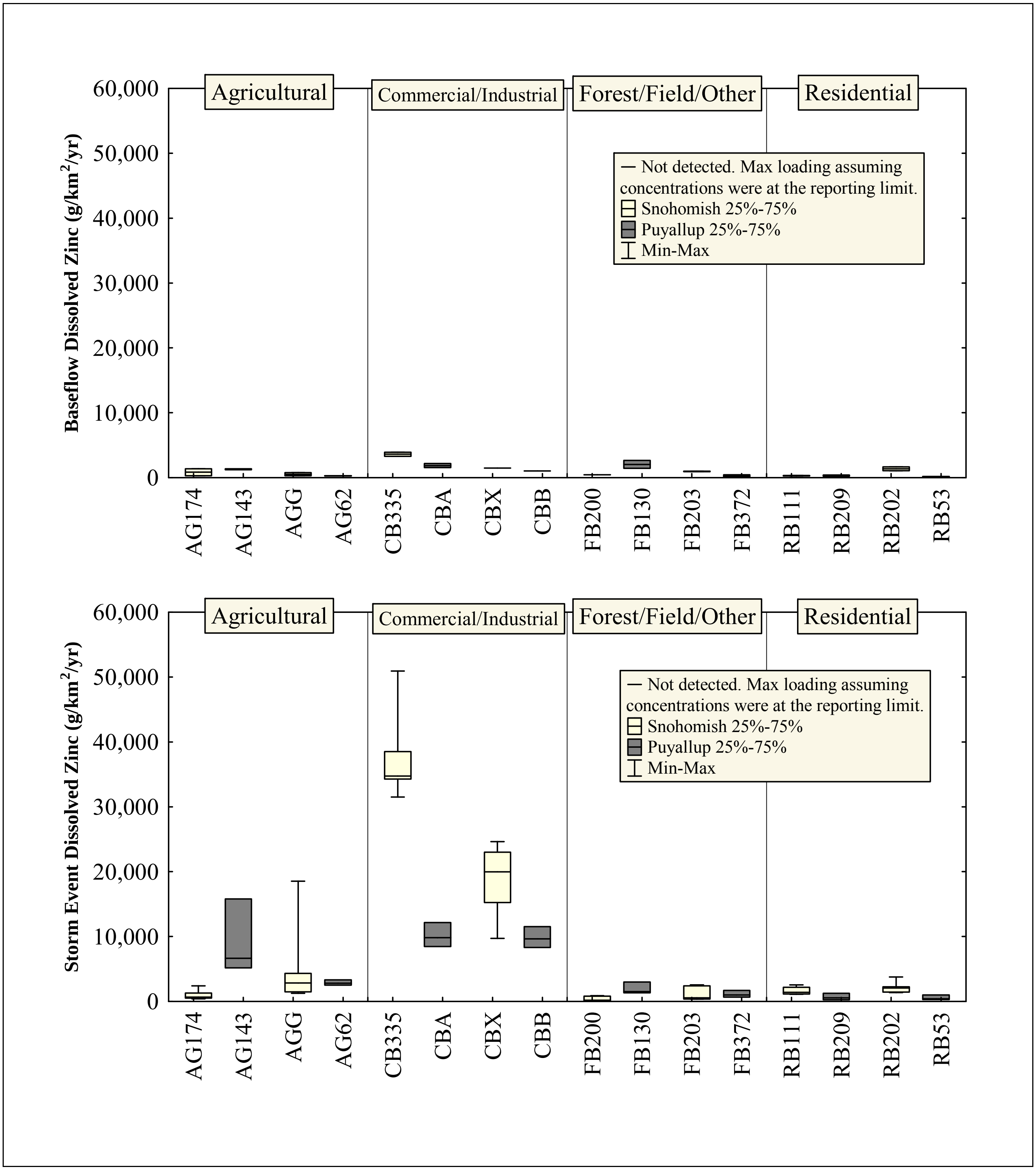

Figure 47. Baseflow and storm-event unit-area chemical loading box plots for dissolved zinc for the Phase 3 study of toxics in surface runoff to Puget Sound.

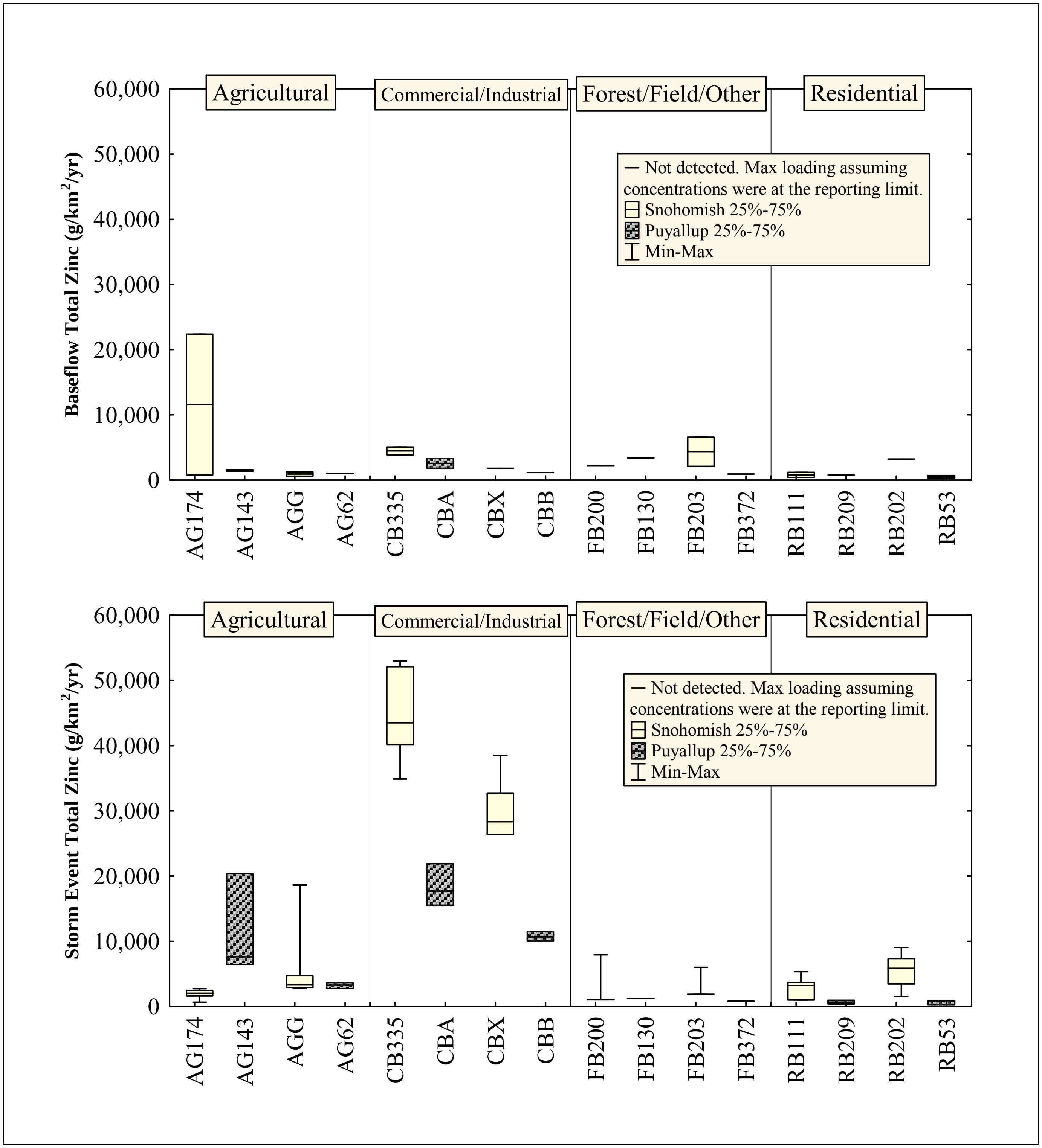

Figure 48. Baseflow and storm-event unit-area chemical loading box plots for total zinc for the Phase 3 study of toxics in surface runoff to Puget Sound.

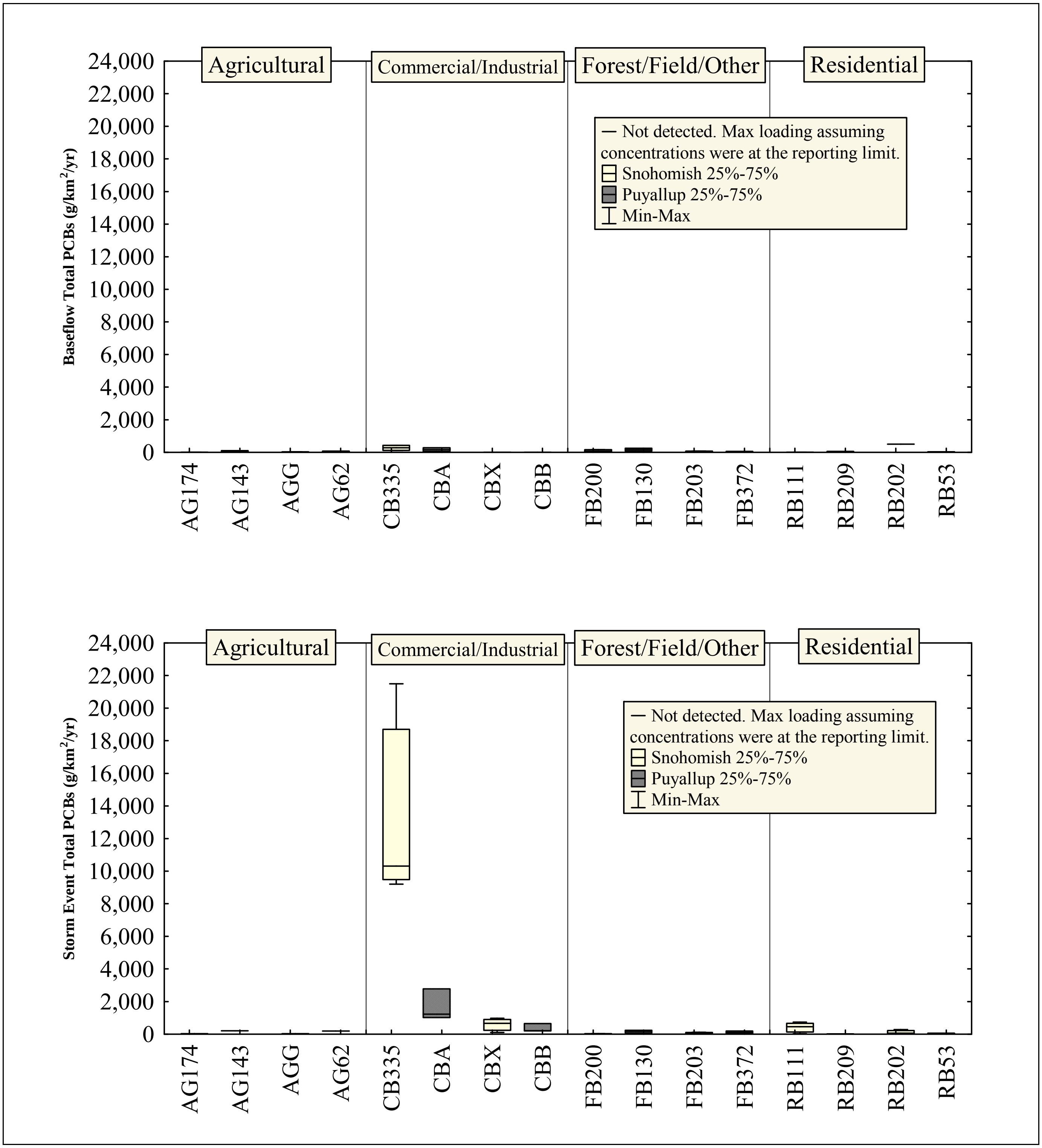

Figure 49. Baseflow and storm-event unit-area chemical loading box plots for total polychlorinated biphenyls (PCBs) for the Phase 3 study of toxics in surface runoff to Puget Sound.

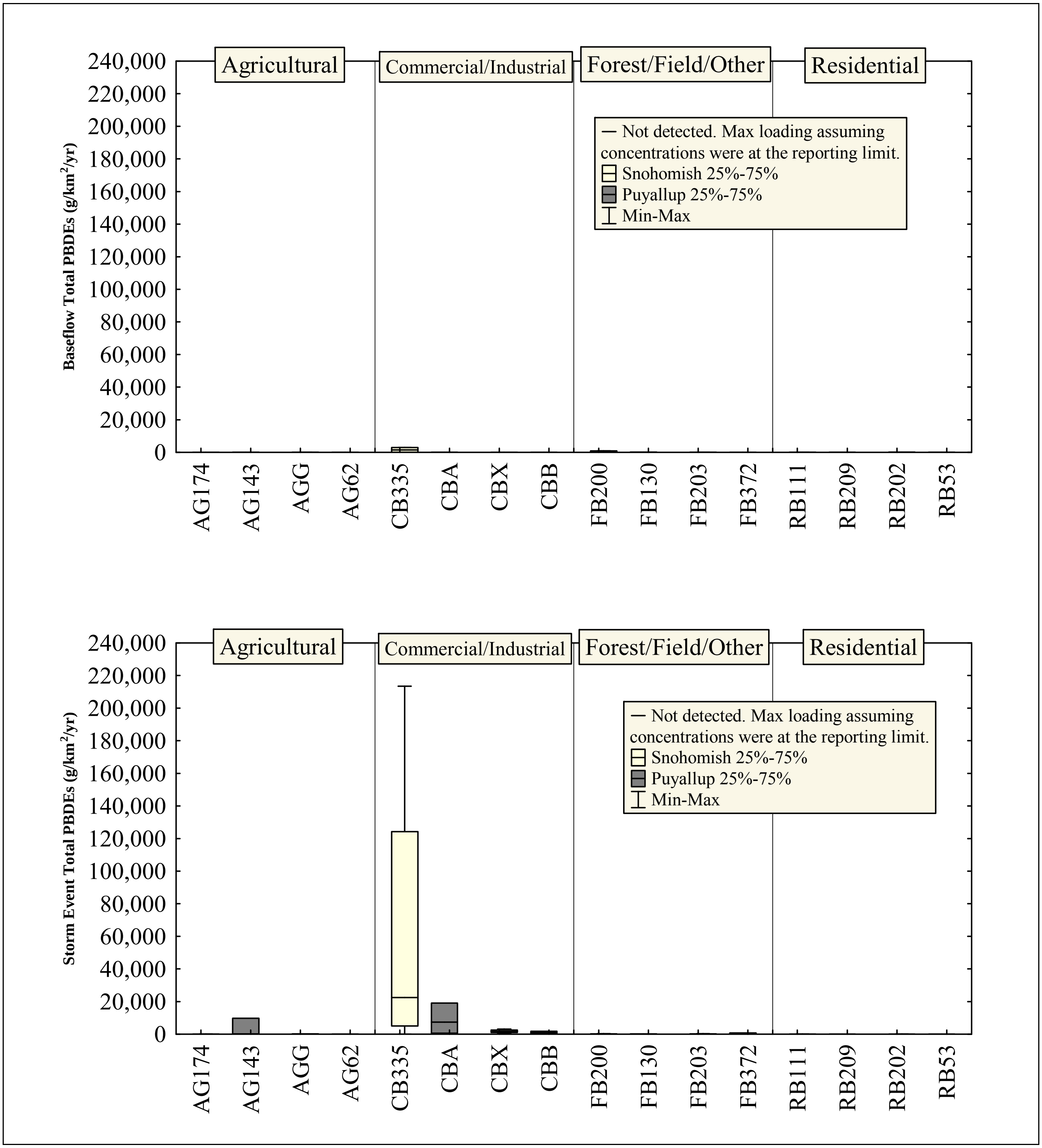

Figure 50. Baseflow and storm-event unit-area chemical loading box plots for total polybrominated diphenyl ethers (PBDEs) for the Phase 3 study of toxics in surface runoff to Puget Sound.

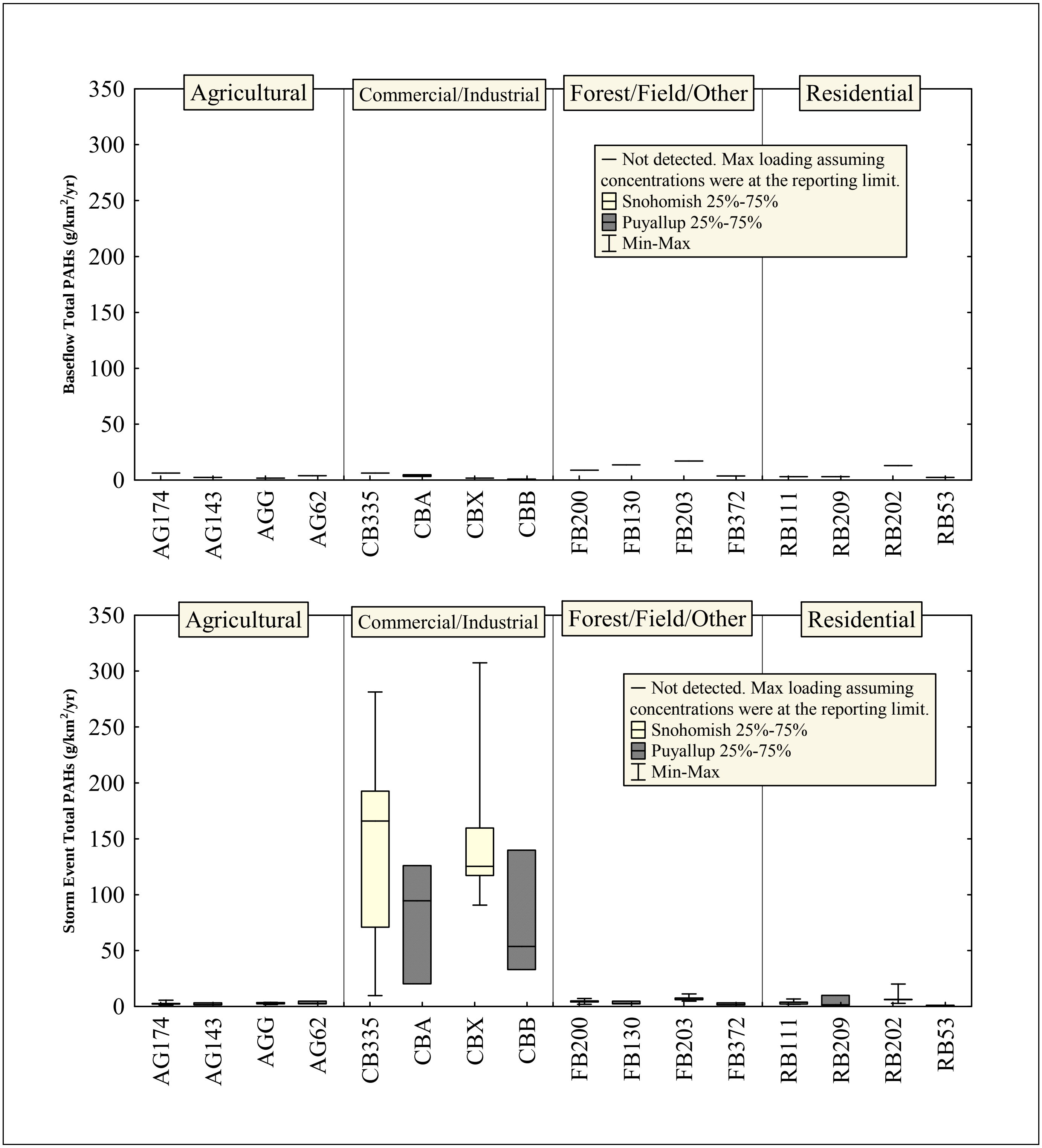

Figure 51. Baseflow and storm-event unit-area chemical loading box plots for total polycyclic aromatic hydrocarbons (PAHs) for the Phase 3 study of toxics in surface runoff to Puget Sound.

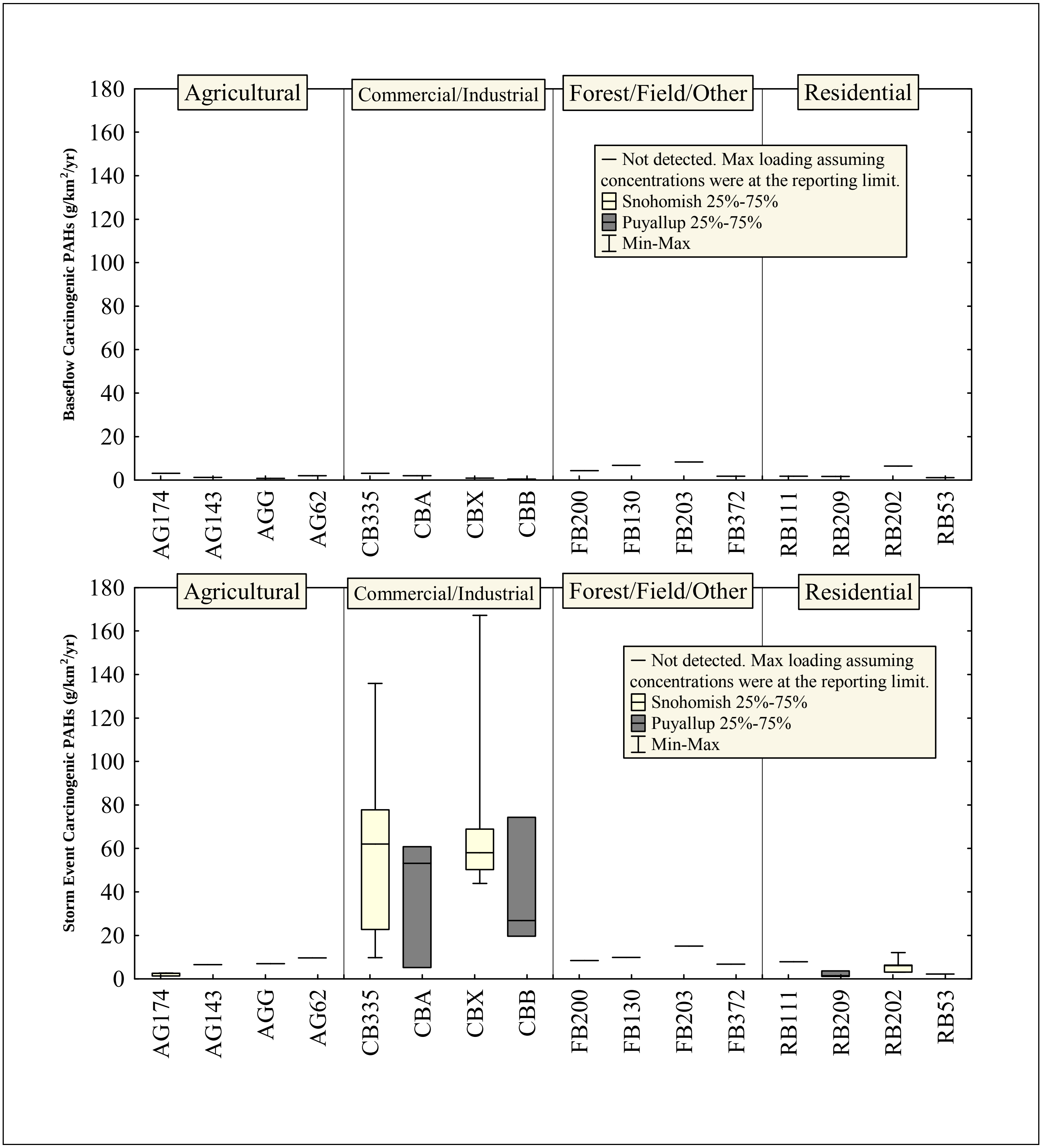

Figure 52. Baseflow and storm-event unit-area chemical loading box plots for carcinogenic polycyclic aromatic hydrocarbons (cPAHs) for the Phase 3 study of toxics in surface runoff to Puget Sound.

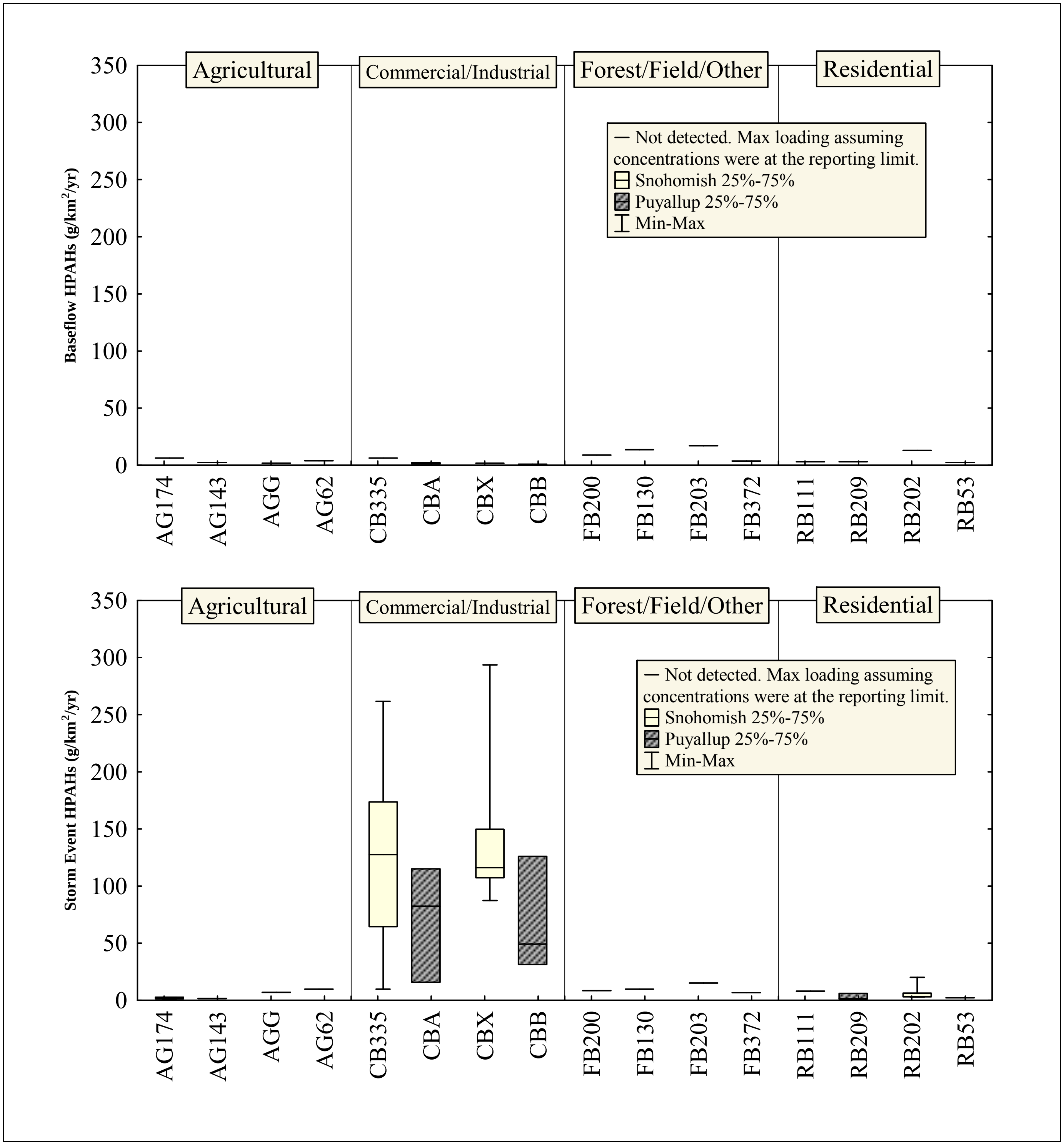

Figure 53. Baseflow and storm-event unit-area chemical loading box plots for high molecular weight polycyclic aromatic hydrocarbons (HPAHs) for the Phase 3 study of toxics in surface runoff to Puget Sound.

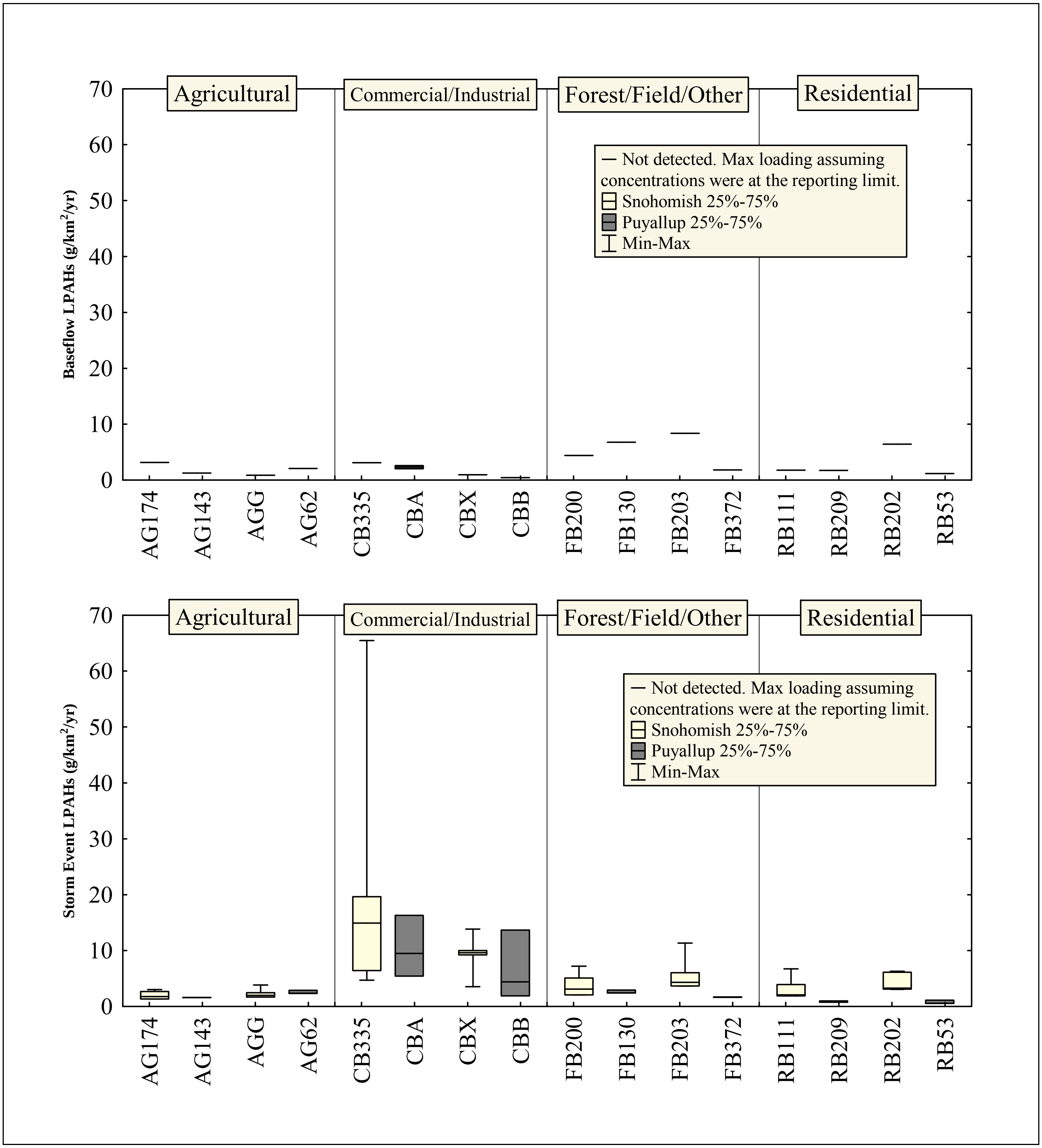

Figure 54. Baseflow and storm-event unit-area chemical loading box plots for low molecular weight polycyclic aromatic hydrocarbons (LPAHs) for the Phase 3 study of toxics in surface runoff to Puget Sound.

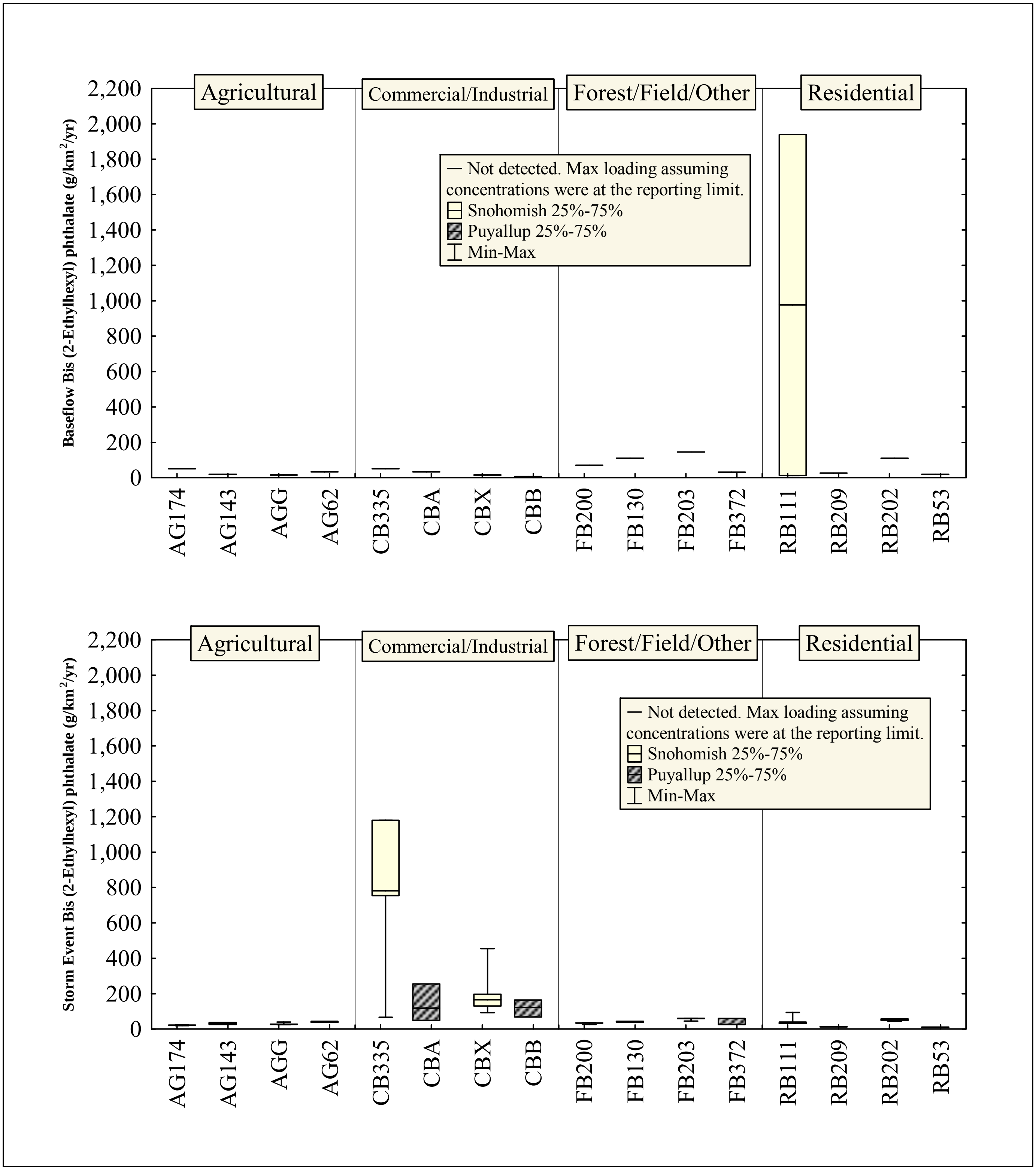

Figure 55. Baseflow and storm-event unit-area chemical loading box plots for bis(2-ethylhexyl) phthalate for the Phase 3 study of toxics in surface runoff to Puget Sound.

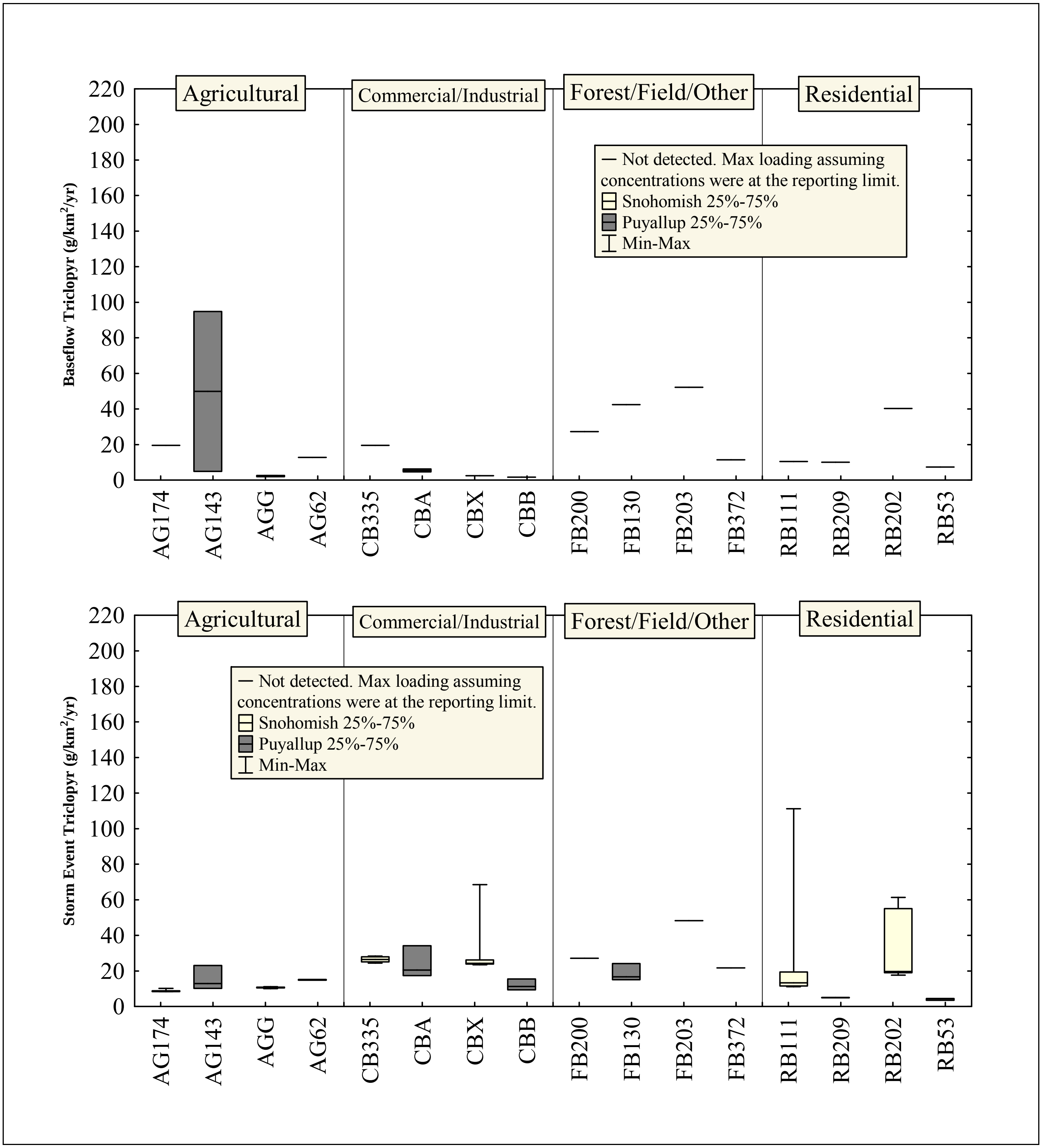

Figure 56. Baseflow and storm-event unit-area chemical loading box plots for triclopyr for the Phase 3 study of toxics in surface runoff to Puget Sound.

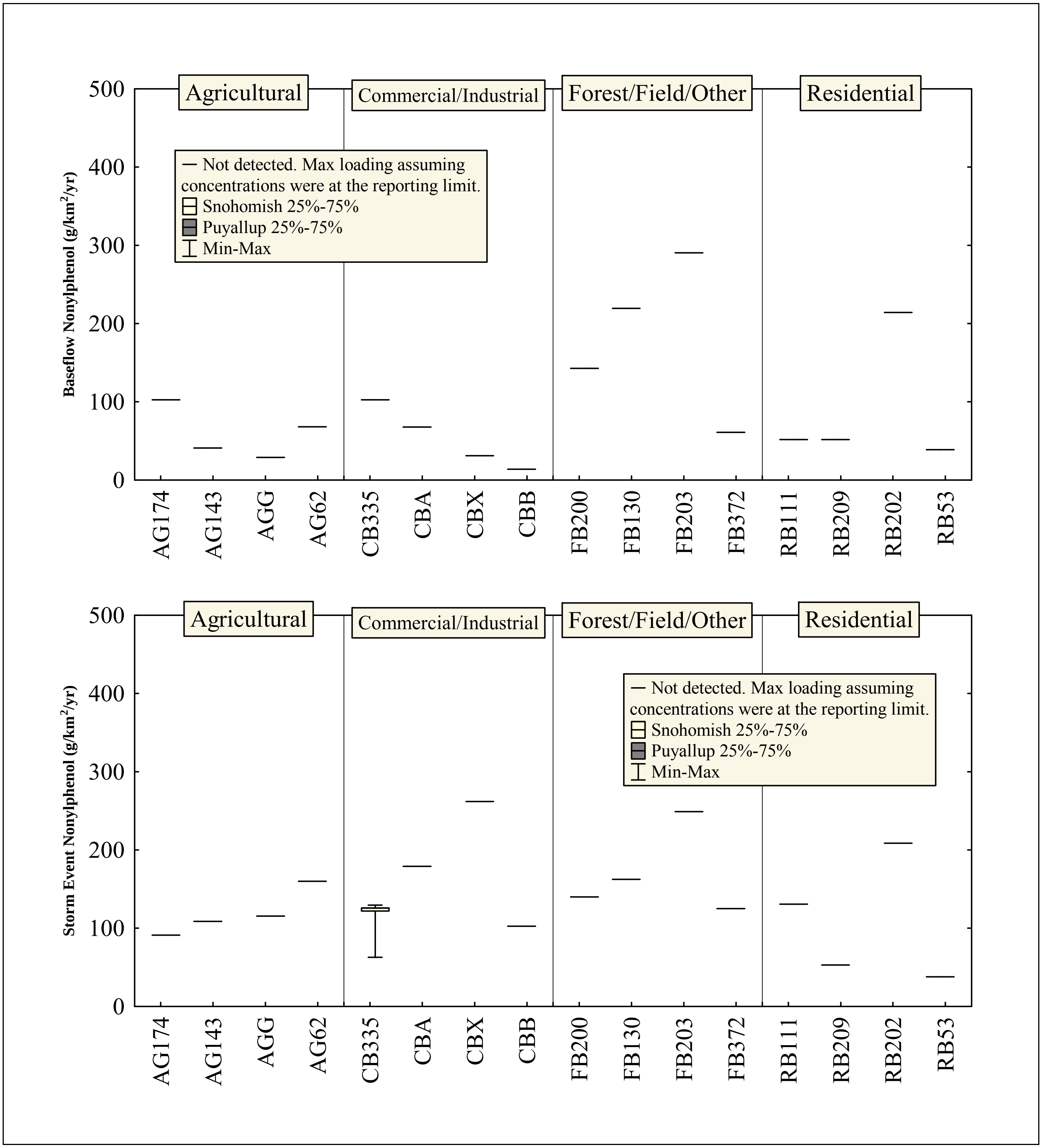

Figure 57. Baseflow and storm-event unit-area chemical loading box plots for nonylphenol for the Phase 3 study of toxics in surface runoff to Puget Sound.

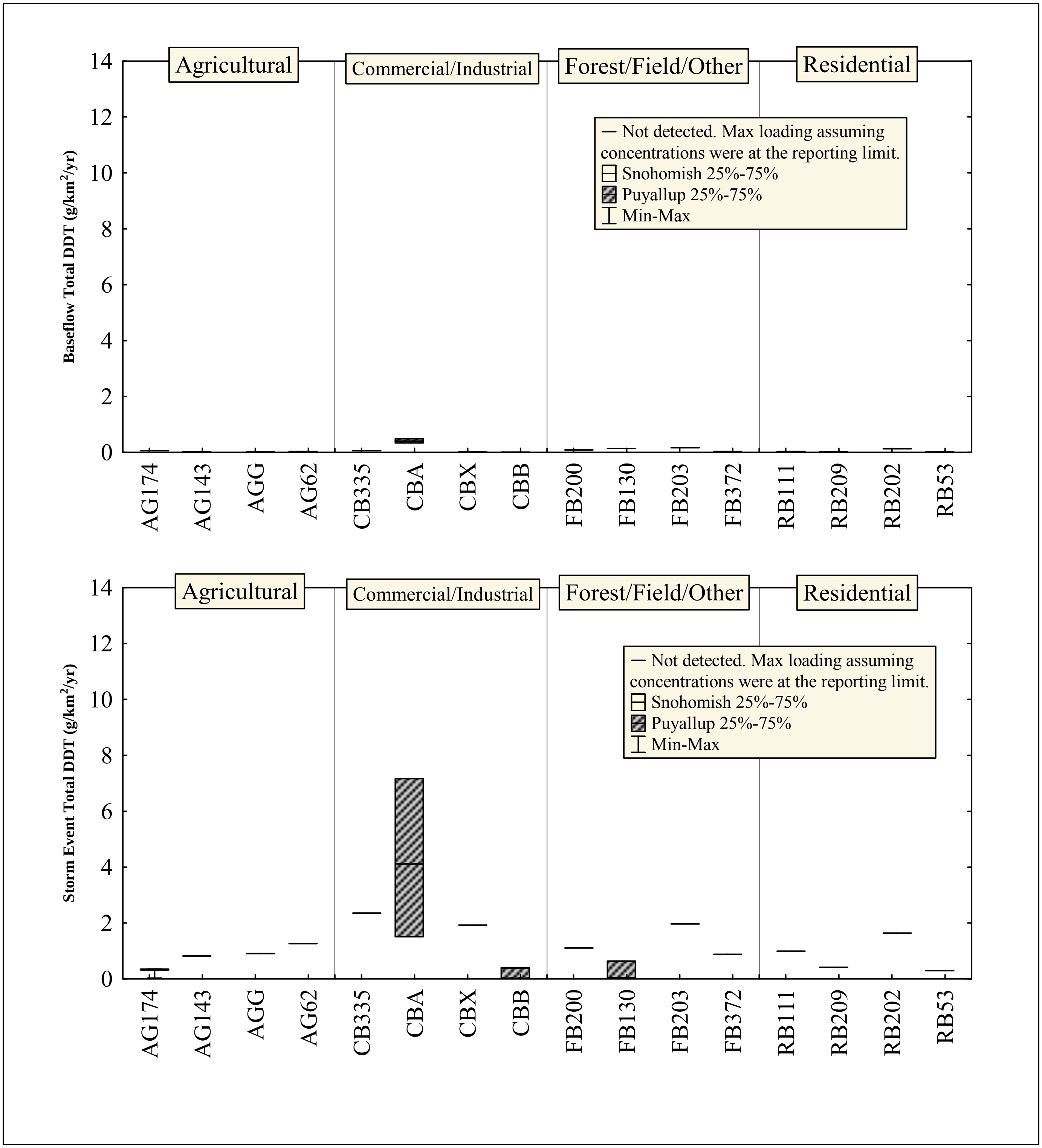

Figure 58. Baseflow and storm-event unit-area chemical loading box plots for total dichlorodiphenyltrichloroethane (DDT) for the Phase 3 study of toxics in surface runoff to Puget Sound.

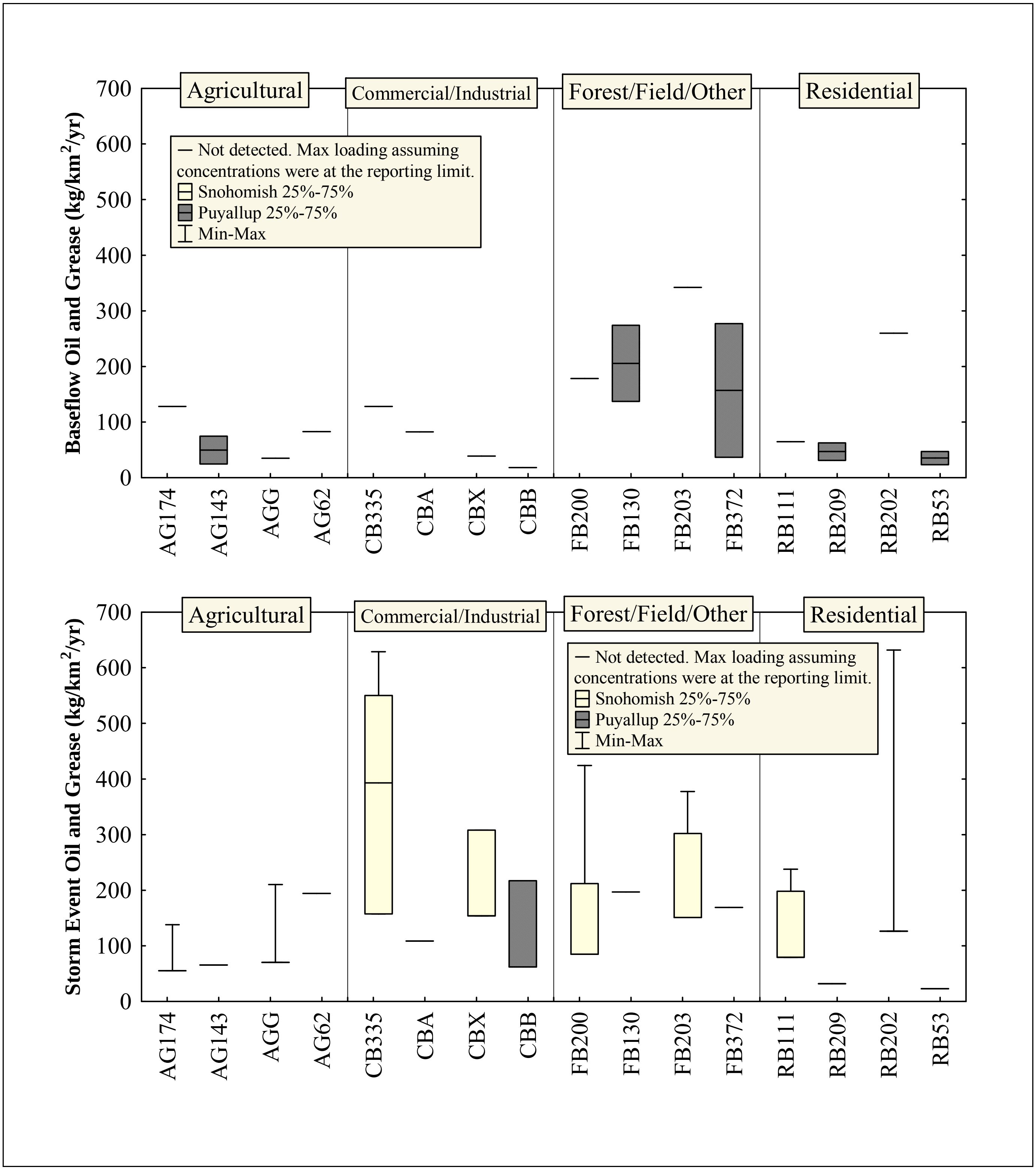

Figure 59. Baseflow and storm-event unit-area chemical loading box plots for oil and grease for the Phase 3 study of toxics in surface runoff to Puget Sound.

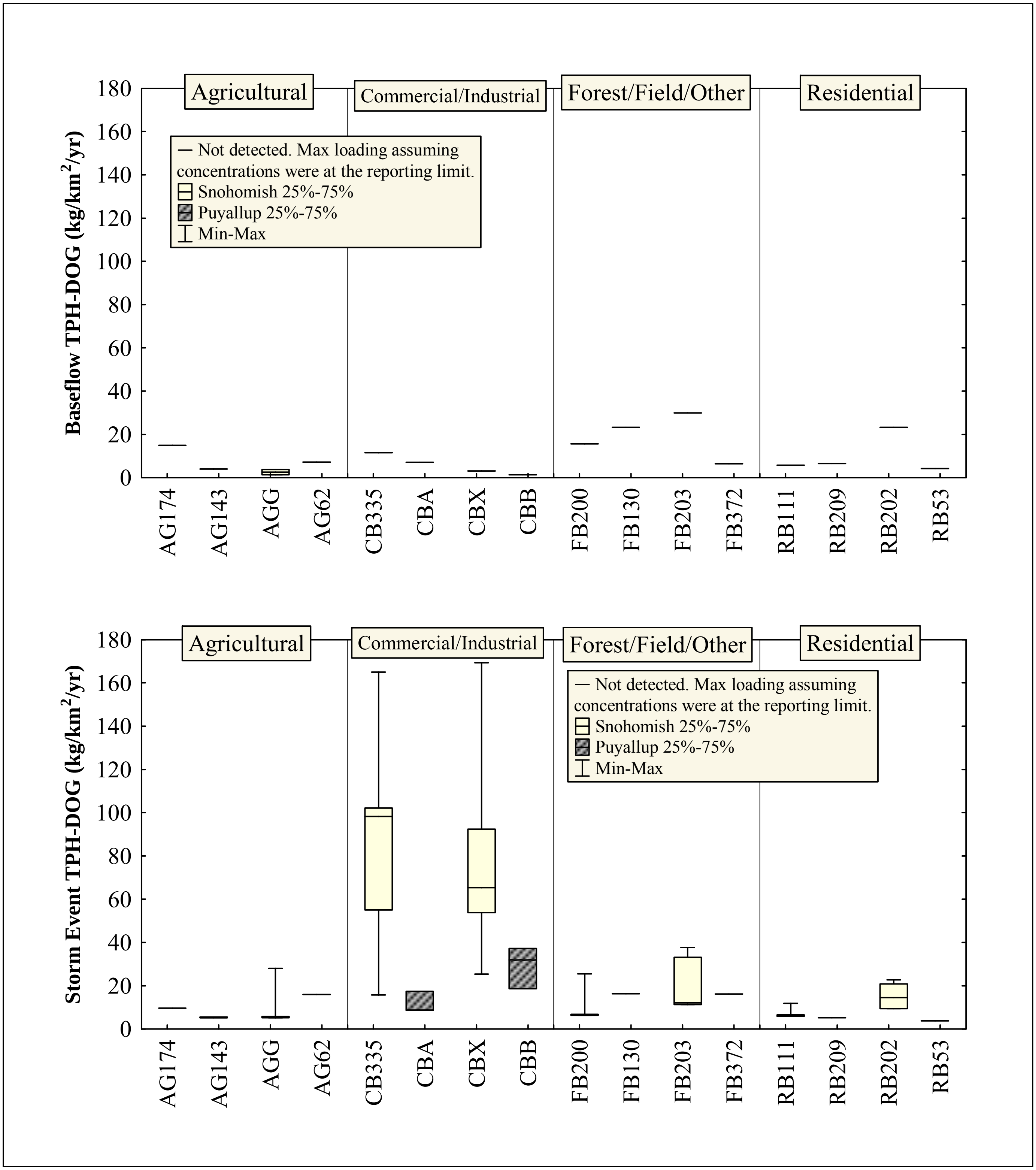

Figure 60. Baseflow and storm-event unit-area chemical loading box plots for lube oil (TPH-DOG) for the Phase 3 study of toxics in surface runoff to Puget Sound.

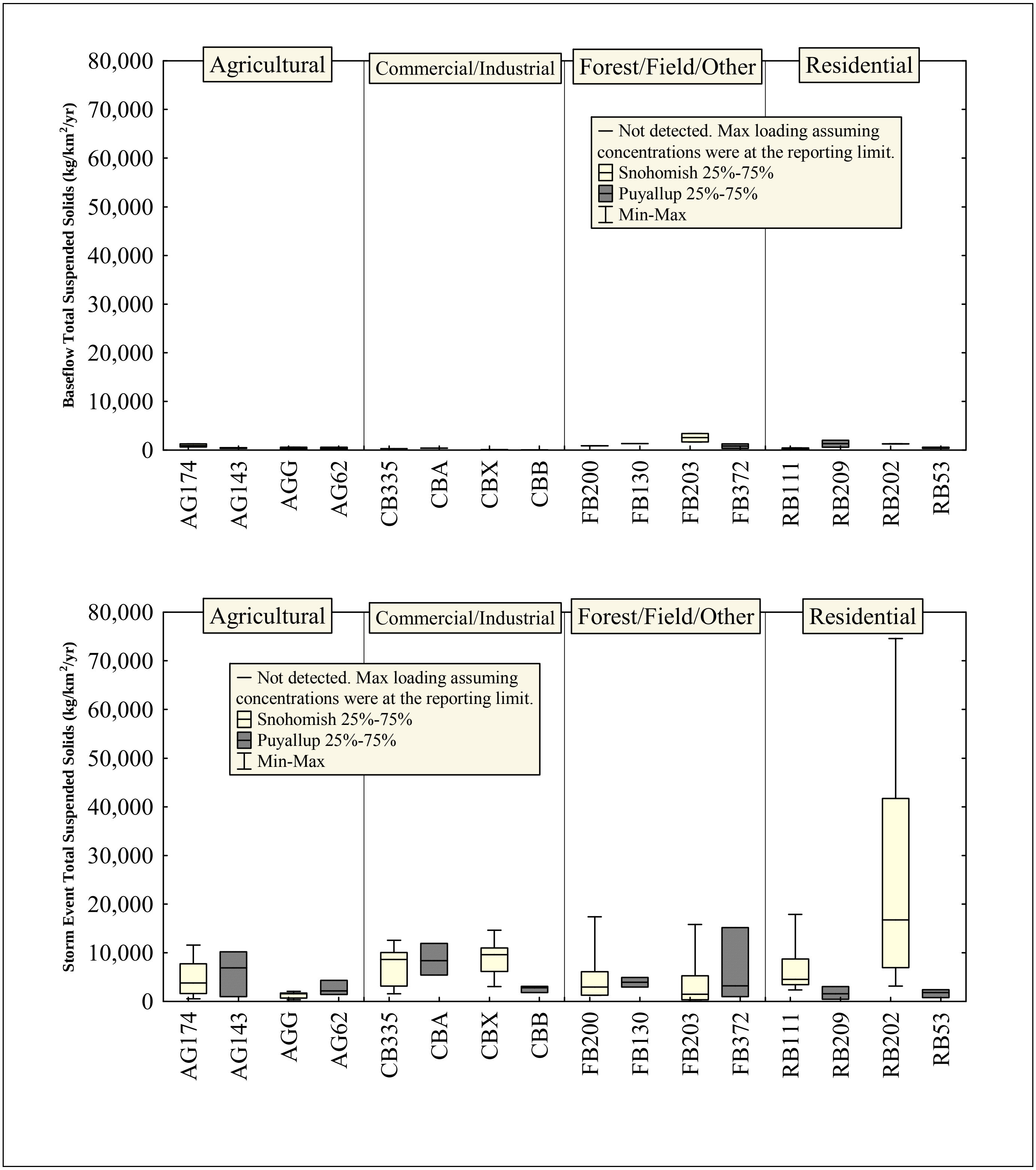

Figure 61. Baseflow and storm-event unit-area chemical loading box plots for total suspended solids (TSS) for the Phase 3 study of toxics in surface runoff to Puget Sound.

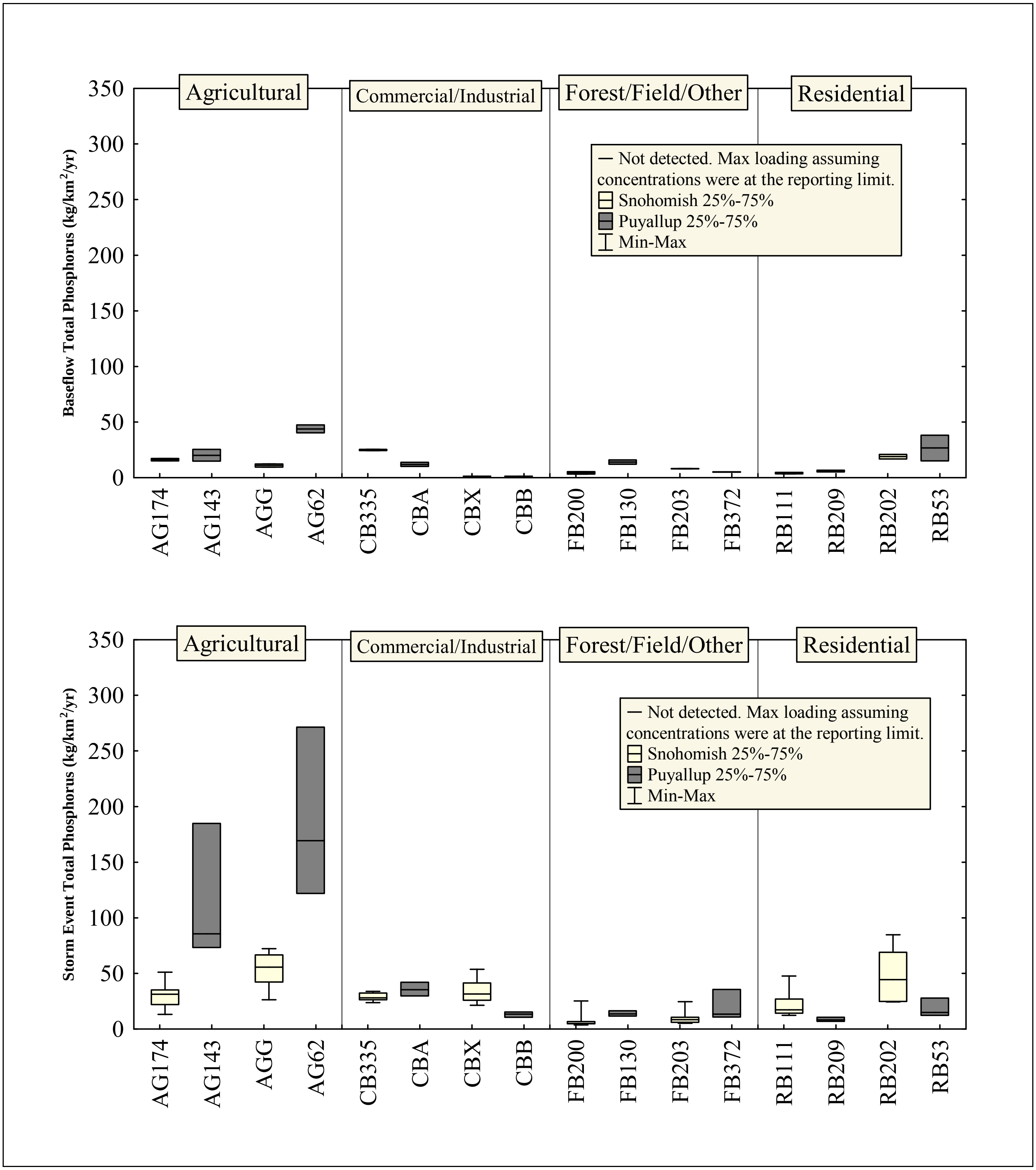

Figure 62. Baseflow and storm-event unit-area chemical loading box plots for total phosphorus for the Phase 3 study of toxics in surface runoff to Puget Sound.

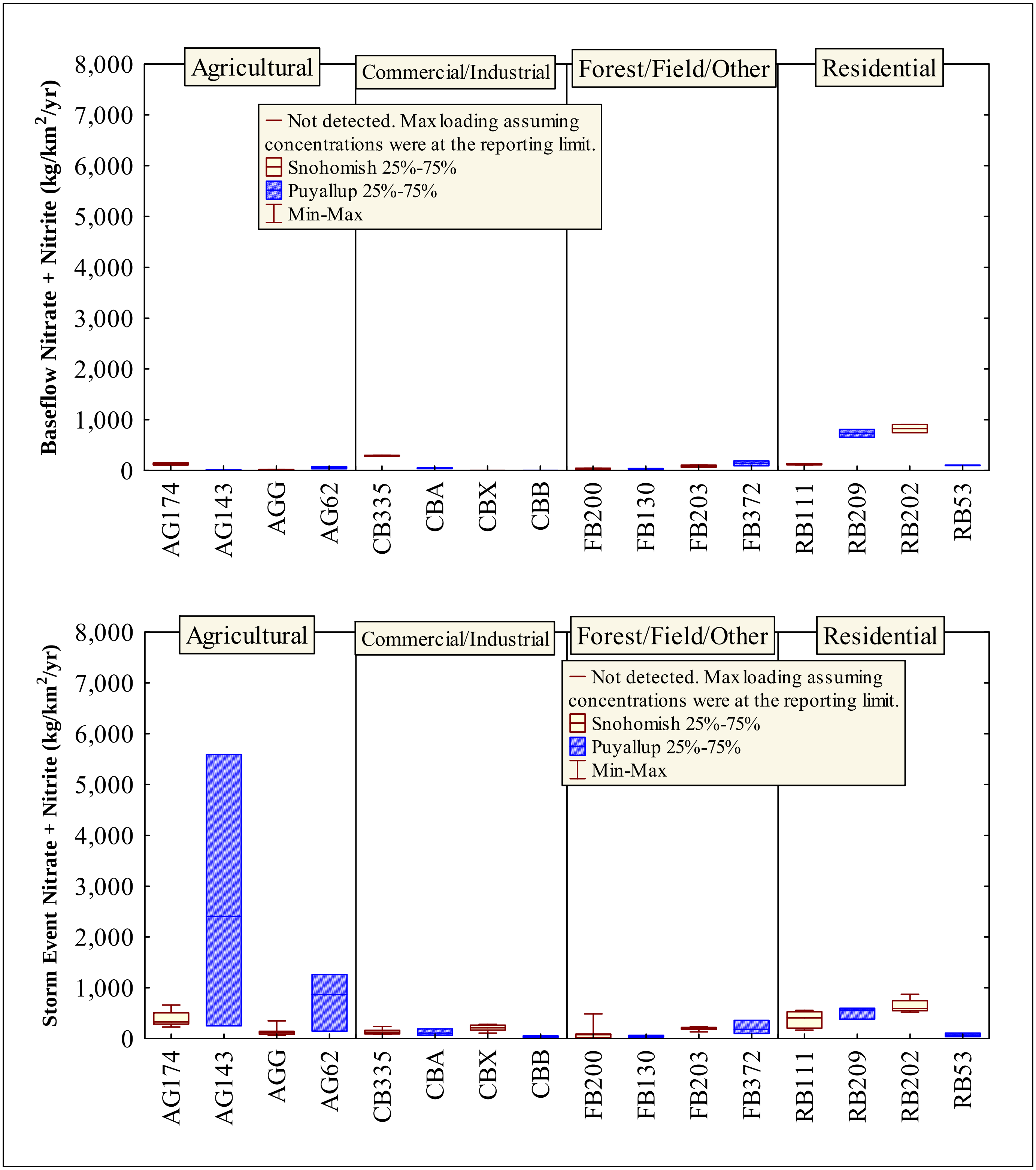

Figure 63. Baseflow and storm-event unit-area chemical loading box plots for nitrate+nitrite nitrogen for the Phase 3 study of toxics in surface runoff to Puget Sound.

Tables

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Table 1. Summary information for selected monitoring locations and their associated drainage basins in the Snohomish River watershed and Puyallup River watershed.

Monitoring Location ID	Monitoring Location Coordinates (UTM)	Drainage Basin Representative Land Use	Drainage Basin Area (hectares)	Land Use Breakdown (%)			
				Commercial/ Industrial	Residential	Agricultural	Forest/Field/ Other
Snohomish River Watershed							
CB335	554014.728964, 5309812.65922	Commercial/Industrial	213.6	62.7%	29.2%	0.0%	7.5%
CBX	555699.664563, 5309826.5359	Commercial/Industrial	219.4	26.4%	64.0%	0.0%	7.9%
RB111	569280.125094, 5311635.31379	Residential	556.3	0.2%	58.8%	3.4%	37.6%
RB202	568103.716954, 5299312.08525	Residential	334.1	0.4%	64.0%	0.0%	35.6%
AG174	569460.091694, 5302197.60046	Agricultural	290.4	0%	11.8%	57.1%	31.1%
AGG	559528.446036, 5330820.43366	Agricultural	246.4	0.0%	25.8%	49.0%	25.2%
FB200	577729.711516, 5318011.24222	Forest/Field/Other	174.4	0.0%	9.3%	0.0%	90.7%
FB203	588161.362388, 5299897.77717	Forest/Field/Other	1656.9	0.0%	2.9%	0.0%	95.8%
Puyallup River Watershed							
CBA	557134.530396, 5234155.0863	Commercial/Industrial	656.5	31.8%	62.1%	0.0%	6.2%
CBB	551484.812353, 5238023.54968	Commercial/Industrial	436.6	38.1%	48.4%	0.0%	13.4%
RB53	551168.088855, 5231526.86235	Residential	376.3	5.1%	81.7%	1.1%	9.8%
RB209	548616.293597, 5228040.37359	Residential	549.2	4.5%	81.6%	0%	13.9%
AG143	576488.827227, 5225382.62099	Agricultural	164.8	0.4%	10.6%	81.5%	7.5%
AG62	571169.400258, 5232968.32363	Agricultural	292.7	0.1%	23.3%	50.7%	25.9%
FB130	590848.135546, 5225066.88834	Forest/Field/Other	80.4	0.0%	3.5%	0.0%	96.5%
FB372	563043.022045, 5214260.42147	Forest/Field/Other	528.4	0.0%	2.5%	0.0%	97.5%

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Table 2. Storm-event and baseflow sampling dates in the Snohomish River watershed and Puyallup River watershed.

Event	Season	Sample Date	Antecedent Dry Period (hours)	Precipitation Duration (hours)	Precipitation Total (inches)	Precipitation Peak Hourly Intensity (inches/hour)
Snohomish Watershed [a]						
Storm - 1	Fall	10/17/2009	13	22	1.06	0.27
Storm - 2	Winter	11/5/2009	57	140	4.11	0.23
Storm - 3	Winter	11/19/2009	22	241	7.1	0.35
Storm - 4	Winter	1/4/2010	17	49	1.96	0.13
Storm - 5	Spring	4/2/2010	13	39	1.03	0.08
Storm - 6	Spring	4/21/2010	14	19	1.42	0.21
Base - 1	Winter	5/14/2010	88	NA	NA	NA
Base - 2	Summer	7/6/2010	28	NA	NA	NA
Puyallup Watershed [b]						
Storm - 1	Fall	10/26/2009	47	26	0.42	0.06
Storm - 2	Winter	11/16/2009	14	47	0.52	0.05
Storm - 3	Winter	12/14/2009	125	56	0.54	0.09
Storm - 4	Winter	1/11/2010	40	14	0.45	0.13
Storm - 5	Spring	5/19/2010	17	31	0.81	0.14
Storm - 6	Spring	5/28/2010	14	42	0.35	0.04
Base - 1	Winter	5/13/2010	124	NA	NA	NA
Base - 2	Summer	7/7/2010	66	NA	NA	NA

[a] Precipitation data for Snohomish watershed from USGS gauge 12143400 (gaps filled with data from 12147900)
[b] Precipitation data for Puyallup watershed from USGS gauge 12092000 (gaps filled with data from 12095000)
NA = not applicable

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Table 3. Monitoring parameters and number of samples collected during baseflow events for the Phase 3 study of toxics in surface runoff to Puget Sound.

Parameter	Snohomish Watershed								Puyallup Watershed								Total Number of Baseflow Event Samples [a]
	CB335	CBX	RB111	RB202	AG174	AGG	FB200	FB203	CBA	CBB	RB53	RB209	AG143	AG62	FB130	FB372	
Dissolved As, Cd, Cu, Pb, Zn	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Total As, Cd, Cu, Pb, Zn	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Dissolved Al, Ba, Be, Co, Mn, Ni, Se, Sn, Tl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Al, Ba, Be, Co, Mn, Ni, Se, Sn, Tl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dissolved Mercury	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Total Mercury	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
PCBs (209 congeners)	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
PBDE (35 congeners)	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
PAHs	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
BNAs (plus Bisphenol A and Nonyphenol)	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Herbicides (plus Triclopyr)	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Pesticides	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
TPH – Gas (first grab only)	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
TPH – Diesel (first grab only)	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
TPH – Lube Oil (first grab only)	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Oil & Grease (first grab only)	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Oil &Grease – Lube Oil (first grab only)	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Total Hardness	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Ammonia Nitrogen	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Nitrate+Nitrite Nitrogen	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Total Nitrogen	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Dissolved Organic Carbon	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Total Organic Carbon	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Orthophosphate Phosphorus	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Total Phosphorus	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Total Suspended Solids	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
Dissolved Oxygen (*in situ*)	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30
pH (*in situ*)	2	1	2	2	2	2	2	2	2	1	2	2	2	2	2	2	30
Specific Conductance (*in situ*)	2	1	2	2	2	2	2	2	2	1	2	2	2	2	2	2	30
Temperature (*in situ*)	2	1	2	2	2	2	2	2	2	1	2	2	2	2	2	2	30
Flow (*in situ*)	2	1	2	2	2	2	2	2	2	1	2	2	2	2	2	2	30

[a] Total number does not include samples collected for QA purposes. Actual number of samples available for each monitoring location may be less if data were rejected during the data validation process

BNAs: base/neutral/acid extractable compounds
PAH: polycyclic aromatic hydrocarbons
PBDEs: polybrominated diphenyl ethers
PCBs: polychlorinated biphenyls
TPH: total petroleum hydrocarbons
Al: aluminum
As: arsenic
Ba: barium
Be: beryllium
Cd: cadmium
Cu: copper
Mn: manganese
Ni: nickel
Pb: lead
Se: selenium
Sn: tin
Tl: thallium
Zn: zinc

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Table 4. Monitoring parameters and number of samples collected during storm events for the Phase 3 study of toxics in surface runoff to Puget Sound.

Parameter	Snohomish Watershed								Puyallup Watershed								Total Number of Storm-Event Samples [a]
	CB335	CBX	RB111	RB202	AG174	AGG	FB200	FB203	CBA	CBB	RB53	RB209	AG143	AG62	FB130	FB372	
Dissolved As, Cd, Cu, Pb, Zn	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Total As, Cd, Cu, Pb, Zn	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Dissolved Al, Ba, Be, Co, Mn, Ni, Se, Sn, Tl	1	1	1	1	0	0	1	1	1	1	1	1	0	0	1	1	12
Total Al, Ba, Be, Co, Mn, Ni, Se, Sn, Tl	1	1	1	1	0	0	1	1	1	1	1	1	0	0	1	1	12
Dissolved Mercury	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Total Mercury	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
PCBs (209 congeners)	3	3	3	3	1	1	3	3	3	3	3	3	1	1	3	3	40
PBDE (35 congeners)	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5	64
PAHs	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
BNAs (plus Bisphenol A and Nonyphenol)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Herbicides (plus Triclopyr)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Pesticides	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
TPH – Gas (first grab only)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
TPH – Diesel(first grab only)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
TPH – Lube Oil (first grab only)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Oil & Grease (first grab only)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Oil & Grease – Lube Oil (first grab only)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Total Hardness	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Ammonia Nitrogen	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Nitrate+Nitrite Nitrogen	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Total Nitrogen	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Dissolved Organic Carbon	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Total Organic Carbon	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Orthophosphate Phosphorus	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Total Phosphorus	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Total Suspended Solids	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Dissolved Oxygen (*in situ*)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
pH (*in situ*)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Specific Conductance (*in situ*)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Temperature (*in situ*)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96
Flow (*in situ*)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	96

[a] Total number does not include samples collected for QA purposes. Actual number of samples available for each monitoring location may be less if data were rejected during the data validation process

BNAs: base/neutral/acid extractable compounds
PAH: polycyclic aromatic hydrocarbons
PBDEs: polybrominated diphenyl ethers
PCBs: polychlorinated biphenyls
TPH: total petroleum hydrocarbons
Al: aluminum
As: arsenic
Ba: barium
Be: beryllium
Cd: cadmium
Cu: copper
Mn: manganese
Ni: nickel
Pb: lead
Se: selenium
Sn: tin
Tl: thallium
Zn: zinc

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Table 5. Average discharge measured at monitoring locations and associated hydrograph separation results from monitoring conducted over the period from August 1, 2009, through July 31, 2010.

Site	Discharge (cfs)			Area-Normalized Discharge (cfs/square mile)			Flow QA Flag [c]
	Average Baseflow [a]	Average Storm-Event [b]	Average Base and Storm	Average Baseflow	Average Storm-Event	Average Base and Storm	
Snohomish Watershed							
CB335	0.77	1.88	2.65	0.93	2.28	3.21	
CBX	0.24	1.89	2.13	0.28	2.19	2.46	
RB111	1.01	2.47	3.48	0.45	1.10	1.55	
RB202	2.43	2.36	4.79	1.88	1.83	3.71	
AG174	1.04	0.90	1.94	0.75	0.65	1.39	j
AGG	0.24	0.97	1.21	0.25	1.00	1.25	
FB200	0.87	0.83	1.70	1.30	1.23	2.53	j
FB203	15.9	14.0	29.9	2.48	2.19	4.67	
Puyallup Watershed							
CBA	1.51	3.99	5.50	0.60	1.58	2.17	
CBB	0.22	1.52	1.74	0.13	0.90	1.04	
RB53	0.50	0.49	0.98	0.34	0.34	0.68	j
RB209	0.96	0.99	1.95	0.46	0.47	0.92	j
AG143	0.23	0.61	0.84	0.18	0.47	0.64	
AG62	0.68	1.59	2.27	0.53	1.25	1.78	
FB130	0.62	0.44	1.06	1.99	1.43	3.42	j
FB372	1.09	2.00	3.09	0.54	0.98	1.52	

[a] Baseflow discharge is calculated as the flow which passed the gauging station between storm events

[b] Storm-event discharge is calculated as the sum of baseflow discharge and storm-event discharge through the duration of each delineated storm event

[c] Quality assurance (QA) flag from the hydrologic data QA memoranda

cfs = cubic feet per second

j = estimate

Table 6. Priority parameters for the Phase 3 study of toxics in surface runoff to Puget Sound.

Key Toxic Chemicals
Arsenic, total [a] and dissolved [b]
Cadmium, total [a] and dissolved [b]
Copper, total [a] and dissolved [b]
Lead, total [a] and dissolved [b]
Mercury. total [a] and dissolved [b]
Zinc, total [a] and dissolved [b]
Total PCBs [a]
Total PBDEs [a]
Total PAHs [b]
Carcinogenic PAHs (cPAHs) [a]
High molecular weight PAHs (HPAHs) [a]
Low molecular weight PAHs (LPAHs) [a]
bis(2-ethylhexyl) phthalate [a]
Triclopyr [a]
Nonylphenol [a]
Total DDT [a]
Oil and grease [a]
Lube oil (TPH-DOG) [b]
Total suspended solids [b]
Total phosphorus [b]
Nitrate+nitrite nitrogen [b]

[a] Priority parameter for the Phase 1 and 2 studies of toxics loading to Puget Sound

[b] Priority parameter added for the Phase 3 study

PCBs = polychlorinated biphenyls

PBDE = polybrominated diphenyl ethers

PAHs = polycyclic aromatic hydrocarbons

DDT = dichlorodiphenyltrichloroethane

TPH-DOG = total petroleum hydrocarbons lube oil from dissolved oil and grease

Table 7. Drainage basin area by land use in the Snohomish watershed and Puyallup watershed.

Land Use	Basin Area (square kilometers)
Snohomish Watershed	
Commercial/Industrial	10.2
Residential	421.2
Agricultural	137.5
Forest	4,057.6
Puyallup Watershed	
Commercial/Industrial	14.1
Residential	301.2
Agricultural	80.4
Forest	2,065.4

Table 8. Drainage basin area by land use for the 14 study areas in the Puget Sound basin.

	Drainage Basin Area (square kilometers)				
	Commercial / Industrial	Residential	Agriculture	Forest	Total
Main Basin	72.8	900.1	21.7	1,069.2	2,063.8
Port Gardner	19.7	452.8	142.9	4,141.1	4,756.5
Elliott Bay	57.3	317.6	55.6	879.1	1,309.6
Commencement Bay	32.5	401.9	75.6	2,181.2	2,691.3
South Sound (East)	27.8	518.3	131.7	2,054.9	2,732.7
South Sound (West)	10.0	257.8	35.5	1,270.1	1,573.4
Hood Canal (South)	0.6	93.3	5.5	2,320.3	2,419.7
Hood Canal (North)	0.5	48.5	0.9	295.6	345.4
Sinclair/Dyes Inlet	7.5	144.0	2.6	223.0	377.1
Admiralty Inlet	1.1	49.3	20.4	223.8	294.6
Strait of Juan de Fuca	7.0	135.1	87.0	2,914.3	3,143.4
Strait of Georgia	15.9	291.3	547.3	2,775.3	3,629.8
Whidbey Basin	9.8	410.9	328.2	8,798.1	9,547.0
San Juan Islands	6.0	98.0	71.0	494.7	669.7
Puget Sound Basin	268.5	4,118.9	1,525.8	29,640.7	35,553.9

Table 9. Monthly and annual precipitation totals (in inches) for 2009-2010 compared to historical totals at the SeaTac airport in SeaTac, Washington.

Month	SeaTac Airport Station #457473 Rainfall Data: 2009-2010	SeaTac Airport Station #457473 Historical Rainfall Data: 1948-2009		
		25th Percentile	Average	75th Percentile
August	1.16	0.32	1.10	1.62
September	1.75	0.79	1.73	2.26
October	**5.54**	2.15	3.48	4.30
November	**8.96**	4.12	6.15	8.02
December	*2.75*	4.40	5.81	7.13
January	6.17	4.09	5.76	7.71
February	3.52	2.31	3.93	4.97
March	3.76	2.67	3.73	4.38
April	**3.49**	1.56	2.52	3.31
May	**2.83**	1.11	1.72	2.10
June	**2.49**	0.72	1.44	1.85
July	*0.31*	0.32	0.75	1.15
Total	**42.73**	33.73	38.12	42.53

[a] Source: SeaTac Airport Station #457473 (WRCC 2011). Based on average monthly and annual precipitation totals measured over the period from 1948 to 2009.

Values in *italics* are below the 25th percentile value from the historical monthly or annual precipitation totals.

Values in **bold** are above the 75th percentile value from the historical monthly or annual precipitation totals.

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Table 10. Summary statistics for measured concentrations of priority parameters identified for the Phase 3 study of toxics in surface runoff to Puget Sound.

Baseflow

		Commercial/Industrial				Residential				Agricultural				Forest/Field/Other				Combined			
	Units	n	Percent Detected	Median Concentration	Flag	n	Percent Detected	Median Concentration	Flag	n	Percent Detected	Median Concentration	Flag	n	Percent Detected	Median Concentration	Flag	n	Percent Detected	Median Concentration	Flag
Metals																					
Dissolved Arsenic	µg/L	6	100%	1.31		8	100%	0.64		8	100%	1.31		8	100%	0.34		30	100%	0.75	
Total Arsenic	µg/L	6	100%	1.32		8	100%	0.63		8	100%	1.37		8	100%	0.36		30	100%	0.77	
Dissolved Cadmium	µg/L	6	67%	0.02		8	0%	< 0.02	U	8	0%	< 0.02	U	8	0%	< 0.02	U	30	13%	0.01	E
Total Cadmium	µg/L	6	0%	< 0.10	U	8	0%	< 0.10	U	8	0%	< 0.10	U	8	0%	< 0.10	U	30	0%	< 0.10	U
Dissolved Copper	µg/L	6	100%	1.45		8	100%	0.63		8	100%	1.47		8	100%	0.47		30	100%	0.74	
Total Copper	µg/L	6	100%	1.88		8	100%	0.88		8	100%	1.69		8	100%	0.63		30	100%	0.97	
Dissolved Lead	µg/L	6	83%	0.16		8	100%	0.04		8	88%	0.05		8	50%	0.02	E	30	80%	0.04	
Total Lead	µg/L	6	67%	0.27		8	100%	0.16		8	50%	0.09	E	8	25%	0.05	E	30	60%	0.13	
Dissolved Mercury	µg/L	6	50%	0.002	E	8	50%	0.002	E	8	100%	0.003		8	25%	0.001	E	30	57%	0.002	
Total Mercury	µg/L	6	100%	0.002		8	88%	0.003		8	100%	0.004		8	63%	0.002		30	87%	0.003	
Dissolved Zinc	µg/L	6	100%	11.5		8	100%	1.7		8	100%	3.9		8	63%	1.2		30	90%	2.3	
Total Zinc	µg/L	6	100%	15.9		8	25%	2.5	E	8	63%	8.8		8	13%	2.5	E	30	47%	2.5	E
Organics																					
Total PCBs	pg/L	6	100%	341.40		8	38%	178.95	E	8	63%	239.50		8	63%	121.00		30	63%	226.95	
Total PBDEs	pg/L	6	100%	436.0		8	38%	125.0	E	9	44%	125.0	E	8	25%	125.0	E	31	48%	125.0	E
Total PAHs	µg/L	6	33%	0.0100	E	8	0%	< 0.0200	U	8	0%	< 0.0200	U	8	0%	< 0.0200	U	30	7%	0.0095	E
cPAHs	µg/L	6	0%	< 0.0098	U	8	0%	< 0.0110	U	8	0%	< 0.0100	U	8	0%	< 0.0099	U	30	0%	< 0.0110	U
LPAHs	µg/L	6	33%	0.0049	E	8	0%	< 0.0110	U	8	0%	< 0.0100	U	8	0%	< 0.0099	U	30	7%	0.0049	E
HPAHs	µg/L	6	33%	0.0097	E	8	0%	< 0.0200	U	8	0%	< 0.0200	U	8	0%	< 0.0200	U	30	7%	0.0095	E
Bis(2-ethylhexyl)phthalate	µg/L	6	0%	< 0.160	U	8	13%	0.085	E	8	0%	< 0.170	U	8	0%	< 0.170	U	30	3%	0.080	E
Triclopyr	µg/L	6	50%	0.0305	E	8	0%	< 0.0650	U	8	38%	0.0307	E	8	0%	< 0.0620	U	30	20%	0.0305	E
Nonylphenol	µg/L	6	0%	< 0.330	U	8	0%	< 0.330	U	8	0%	< 0.330	U	8	0%	< 0.340	U	30	0%	< 0.340	U
Total DDTs	ng/L	6	33%	0.100	E	8	0%	< 0.210	U	8	0%	< 0.220	U	8	0%	< 0.200	U	30	7%	0.100	E
Oil and Grease	mg/L	6	17%	0.20	E	8	25%	0.20	E	8	13%	0.20	E	8	25%	0.20	E	30	20%	0.20	E
TPH - DOG	mg/L	6	0%	< 0.036	U	8	0%	< 0.042	U	8	13%	0.016	E	8	0%	< 0.035	U	30	3%	0.016	E
Conventionals																					
Total Suspended Solids	mg/L	6	33%	0.50	E	8	100%	3.00		8	100%	3.00		8	100%	2.00		30	87%	2.00	
Total Phosphorus	mg/L	6	100%	0.058		8	100%	0.033		8	100%	0.131		8	100%	0.015		30	100%	0.038	
Nitrate + Nitrite Nitrogen	mg/L	6	100%	0.230		8	100%	1.027		8	100%	0.216		8	100%	0.089		30	100%	0.308	

Storm Event

		Commercial/Industrial				Residential				Agricultural				Forest/Field/Other				Combined			
	Units	n	Percent Detected	Median Concentration	Flag	n	Percent Detected	Median Concentration	Flag	n	Percent Detected	Median Concentration	Flag	n	Percent Detected	Median Concentration	Flag	n	Percent Detected	Median Concentration	Flag
Metals																					
Dissolved Arsenic	µg/L	24	100%	0.64		24	96%	0.60		24	100%	1.14		24	100%	0.26		96	99%	0.60	
Total Arsenic	µg/L	24	100%	0.92		24	100%	0.85		24	100%	1.17		24	100%	0.37		96	100%	0.81	
Dissolved Cadmium	µg/L	24	92%	0.03		24	0%	< 0.02	U	24	46%	0.01	E	24	0%	< 0.02	U	96	34%	0.01	E
Total Cadmium	µg/L	24	33%	0.05	E	24	0%	< 0.10	U	24	0%	< 0.10	U	24	0%	< 0.10	U	96	8%	0.05	E
Dissolved Copper	µg/L	24	100%	2.28		24	96%	1.13		24	100%	4.07		24	100%	0.47		96	99%	2.03	
Total Copper	µg/L	24	100%	3.84		24	100%	2.21		24	100%	5.19		24	100%	0.82		96	100%	3.24	
Dissolved Lead	µg/L	24	100%	0.23		24	96%	0.12		24	100%	0.11		24	88%	0.05		96	96%	0.12	
Total Lead	µg/L	24	100%	1.68		24	100%	0.52		24	92%	0.31		24	71%	0.13		96	91%	0.50	
Dissolved Mercury	µg/L	24	88%	0.003		24	75%	0.005		24	100%	0.007		24	63%	0.002		96	81%	0.004	
Total Mercury	µg/L	24	100%	0.007		24	100%	0.008		24	100%	0.011		24	96%	0.004		96	99%	0.008	
Dissolved Zinc	µg/L	24	100%	29.1		24	100%	3.4		24	100%	6.7		24	71%	2.3		96	93%	5.5	
Total Zinc	µg/L	24	100%	37.2		24	67%	7.3		24	92%	9.0		24	17%	2.5	E	96	69%	8.4	
Organics																					
Total PCBs	pg/L	12	100%	2019.75		12	83%	129.80		4	100%	275.50		12	58%	105.00		40	83%	348.00	
Total PBDEs	pg/L	16	100%	3273.1		16	56%	108.7		16	63%	125.0		16	44%	125.0	E	64	66%	125.0	
Total PAHs	µg/L	24	96%	0.1756		24	42%	0.0098	E	24	21%	0.0088	E	24	21%	0.0096	E	96	45%	0.0100	E
cPAHs	µg/L	24	92%	0.0845		24	21%	0.0075	E	24	4%	0.0049	E	24	0%	< 0.0200	U	96	29%	0.0095	E
LPAHs	µg/L	24	96%	0.0135		24	25%	0.0050	E	24	21%	0.0049	E	24	21%	0.0050	E	96	41%	0.0058	E
HPAHs	µg/L	24	96%	0.1516		24	25%	0.0082	E	24	8%	0.0049	E	24	0%	< 0.0200	U	96	32%	0.0095	E
Bis(2-ethylhexyl)phthalate	µg/L	24	54%	0.340		24	17%	0.080	E	24	25%	0.080	E	24	25%	0.080	E	96	30%	0.080	E
Triclopyr	µg/L	24	46%	0.0323	E	24	54%	0.0310		24	29%	0.0310	E	24	21%	0.0310	E	96	38%	0.0310	E
Nonylphenol	µg/L	24	4%	0.160	E	24	0%	< 0.330	U	24	0%	< 0.330	U	24	0%	< 0.370	U	96	1%	0.160	E
Total DDTs	ng/L	24	25%	1.250	E	24	0%	< 2.600	U	24	4%	1.250	E	24	4%	1.250	E	96	8%	1.250	E
Oil and Grease	mg/L	24	38%	0.20	E	24	21%	0.20	E	24	13%	0.20	E	24	17%	0.20	E	96	22%	0.20	E
TPH - DOG	mg/L	24	75%	0.075		24	17%	0.016	E	24	8%	0.016	E	24	13%	0.016	E	96	28%	0.016	E
Conventionals																					
Total Suspended Solids	mg/L	24	100%	10.00		24	100%	14.00		24	96%	5.50		24	92%	7.00		96	97%	9.00	
Total Phosphorus	mg/L	24	100%	0.044		24	100%	0.067		24	100%	0.206		24	100%	0.024		96	100%	0.054	
Nitrate + Nitrite Nitrogen	mg/L	24	100%	0.174		24	100%	0.994		24	100%	1.025		24	100%	0.228		96	100%	0.345	

Colored bars indicate relative magnitude across each row in the table

pg/L = pictograms per liter

mg/L = milligrams per liter

E = 50 percent or more of the data are non-detect values; reported values are considered estimates with relatively low accuracy.

U = All of the data are non-detect values; reported values were computed based on the maximum reporting limit.

cPAHs = carcinogenic polycyclic aromatic hydrocarbons

DDT = dichlorodiphenyltrichloroethane

HPAHs = high molecular weight polycyclic aromatic hydrocarbons

LPAHs = low molecular weight polycyclic aromatic hydrocarbons

PAHs = polycyclic aromatic hydrocarbons

PBDE = polybrominated diphenyl ethers

PCBs = polychlorinated biphenyls

TPH-DOG = total petroleum hydrocarbons, dissolved lube oil extract of oil and grease

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Table 11. Subbasin scale unit-area loads for priority parameters identified for the Phase 3 study of toxics in surface runoff to Puget Sound.

Baseflow

		Commercial/Industrial				Residential				Agricultural				Forest/Field/Other				Combined			
	Units	n	Percent Detected	Median Load	Flag	n	Percent Detected	Median Load	Flag	n	Percent Detected	Median Load	Flag	n	Percent Detected	Median Load	Flag	n	Percent Detected	Median Load	Flag
Metals																					
Dissolved Arsenic	g/km^2/yr	6	100%	210		8	100%	154		8	100%	258		8	100%	229		30	100%	279	
Total Arsenic	g/km^2/yr	6	100%	212		8	100%	152		8	100%	269		8	100%	243		30	100%	287	
Dissolved Cadmium	g/km^2/yr	6	67%	3.21		8	0%	< 4.82	U	8	0%	< 3.93	U	8	0%	< 13.5	U	30	13%	3.72	E
Total Cadmium	g/km^2/yr	6	0%	< 16.0	U	8	0%	< 24.1	U	8	0%	< 19.7	U	8	0%	< 67.5	U	30	0%	< 37.2	U
Dissolved Copper	g/km^2/yr	6	100%	233		8	100%	152		8	100%	289		8	100%	317		30	100%	276	
Total Copper	g/km^2/yr	6	100%	302		8	100%	212		8	100%	332		8	100%	425		30	100%	361	
Dissolved Lead	g/km^2/yr	6	83%	25.7		8	100%	9.63		8	88%	9.83		8	50%	13.5	E	30	80%	14.9	
Total Lead	g/km^2/yr	6	67%	43.3		8	100%	38.5		8	50%	17.7	E	8	25%	33.7	E	30	60%	48.4	
Dissolved Mercury	g/km^2/yr	6	50%	0.321	E	8	50%	0.482	E	8	100%	0.590		8	25%	0.675	E	30	57%	0.745	
Total Mercury	g/km^2/yr	6	100%	0.321		8	88%	0.722		8	100%	0.787		8	63%	1.35		30	87%	1.12	
Dissolved Zinc	g/km^2/yr	6	100%	1840		8	100%	409		8	100%	767		8	63%	810		30	90%	857	
Total Zinc	g/km^2/yr	6	100%	2550		8	25%	602	E	8	63%	1730		8	13%	1690	E	30	47%	931	E
Organics																					
Total PCBs	mg/km^2/yr	6	100%	54.8		8	38%	43.1	E	8	63%	47.1		8	63%	81.6		30	63%	84.5	
Total PBDEs	mg/km^2/yr	6	100%	69.9		8	38%	30.1	E	9	44%	24.6	E	8	25%	84.3	E	31	48%	46.6	E
Total PAHs	g/km^2/yr	6	33%	1.60	E	8	0%	< 4.82	U	8	0%	< 3.93	U	8	0%	< 13.5	U	30	7%	3.54	E
cPAHs	g/km^2/yr	6	0%	< 1.57	U	8	0%	< 2.65	U	8	0%	< 1.97	U	8	0%	< 6.68	U	30	0%	< 4.10	U
LPAHs	g/km^2/yr	6	33%	0.786	E	8	0%	< 2.65	U	8	0%	< 1.97	U	8	0%	< 6.68	U	30	7%	1.84	E
HPAHs	g/km^2/yr	6	33%	1.56	E	8	0%	< 4.82	U	8	0%	< 3.93	U	8	0%	< 13.5	U	30	7%	3.54	E
Bis(2-ethylhexyl)phthalate	g/km^2/yr	6	0%	< 25.7	U	8	13%	20.5	E	8	0%	< 33.4	U	8	0%	< 115	U	30	3%	29.8	E
Triclopyr	g/km^2/yr	6	50%	4.89	E	8	0%	< 15.7	U	8	38%	6.04	E	8	0%	< 41.8	U	30	20%	11.4	E
Nonylphenol	g/km^2/yr	6	0%	< 52.9	U	8	0%	< 79.5	U	8	0%	< 64.9	U	8	0%	< 229	U	30	0%	< 127	U
Total DDTs	g/km^2/yr	6	33%	0.0160	E	8	0%	< 0.0506	U	8	0%	< 0.0433	U	8	0%	< 0.135	U	30	7%	0.0372	E
Oil and Grease	kg/km^2/yr	6	17%	32.1	E	8	25%	48.2	E	8	13%	39.3	E	8	25%	135	E	30	20%	74.5	E
TPH-DOG	kg/km^2/yr	6	0%	< 5.77	U	8	0%	< 10.1	U	8	13%	3.15	E	8	0%	< 23.6	U	30	3%	5.96	E
Conventionals																					
Total Suspended Solids	kg/km^2/yr	6	33%	80.2	E	8	100%	722		8	100%	590		8	100%	1350		30	87%	745	
Total Phosphorus	kg/km^2/yr	6	100%	9.34		8	100%	7.83		8	100%	25.8		8	100%	10.1		30	100%	14.2	
Nitrate + Nitrite Nitrogen	kg/km^2/yr	6	100%	36.9		8	100%	247		8	100%	42.5		8	100%	60.1		30	100%	115	

Storm Event

		Commercial/Industrial				Residential				Agricultural				Forest/Field/Other				Combined			
	Units	n	Percent Detected	Median Load	Flag	n	Percent Detected	Median Load	Flag	n	Percent Detected	Median Load	Flag	n	Percent Detected	Median Load	Flag	n	Percent Detected	Median Load	Flag
Metals																					
Dissolved Arsenic	g/km^2/yr	24	100%	348		24	96%	186		24	100%	416		24	100%	164		96	99%	292	
Total Arsenic	g/km^2/yr	24	100%	500		24	100%	264		24	100%	427		24	100%	234		96	100%	394	
Dissolved Cadmium	g/km^2/yr	24	92%	16.3		24	0%	< 6.21	U	24	46%	3.65	E	24	0%	< 12.6	U	96	34%	4.87	E
Total Cadmium	g/km^2/yr	24	33%	27.1	E	24	0%	< 31.0	U	24	0%	< 36.5	U	24	0%	< 63.2	U	96	8%	24.3	E
Dissolved Copper	g/km^2/yr	24	100%	1240		24	96%	351		24	100%	1490		24	100%	297		96	99%	988	
Total Copper	g/km^2/yr	24	100%	2090		24	100%	686		24	100%	1890		24	100%	518		96	100%	1580	
Dissolved Lead	g/km^2/yr	24	100%	125		24	96%	37.2		24	100%	40.1		24	88%	31.6		96	96%	58.4	
Total Lead	g/km^2/yr	24	100%	912		24	100%	161		24	92%	113		24	71%	82.2		96	91%	243	
Dissolved Mercury	g/km^2/yr	24	88%	1.63		24	75%	1.55		24	100%	2.55		24	63%	1.26		96	81%	1.95	
Total Mercury	g/km^2/yr	24	100%	3.80		24	100%	2.48		24	100%	4.01		24	96%	2.53		96	99%	3.89	
Dissolved Zinc	g/km^2/yr	24	100%	15800		24	100%	1050		24	100%	2450		24	71%	1450		96	93%	2680	
Total Zinc	g/km^2/yr	24	100%	20200		24	67%	2270		24	92%	3280		24	17%	1580	E	96	69%	4090	
Organics																					
Total PCBs	mg/km^2/yr	12	100%	1100		12	83%	40.3		4	100%	101		12	58%	66.4		40	83%	169	
Total PBDEs	mg/km^2/yr	16	100%	1780		16	56%	33.7		16	63%	45.6		16	44%	79.0	E	64	66%	60.8	
Total PAHs	g/km^2/yr	24	96%	95.3		24	42%	3.04	E	24	21%	3.19	E	24	21%	6.07	E	96	45%	4.87	E
cPAHs	g/km^2/yr	24	92%	45.9		24	21%	2.33	E	24	4%	1.81	E	24	0%	< 12.6	U	96	29%	4.62	E
LPAHs	g/km^2/yr	24	96%	7.33		24	25%	1.54	E	24	21%	1.81	E	24	21%	3.14	E	96	41%	2.80	E
HPAHs	g/km^2/yr	24	96%	82.3		24	25%	2.56	E	24	8%	1.81	E	24	0%	< 12.6	U	96	32%	4.62	E
Bis(2-ethylhexyl)phthalate	g/km^2/yr	24	54%	185		24	17%	24.8	E	24	25%	29.2	E	24	25%	50.6	E	96	30%	38.9	E
Triclopyr	g/km^2/yr	24	46%	17.5	E	24	54%	9.62		24	29%	11.3	E	24	21%	19.6	E	96	38%	15.1	E
Nonylphenol	g/km^2/yr	24	4%	86.9	E	24	0%	< 102	U	24	0%	< 120	U	24	0%	< 234	U	96	1%	77.9	E
Total DDTs	g/km^2/yr	24	25%	0.679	E	24	0%	< 0.807	U	24	4%	0.456	E	24	4%	0.790	E	96	8%	0.608	E
Oil and Grease	kg/km^2/yr	24	38%	109	E	24	21%	62.1	E	24	13%	73.0	E	24	17%	126	E	96	22%	97.3	E
TPH-DOG	kg/km^2/yr	24	75%	40.7		24	17%	4.96	E	24	8%	5.84	E	24	13%	10.1	E	96	28%	7.79	E
Conventionals																					
Total Suspended Solids	kg/km^2/yr	24	100%	5430		24	100%	4340		24	96%	2010		24	92%	4420		96	97%	4380	
Total Phosphorus	kg/km^2/yr	24	100%	23.8		24	100%	20.9		24	100%	75.2		24	100%	15.3		96	100%	26.3	
Nitrate + Nitrite Nitrogen	kg/km^2/yr	24	100%	94.5		24	100%	308		24	100%	374		24	100%	144		96	100%	168	

Colored bars indicate relative magnitude across each row in the table.
E = 50 percent or more of the data are non-detect values; reported values are considered estimates with relatively low accuracy.
U = All of the data are non-detect values; reported values were computed based on the maximum reporting limit.
g/km^2/yr = grams per square kilometer per year
mg/km^2/yr = milligrams per square kilometer per year
kg/km^2/yr = kilograms per square kilometer per year
cPAHs = carcinogenic polycyclic aromatic hydrocarbons
DDT = dichlorodiphenyltrichloroethane

HPAHs = high molecular weight polycyclic aromatic hydrocarbons
LPAHs = low molecular weight polycyclic aromatic hydrocarbons
PAHs = polycyclic aromatic hydrocarbons
PBDE = polybrominated diphenyl ethers
PCBs = polychlorinated biphenyls
TPH-DOG = total petroleum hydrocarbons, dissolved lube oil extract of oil and grease

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Table 12. Water quality criteria exceedances for the Phase 3 study of toxics in surface runoff to Puget Sound.

		Acute Freshwater Criteria Exceedances								Chronic Freshwater Criteria Exceedances								Human Health Freshwater Criteria Exceedances							
	n	Criterion	AG	CB	FB	RB	Storm	Base	Total	Criterion	AG	CB	FB	RB	Storm	Base	Total	Criterion	AG	CB	FB	RB	Storm	Base	Total
Metals																									
Dissolved Arsenic	126	360 µg/L	0	0	0	0	0	0	0	190 µg/L	0	0	0	0	0	0	0	NA	--	--	--	--	--	--	--
Dissolved Cadmium	126	Hardness dependent	0	0	0	0	0	0	0	Hardness dependent	0	0	0	0	0	0	0	NA	--	--	--	--	--	--	--
Dissolved Copper	126	Hardness dependent	0	2	0	0	2	0	2	Hardness dependent	4	5	1	0	9	1	10	NA	--	--	--	--	--	--	--
Dissolved Lead	126	Hardness dependent	0	0	0	0	0	0	0	Hardness dependent	0	6	0	0	6	0	6	NA	--	--	--	--	--	--	--
Total Mercury	126	2.1 µg/L	0	0	0	0	0	0	0	0.012 µg/L	1	0	2	0	3	0	3	0.14 µg/L	0	0	0	0	0	0	0
Dissolved Zinc	126	Hardness dependent	0	11	0	0	11	0	11	Hardness dependent	0	13	0	0	13	0	13	NA	--	--	--	--	--	--	--
Organics																									
Total PCBs	70	2 µg/L	0	0	0	0	0	0	0	0.014 µg/L	0	1	0	0	1	0	1	0.00017 µg/L	2	13	4	4	18	5	23
cPAHs																									
Benzo(a)anthracene	126	NA	--	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	0.0028 µg/L	0	12	0	0	12	0	12
Benzo(a)pyrene	126	NA	--	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	0.0028 µg/L	0	10	0	0	10	0	10
Benzo(b)fluoranthene	126	NA	--	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	0.0028 µg/L	0	14	0	0	14	0	14
Benzo(k)fluoranthene	126	NA	--	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	0.0028 µg/L	0	7	0	0	7	0	7
Chrysene	126	NA	--	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	0.0028 µg/L	0	18	0	0	18	0	18
Indeno(1,2,3-cd)pyrene	126	NA	--	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	0.0028 µg/L	0	5	0	0	5	0	5
Bis(2-ethylhexyl)phthalate	126	NA	--	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	1.8 µg/L	0	0	0	1	0	1	1
Nonylphenol	126	27.9 µg/L	0	0	0	0	0	0	0	5.9 µg/L	0	0	0	0	0	0	0	NA	--	--	--	--	--	--	--
DDTs																									
4,4'-DDD	126	1.1 µg/L	0	0	0	0	0	0	0	0.001 µg/L	0	6	0	0	5	1	6	0.00083 µg/L	0	6	0	0	5	1	6
4,4'-DDE	126	1.1 µg/L	0	0	0	0	0	0	0	0.001 µg/L	0	3	0	0	3	0	3	0.00059 µg/L	0	3	0	0	3	0	3
4,4'-DDT	126	1.1 µg/L	0	0	0	0	0	0	0	0.001 µg/L	0	4	0	0	4	0	4	0.00059 µg/L	0	4	0	0	4	0	4
Conventionals																									
Nitrate + Nitrite Nitrogen	126	NA	--	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	10 mg/L	3	0	0	0	3	0	3

Acute and chronic freshwater criteria from WAC 173-201A. Human health freshwater criteria from National Toxics Rule (40 CFR 131.36) and EPA National Recommended Water Quality Criteria (EPA 822-R-02-47).
mg/L = milligrams per liter
µg/L = micrograms per liter
pg/L= pictograms per liter
AG = agricultural basin
CB = commercial/industrial basin
FB = forested basin
RB = residential basin
n = sample size
NA = not applicable
PCBs = polychlorinated biphenyls
cPAHs = carcinogenic polycyclic aromatic hydrocarbons
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane

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Table 13. Snohomish watershed total loading rates for priority parameters identified for the Phase 3 study of toxics in surface runoff to Puget Sound.

	Baseflow					Storm Event					Total [b]		
	n	25th Percentile	Median	75th Percentile	Flag	n	25th Percentile	Median	75th Percentile	Flag	25th Percentile	Median	75th Percentile
Dissolved Arsenic (kg/year)													
Commercial/Industrial	3	3.32	3.36	5.57		12	5.22	6.17	7.83		8.54	9.53	13.4
Residential	4	77.1	92.7	119		12	102	118	141		179	211	260
Agriculture	4	40.2	46.1	56.0		12	55.0	63.1	74.3		95.2	109	130
Forest/Field/Other	4	1030	1260	2410		12	645	791	1050		1680	2050	3460
All Land Uses [a]		1150	1400	2590			807	978	1270		1960	2380	3860
Total Arsenic (kg/year)													
Commercial/Industrial	3	3.10	3.10	5.34		12	6.80	7.91	9.17		9.90	11.0	14.5
Residential	4	77.1	90.1	115		12	137	172	214		214	262	329
Agriculture	4	46.6	55.4	66.3		12	77.7	85.8	104		124	141	170
Forest/Field/Other	4	1120	1420	2880		12	763	998	1410		1880	2420	4290
All Land Uses [a]		1250	1570	3070			985	1260	1740		2230	2830	4800
Dissolved Cadmium (kg/year)													
Commercial/Industrial	3	0.0633	0.0633	0.0633		12	0.237	0.475	0.791		0.300	0.538	0.854
Residential	4	0.00-2.90	0.00-2.90	0.00-2.90	U	12	0.00-4.09	0.00-4.09	0.00-4.09	U	0.00-6.99	0.00-6.99	0.00-6.99
Agriculture	4	0.00-0.587	0.00-0.587	0.00-0.587	U	12	0.426	0.426	0.853	E	0.426-1.01	0.426-1.01	0.853-1.44
Forest/Field/Other	4	0.00-66.1	0.00-66.1	0.00-66.1	U	12	0.00-58.8	0.00-58.8	0.00-58.8	U	0.00-125	0.00-125	0.00-125
All Land Uses [a]		0.0633-69.7	0.0633-69.7	0.0633-69.7			0.663-63.6	0.901-63.8	1.64-64.5		0.726-133	0.964-134	1.71-134
Total Cadmium (kg/year)													
Commercial/Industrial	3	0.00-0.211	0.00-0.211	0.00-0.211	U	12	0.396	0.633	1.26	E	0.396-0.607	0.633-0.844	1.26-1.47
Residential	4	0.00-14.5	0.00-14.5	0.00-14.5	U	12	0.00-20.4	0.00-20.4	0.00-20.4	U	0.00-34.9	0.00-34.9	0.00-34.9
Agriculture	4	0.00-2.93	0.00-2.93	0.00-2.93	U	12	0.00-4.26	0.00-4.26	0.00-4.26	U	0.00-7.19	0.00-7.19	0.00-7.19
Forest/Field/Other	4	0.00-331	0.00-331	0.00-331	U	12	0.00-293	0.00-293	0.00-293	U	0.00-624	0.00-624	0.00-624
All Land Uses [a]		0.00-349	0.00-349	0.00-349			0.396-318	0.633-318	1.26-319		0.396-667	0.633-667	1.26-668
Dissolved Copper (kg/year)													
Commercial/Industrial	3	1.67	1.90	2.77		12	17.3	18.7	23.5		19.0	20.6	26.3
Residential	4	91.4	102	109		12	161	213	298		252	315	407
Agriculture	4	23.8	29.0	42.2		12	89.5	142	191		113	171	233
Forest/Field/Other	4	1190	1230	1660		12	1200	1350	1580		2390	2580	3240
All Land Uses [a]		1310	1360	1810			1470	1720	2090		2770	3090	3910
Total Copper (kg/year)													
Commercial/Industrial	3	2.04	2.70	3.38		12	29.2	34.9	38.7		31.2	37.6	42.1
Residential	4	116	128	136		12	313	451	758		429	579	894
Agriculture	4	27.9	34.9	51.0		12	117	165	304		145	200	355
Forest/Field/Other	4	1490	1820	2220		12	1550	2050	3720		3040	3870	5940
All Land Uses [a]		1640	1990	2410			2010	2700	4820		3650	4690	7230
Dissolved Lead (kg/year)													
Commercial/Industrial	3	0.0211	0.0633	0.169		12	1.26	1.42	1.97		1.28	1.48	2.14
Residential	4	7.25	11.6	16.0		12	16.3	22.5	38.8		23.6	34.1	54.8
Agriculture	4	0.587	1.17	1.76		12	3.84	4.69	5.97		4.43	5.86	7.73
Forest/Field/Other	4	33.1	99.4	198	E	12	117	147	176		150	246	374
All Land Uses [a]		41.0	112	216			138	176	223		179	287	439
Total Lead (kg/year)													
Commercial/Industrial	3	0.106	0.106	0.253	E	12	6.72	10.8	15.9		6.83	10.9	16.2
Residential	4	18.9	23.2	24.7		12	88.0	131	235		107	154	260
Agriculture	4	1.47	2.64	3.81	E	12	8.53	13.2	37.5		10.0	15.8	41.3
Forest/Field/Other	4	166	298	430	E	12	147	323	471		313	621	901
All Land Uses [a]		186	324	459			250	478	759		437	802	1220
Dissolved Mercury (kg/year)													
Commercial/Industrial	3	0.00-0.00422	0.00-0.00422	0.00-0.00422	U	12	0.0159	0.0237	0.0316		0.0159-0.0201	0.0237-0.0279	0.0316-0.0358
Residential	4	0.145	0.290	0.434	E	12	0.817	1.02	1.23		0.962	1.31	1.66
Agriculture	4	0.0587	0.0587	0.0880		12	0.213	0.256	0.341		0.272	0.315	0.429
Forest/Field/Other	4	0.00-6.61	0.00-6.61	0.00-6.61	U	12	2.93	5.88	8.80		2.93-9.54	5.88-12.5	8.80-15.4
All Land Uses [a]		0.204-6.82	0.349-6.96	0.522-7.14			3.98	7.18	10.4		4.18-10.8	7.53-14.2	10.9-17.5
Total Mercury (kg/year)													
Commercial/Industrial	3	0.00422	0.00422	0.00422		12	0.0396	0.0553	0.0712		0.0438	0.0595	0.0754
Residential	4	0.290	0.434	0.581		12	1.43	1.84	2.45		1.72	2.27	3.03
Agriculture	4	0.0880	0.117	0.117		12	0.341	0.469	0.512		0.429	0.586	0.629
Forest/Field/Other	4	3.31	6.61	6.61	E	12	5.88	8.80	11.7		9.19	15.4	18.3
All Land Uses [a]		3.69	7.17	7.31			7.69	11.2	14.7		11.4	18.3	22.0
Dissolved Zinc (kg/year)													
Commercial/Industrial	3	22.8	25.9	30.8		12	205	285	350		228	311	381
Residential	4	247	276	334		12	573	695	939		820	971	1270
Agriculture	4	64.5	114	197		12	102	193	392		167	307	589
Forest/Field/Other	4	1660	2650	3970	E	12	1470	1470	5880	E	3130	4120	9850
All Land Uses [a]		1990	3070	4530			2350	2640	7560		4350	5710	12100
Total Zinc (kg/year)													
Commercial/Industrial	3	27.5	33.6	37.7		12	291	373	437		319	407	475
Residential	4	363	363	712	E	12	817	1720	2230		1180	2080	2940
Agriculture	4	135	311	1240		12	298	375	422		433	686	1660
Forest/Field/Other	4	8280	8280	16900	E	12	7340	7340	7340	E	15600	15600	24200
All Land Uses [a]		8810	8990	18900			8750	9810	10400		17500	18800	29300

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Table 13 (continued). Snohomish watershed total loading rates for priority parameters identified for the Phase 3 study of toxics in surface runoff to Puget Sound.

	Baseflow					Storm Event					Total [b]		
	n	25th Percentile	Median	75th Percentile	Flag	n	25th Percentile	Median	75th Percentile	Flag	25th Percentile	Median	75th Percentile
Total PCBs (g/year)													
Commercial/Industrial	3	0.366	0.786	2.38		6	6.90	51.4	104		7.27	52.2	106
Residential	4	1.42	2.54	30.5	E	6	20.0	56.0	235		21.4	58.5	266
Agriculture	4	0.704	2.05	6.19	E	2	3.76	4.50	5.23		4.46	6.55	11.4
Forest/Field/Other	4	61.3	209	771		6	104	145	293	E	165	354	1060
All Land Uses [a]		63.8	214	810			135	257	637		198	471	1440
Total PBDEs (g/year)													
Commercial/Industrial	3	0.702	0.899	15.0		8	10.6	25.9	227		11.3	26.8	242
Residential	4	18.6	31.8	67.8	E	8	3.15	5.01	18.3		21.8	36.8	86.1
Agriculture	4	2.34	3.75	6.04	E	8	1.50	5.34	5.36	E	3.84	9.09	11.4
Forest/Field/Other	4	297	414	3490	E	8	227	438	925		524	852	4420
All Land Uses [a]		319	450	3580			242	474	1180		561	925	4760
Total PAHs (kg/year)													
Commercial/Industrial	3	0.00-0.0422	0.00-0.0422	0.00-0.0422	U	12	1.07	1.42	1.88		1.07-1.11	1.42-1.46	1.88-1.92
Residential	4	0.00-2.90	0.00-2.90	0.00-2.90	U	12	1.53	2.00	2.04	E	1.53-4.43	2.00-4.90	2.04-4.94
Agriculture	4	0.00-0.587	0.00-0.587	0.00-0.587	U	12	0.320	0.406	0.426	E	0.320-0.907	0.406-0.993	0.426-1.01
Forest/Field/Other	4	0.00-66.1	0.00-66.1	0.00-66.1	U	12	25.7	29.3	32.3	E	25.7-91.8	29.3-95.4	32.3-98.4
All Land Uses [a]		0.00-69.6	0.00-69.6	0.00-69.6			28.6	33.1	36.6		28.6-98.2	33.1-103	36.6-106
cPAHs (kg/year)													
Commercial/Industrial	3	0.00-0.0206	0.00-0.0206	0.00-0.0206	U	12	0.484	0.621	0.746		0.484-0.505	0.621-0.642	0.746-0.767
Residential	4	0.00-1.60	0.00-1.60	0.00-1.60	U	12	1.02	1.94	2.04	E	1.02-2.62	1.94-3.54	2.04-3.64
Agriculture	4	0.00-0.290	0.00-0.290	0.00-0.290	U	12	0.212	0.406	0.411	E	0.212-0.502	0.406-0.696	0.411-0.701
Forest/Field/Other	4	0.00-32.8	0.00-32.8	0.00-32.8	U	12	0.00-58.8	0.00-58.8	0.00-58.8	U	0.00-91.6	0.00-91.6	0.00-91.6
All Land Uses [a]		0.00-34.7	0.00-34.7	0.00-34.7			1.72-60.5	2.97-61.8	3.20-62		1.72-95.2	2.97-96.5	3.20-96.7
LPAHs (kg/year)													
Commercial/Industrial	3	0.00-0.0206	0.00-0.0206	0.00-0.0206	U	12	0.0799	0.103	0.166		0.0799-0.101	0.103-0.124	0.166-0.187
Residential	4	0.00-1.60	0.00-1.60	0.00-1.60	U	12	0.998	1.07	2.00	E	0.998-2.60	1.07-2.67	2.00-3.60
Agriculture	4	0.00-0.290	0.00-0.290	0.00-0.290	U	12	0.208	0.245	0.378	E	0.208-0.498	0.245-0.535	0.378-0.668
Forest/Field/Other	4	0.00-32.8	0.00-32.8	0.00-32.8	U	12	14.4	16.9	31.9	E	14.4-47.2	16.9-49.7	31.9-64.7
All Land Uses [a]		0.00-34.7	0.00-34.7	0.00-34.7			15.7	18.3	34.4		15.7-50.4	18.3-53	34.4-69.2
HPAHs (kg/year)													
Commercial/Industrial	3	0.00-0.0422	0.00-0.0422	0.00-0.0422	U	12	0.999	1.20	1.65		0.999-1.04	1.20-1.24	1.65-1.69
Residential	4	0.00-2.90	0.00-2.90	0.00-2.90	U	12	1.02	1.94	2.04	E	1.02-3.92	1.94-4.84	2.04-4.94
Agriculture	4	0.00-0.587	0.00-0.587	0.00-0.587	U	12	0.212	0.406	0.411	E	0.212-0.799	0.406-0.993	0.411-0.998
Forest/Field/Other	4	0.00-66.1	0.00-66.1	0.00-66.1	U	12	0.00-58.8	0.00-58.8	0.00-58.8	U	0.00-125	0.00-125	0.00-125
All Land Uses [a]		0.00-69.6	0.00-69.6	0.00-69.6			2.23-61	3.55-62.3	4.10-62.9		2.23-131	3.55-132	4.10-133
BEHP (kg/year)													
Commercial/Industrial	3	0.00-0.338	0.00-0.338	0.00-0.338	U	12	1.42	3.34	7.87	E	1.42-1.76	3.34-3.68	7.87-8.21
Residential	4	11.9	12.3	876	E	12	16.3	16.3	18.4	E	28.2	28.6	894
Agriculture	4	0.00-4.99	0.00-4.99	0.00-4.99	U	12	3.33	3.41	3.41	E	3.33-8.32	3.41-8.40	3.41-8.40
Forest/Field/Other	4	0.00-564	0.00-564	0.00-564	U	12	235	235	235	E	235-799	235-799	235-799
All Land Uses [a]		11.9-581	12.3-582	876-1450			256	258	265		268-837	270-840	1140-1710
Triclopyr (kg/year)													
Commercial/Industrial	3	0.0572	0.0644	0.0644	E	12	0.245	0.253	0.281	E	0.302	0.317	0.345
Residential	4	0.00-9.44	0.00-9.44	0.00-9.44	U	12	5.94	6.32	13.9		5.94-15.4	6.32-15.8	13.9-23.3
Agriculture	4	0.772	0.895	0.895	E	12	1.29	1.31	1.34	E	2.06	2.21	2.24
Forest/Field/Other	4	0.00-202	0.00-202	0.00-202	U	12	0.00-188	0.00-188	0.00-188	U	0.00-390	0.00-390	0.00-390
All Land Uses [a]		0.829-212	0.959-212	0.959-212			7.48-195	7.88-196	15.5-204		8.30-408	8.85-408	16.5-416
Nonyphenol (kg/year)													
Commercial/Industrial	3	0.00-0.675	0.00-0.675	0.00-0.675	U	12	1.24	1.26	1.30	E	1.24-1.92	1.26-1.94	1.30-1.98
Residential	4	0.00-48.0	0.00-48.0	0.00-48.0	U	12	0.00-67.4	0.00-67.4	0.00-67.4	U	0.00-115	0.00-115	0.00-115
Agriculture	4	0.00-9.68	0.00-9.68	0.00-9.68	U	12	0.00-14.0	0.00-14.0	0.00-14.0	U	0.00-23.7	0.00-23.7	0.00-23.7
Forest/Field/Other	4	0.00-1120	0.00-1120	0.00-1120	U	12	0.00-970	0.00-970	0.00-970	U	0.00-2090	0.00-2090	0.00-2090
All Land Uses [a]		0.00-1180	0.00-1180	0.00-1180			1.24-1050	1.26-1050	1.30-1050		1.24-2230	1.26-2230	1.30-2230
Total DDTs (kg/year)													
Commercial/Industrial	3	0.00-0.000422	0.00-0.000422	0.00-0.000422	U	12	0.00-0.0237	0.00-0.0237	0.00-0.0237	U	0.00-0.0241	0.00-0.0241	0.00-0.0241
Residential	4	0.00-0.0305	0.00-0.0305	0.00-0.0305	U	12	0.00-0.531	0.00-0.531	0.00-0.531	U	0.00-0.562	0.00-0.562	0.00-0.562
Agriculture	4	0.00-0.00587	0.00-0.00587	0.00-0.00587	U	12	0.0276	0.0534	0.0534	E	0.0276-0.0335	0.0534-0.0593	0.0534-0.0593
Forest/Field/Other	4	0.00-0.661	0.00-0.661	0.00-0.661	U	12	0.00-7.63	0.00-7.63	0.00-7.63	U	0.00-8.29	0.00-8.29	0.00-8.29
All Land Uses [a]		0.00-0.698	0.00-0.698	0.00-0.698			0.0276-8.21	0.0534-8.24	0.0534-8.24		0.0276-8.91	0.0534-8.94	0.0534-8.94
Oil and Grease (MT/year)													
Commercial/Industrial	3	0.00-0.844	0.00-0.844	0.00-0.844	U	12	1.59	2.37	3.96	E	1.59-2.43	2.37-3.21	3.96-4.80
Residential	4	0.00-58.1	0.00-58.1	0.00-58.1	U	12	40.9	40.9	71.6	E	40.9-99.0	40.9-99.0	71.6-130
Agriculture	4	0.00-11.7	0.00-11.7	0.00-11.7	U	12	8.53	8.53	8.53	E	8.53-20.2	8.53-20.2	8.53-20.2
Forest/Field/Other	4	0.00-1320	0.00-1320	0.00-1320	U	12	588	588	1320	E	588-1910	588-1910	1320-2640
All Land Uses [a]		0.00-1390	0.00-1390	0.00-1390			639	640	1400		639-2030	640-2030	1400-2800
TPH-DOG (MT/year)													
Commercial/Industrial	3	0.00-0.076	0.00-0.076	0.00-0.076	U	12	0.553	0.831	1.03		0.553-0.629	0.831-0.907	1.03-1.11
Residential	4	0.00-5.22	0.00-5.22	0.00-5.22	U	12	3.07	3.27	6.15	E	3.07-8.29	3.27-8.49	6.15-11.4
Agriculture	4	0.469	0.578	0.989	E	12	0.640	0.682	0.692	E	1.11	1.26	1.68
Forest/Field/Other	4	0.00-116	0.00-116	0.00-116	U	12	43.8	47.1	88.0	E	43.8-160	47.1-163	88.0-204
All Land Uses [a]		0.469-122	0.578-122	0.989-122			48.1	51.9	95.9		48.5-170	52.5-174	96.9-218

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Table 13 (continued). Snohomish watershed total loading rates for priority parameters identified for the Phase 3 study of toxics in surface runoff to Puget Sound.

	Baseflow					Storm Event					Total [b]		
	n	25th Percentile	Median	75th Percentile	Flag	n	25th Percentile	Median	75th Percentile	Flag	25th Percentile	Median	75th Percentile
Total Suspended Solids (MT/year)													
Commercial/Industrial	3	0.00-2.11	0.00-2.11	0.00-2.11	U	12	47.5	90.9	112		47.5-49.6	90.9-93.0	112-114
Residential	4	218	290	363		12	1810	3580	7880		2030	3870	8240
Agriculture	4	58.7	88.0	161		12	132	235	587		191	323	748
Forest/Field/Other	4	6610	6610	9940		12	5880	11700	34300		12500	18300	44200
All Land Uses [a]		6890	6990	10500			7870	15600	42900		14800	22600	53300
Total Phosphorus (MT/year)													
Commercial/Industrial	3	0.0620	0.161	0.167		12	0.264	0.297	0.347		0.326	0.458	0.514
Residential	4	3.45	4.01	4.42		12	7.96	9.94	20.0		11.4	14.0	24.4
Agriculture	4	1.50	2.41	3.70		12	3.86	5.38	7.39		5.36	7.79	11.1
Forest/Field/Other	4	28.1	31.4	36.7		12	27.9	35.5	43.8		56.0	66.9	80.5
All Land Uses [a]		33.1	38.0	45.0			40.0	51.1	71.5		73.1	89.1	117
Nitrate+Nitrite Nitrogen (MT/year)													
Commercial/Industrial	3	0.515	1.89	1.95		12	1.12	1.67	2.37		1.64	3.56	4.32
Residential	4	112	144	185		12	171	192	259		283	336	444
Agriculture	4	5.67	9.04	12.0		12	13.9	38.8	50.8		19.6	47.8	62.8
Forest/Field/Other	4	155	295	377		12	483	653	840		638	948	1220
All Land Uses [a]		273	450	576			669	885	1150		942	1340	1730

[a] Values calculated by summing loading rates for all four land use types.

[b] Values calculated by summing baseflow and storm-event loading rates.

Flag:
E = 50 percent or more of the data are non-detect values; reported values are considered estimates with relatively low accuracy.
U = All of the data are non-detect values. The low value in range was calculated by assuming a zero for nondetect values; the high value in range was calculated assuming the maximum method reporting limit for non-detect values.

kg/yr = kilograms per year

g/yr = grams per year

MT/yr = metric tons per year

BEHP = Bis(2-ethylhexyl) phthalate

cPAHs = carcinogenic polycyclic aromatic hydrocarbons

DDT = dichlorodiphenyltrichloroethane

HPAHs = high molecular weight polycyclic aromatic hydrocarbons

LPAHs = low molecular weight polycyclic aromatic hydrocarbons

PAHs = polycyclic aromatic hydrocarbons

PBDE = polybrominated diphenyl ethers

PCBs = polychlorinated biphenyls

TPH-DOG = total petroleum hydrocarbons, extract of oil and grease (lube oil)

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Table 14. Puyallup watershed total loading rates for priority parameters identified for the Phase 3 study of toxics in surface runoff to Puget Sound.

	Baseflow					Storm Event					Total [b]		
	n	**25th Percentile**	**Median**	**75th Percentile**	**Flag**	**n**	**25th Percentile**	**Median**	**75th Percentile**	**Flag**	**25th Percentile**	**Median**	**75th Percentile**
Dissolved Arsenic (kg/year)													
Commercial/Industrial	3	1.36	1.97	2.07		12	2.97	3.55	3.98		4.33	5.52	6.05
Residential	4	24.2	93.4	263		12	23.9	29.1	48.2		48.1	123	311
Agriculture	4	8.85	10.5	15.0		12	18.3	21.1	26.5		27.2	31.6	41.5
Forest/Field/Other	4	140	176	187		12	156	192	252		296	368	439
All Land Uses [a]		174	282	467			201	246	331		376	528	798
Total Arsenic (kg/year)													
Commercial/Industrial	3	1.40	2.15	2.29		12	3.98	5.07	7.65		5.38	7.22	9.94
Residential	4	23.8	86.7	249		12	25.7	37.9	57.2		49.5	125	306
Agriculture	4	8.37	10.1	14.6		12	17.6	19.7	30.4		26.0	29.8	45.0
Forest/Field/Other	4	156	181	192		12	223	289	355		379	470	547
All Land Uses [a]		190	280	458			270	352	450		460	632	908
Dissolved Cadmium (kg/year)													
Commercial/Industrial	3	0.0200	0.0200	0.0400	E	12	0.190	0.190	0.253		0.210	0.210	0.293
Residential	4	0.00-0.849	0.00-0.849	0.00-0.849	U	12	0.00-0.855	0.00-0.855	0.00-0.855	U	0.00-1.70	0.00-1.70	0.00-1.70
Agriculture	4	0.00-0.285	0.00-0.285	0.00-0.285	U	12	0.345	0.345	1.04	E	0.345-0.63	0.345-0.63	1.04-1.33
Forest/Field/Other	4	0.00-10.4	0.00-10.4	0.00-10.4	U	12	0.00-14.8	0.00-14.8	0.00-14.8	U	0.00-25.2	0.00-25.2	0.00-25.2
All Land Uses [a]		0.0200-11.6	0.0200-11.6	0.0400-11.6			0.535-16.2	0.535-16.2	1.29-16.9		0.555-27.7	0.555-27.7	1.33-28.5
Total Cadmium (kg/year)													
Commercial/Industrial	3	0.00-0.200	0.00-0.200	0.00-0.200	U	12	0.317	0.317	0.317	E	0.317-0.517	0.317-0.517	0.317-0.517
Residential	4	0.00-4.25	0.00-4.25	0.00-4.25	U	12	0.00-4.28	0.00-4.28	0.00-4.28	U	0.00-8.53	0.00-8.53	0.00-8.53
Agriculture	4	0.00-1.42	0.00-1.42	0.00-1.42	U	12	0.00-3.45	0.00-3.45	0.00-3.45	U	0.00-4.87	0.00-4.87	0.00-4.87
Forest/Field/Other	4	0.00-51.8	0.00-51.8	0.00-51.8	U	12	0.00-73.9	0.00-73.9	0.00-73.9	U	0.00-126	0.00-126	0.00-126
All Land Uses [a]		0.00-57.7	0.00-57.7	0.00-57.7			0.317-81.9	0.317-81.9	0.317-81.9		0.317-140	0.317-140	0.317-140
Dissolved Copper (kg/year)													
Commercial/Industrial	3	3.04	3.53	5.44		12	10.3	12.9	16.9		13.3	16.4	22.3
Residential	4	16.6	17.9	24.6		12	34.6	63.2	98.5		51.2	81.1	123
Agriculture	4	20.9	68.0	117		12	129	201	288		150	269	405
Forest/Field/Other	4	244	322	518		12	326	533	1440		570	855	1960
All Land Uses [a]		285	411	665			500	810	1840		785	1220	2510
Total Copper (kg/year)													
Commercial/Industrial	3	4.16	4.43	6.25		12	19.8	22.9	29.8		24.0	27.3	36.1
Residential	4	26.8	33.4	41.6		12	51.8	107	145		78.6	140	187
Agriculture	4	24.0	78.7	132		12	158	255	342		182	334	474
Forest/Field/Other	4	322	388	622		12	607	1060	1670		929	1450	2290
All Land Uses [a]		377	505	802			837	1440	2190		1210	1950	2990
Dissolved Lead (kg/year)													
Commercial/Industrial	3	0.459	0.459	0.878		12	1.20	2.15	4.05		1.66	2.61	4.93
Residential	4	1.27	1.70	1.70		12	2.99	5.12	5.99		4.26	6.82	7.69
Agriculture	4	0.427	0.853	1.42		12	2.76	3.80	4.83		3.19	4.65	6.25
Forest/Field/Other	4	5.18	10.4	15.6	E	12	7.39	29.5	66.7		12.6	39.9	82.3
All Land Uses [a]		7.34	13.4	19.6			14.3	40.6	81.6		21.7	54.0	101
Total Lead (kg/year)													
Commercial/Industrial	3	0.837	0.978	1.36		12	8.92	12.8	19.7		9.76	13.8	21.1
Residential	4	5.51	6.81	13.6		12	13.7	20.5	42.8		19.2	27.3	56.4
Agriculture	4	0.712	1.71	2.99	E	12	6.21	9.97	17.6		6.92	11.7	20.6
Forest/Field/Other	4	0.00-51.8	0.00-51.8	0.00-51.8	U	12	88.8	111	148		88.8-141	111-163	148-200
All Land Uses [a]		7.06-58.9	9.50-61.3	18.0-69.8			118	154	228		125-177	164-216	246-298
Dissolved Mercury (kg/year)													
Commercial/Industrial	3	0.00598	0.00798	0.00998		12	0.0190	0.0190	0.0253		0.0250	0.0270	0.0353
Residential	4	0.0425	0.0849	0.0849	E	12	0.0428	0.171	0.257		0.0853	0.256	0.342
Agriculture	4	0.0427	0.0853	0.142		12	0.241	0.310	0.483		0.284	0.395	0.625
Forest/Field/Other	4	0.518	1.04	2.07	E	12	0.739	2.23	8.14		1.26	3.27	10.2
All Land Uses [a]		0.609	1.22	2.31			1.04	2.73	8.91		1.65	3.95	11.2
Total Mercury (kg/year)													
Commercial/Industrial	3	0.00598	0.00998	0.0120		12	0.0317	0.0443	0.0570		0.0377	0.0543	0.0690
Residential	4	0.0849	0.127	0.170		12	0.0855	0.299	0.385		0.170	0.426	0.555
Agriculture	4	0.0569	0.114	0.185		12	0.345	0.380	0.483		0.402	0.494	0.668
Forest/Field/Other	4	1.04	1.56	2.07		12	2.23	4.44	8.14		3.27	6.00	10.2
All Land Uses [a]		1.19	1.81	2.44			2.69	5.16	9.07		3.88	6.97	11.5
Dissolved Zinc (kg/year)													
Commercial/Industrial	3	16.6	21.1	39.5		12	115	165	221		132	186	261
Residential	4	55.1	68.1	93.4		12	111	154	355		166	222	448
Agriculture	4	21.4	81.2	150		12	200	314	701		221	395	851
Forest/Field/Other	4	673	1190	1660		12	2000	2290	4150		2670	3480	5810
All Land Uses [a]		766	1360	1940			2430	2920	5430		3190	4280	7370

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Table 14 (continued). Puyallup watershed total loading rates for priority parameters identified for the Phase 3 study of toxics in surface runoff to Puget Sound.

	Baseflow					Storm Event					Total [b]		
	n	25th Percentile	Median	75th Percentile	Flag	n	25th Percentile	Median	75th Percentile	Flag	25th Percentile	Median	75th Percentile
Total Zinc (kg/year)													
Commercial/Industrial	3	21.4	31.9	46.4		12	203	214	245		224	246	291
Residential	4	106	106	183	E	12	107	252	325		213	358	508
Agriculture	4	35.6	95.7	170	E	12	235	383	797		271	479	967
Forest/Field/Other	4	0.00-2580	0.00-2580	0.00-2580	U	12	1850	1850	1850	E	1850-4430	1850-4430	1850-4430
All Land Uses [a]		163-2740	234-2810	399-2980			2400	2700	3220		2560-5140	2930-5510	3620-6200
Total PCBs (g/year)													
Commercial/Industrial	3	0.498	0.619	2.18		6	4.50	12.8	16.2		5.00	13.4	18.4
Residential	4	7.59	11.8	15.7	E	6	1.07	5.24	14.3		8.66	17.0	30.0
Agriculture	4	3.98	5.77	9.09		2	16.3	18.4	20.6		20.3	24.2	29.7
Forest/Field/Other	4	62.8	118	181	E	6	81.4	244	405		144	362	586
All Land Uses [a]		74.9	136	208			103	280	456		178	417	664
Total PBDEs (g/year)													
Commercial/Industrial	6	0.252	0.889	0.981		16	8.57	23.6	104		8.82	24.5	105
Residential	8	0.620	3.00	5.30	E	16	5.36	5.39	8.67	E	5.98	8.39	14.0
Agriculture	9	0.386	1.78	1.85	E	16	0.949	4.31	24.6		1.34	6.09	26.5
Forest/Field/Other	8	0.00-135	0.00-135	0.00-135	U	16	92.5	92.5	97.1	E	92.5-228	92.5-228	97.1-232
All Land Uses [a]		1.26-136	5.67-141	8.13-143			107	126	234		109-244	131-267	243-378
Total PAHs (kg/year)													
Commercial/Industrial	3	0.0229	0.0317	0.0428		12	0.454	1.10	1.93		0.477	1.13	1.97
Residential	4	0.00-0.849	0.00-0.849	0.00-0.849	U	12	0.209	0.422	0.593	E	0.209-1.06	0.422-1.27	0.593-1.44
Agriculture	4	0.00-0.270	0.00-0.270	0.00-0.270	U	12	0.169	0.171	0.345	E	0.169-0.439	0.171-0.441	0.345-0.615
Forest/Field/Other	4	0.00-10.4	0.00-10.4	0.00-10.4	U	12	3.64	3.70	7.39	E	3.64-14	3.70-14.1	7.39-17.8
All Land Uses [a]		0.0229-11.5	0.0317-11.6	0.0428-11.6			4.47	5.39	10.3		4.50-16.0	5.42-16.9	10.3-21.8
cPAHs (kg/year)													
Commercial/Industrial	3	0.00-0.0196	0.00-0.0196	0.00-0.0196	U	12	0.231	0.574	0.913		0.231-0.251	0.574-0.594	0.913-0.933
Residential	4	0.00-0.467	0.00-0.467	0.00-0.467	U	12	0.207	0.257	0.428	E	0.207-0.674	0.257-0.724	0.428-0.895
Agriculture	4	0.00-0.142	0.00-0.142	0.00-0.142	U	12	0.00-0.690	0.00-0.690	0.00-0.690	U	0.00-0.832	0.00-0.832	0.00-0.832
Forest/Field/Other	4	0.00-5.12	0.00-5.12	0.00-5.12	U	12	0.00-14.8	0.00-14.8	0.00-14.8	U	0.00-19.9	0.00-19.9	0.00-19.9
All Land Uses [a]		0.00-5.75	0.00-5.75	0.00-5.75			0.438-15.9	0.831-16.3	1.34-16.8		0.438-21.7	0.831-22.1	1.34-22.6
LPAHs (kg/year)													
Commercial/Industrial	3	0.0123	0.0197	0.0239		12	0.0497	0.111	0.234		0.0620	0.131	0.258
Residential	4	0.00-0.467	0.00-0.467	0.00-0.467	U	12	0.209	0.213	0.340	E	0.209-0.676	0.213-0.68	0.340-0.807
Agriculture	4	0.00-0.142	0.00-0.142	0.00-0.142	U	12	0.169	0.171	0.189	E	0.169-0.311	0.171-0.313	0.189-0.331
Forest/Field/Other	4	0.00-5.12	0.00-5.12	0.00-5.12	U	12	3.64	3.66	4.07	E	3.64-8.76	3.66-8.78	4.07-9.19
All Land Uses [a]		0.0123-5.74	0.0197-5.75	0.0239-5.75			4.07	4.16	4.83		4.08-9.81	4.18-9.9	4.86-10.6
HPAHs (kg/year)													
Commercial/Industrial	3	0.0140	0.0200	0.0208		12	0.412	0.960	1.63		0.426	0.980	1.65
Residential	4	0.00-0.849	0.00-0.849	0.00-0.849	U	12	0.207	0.257	0.446	E	0.207-1.06	0.257-1.11	0.446-1.3
Agriculture	4	0.00-0.270	0.00-0.270	0.00-0.270	U	12	0.168	0.169	0.171	E	0.168-0.438	0.169-0.439	0.171-0.441
Forest/Field/Other	4	0.00-10.4	0.00-10.4	0.00-10.4	U	12	0.00-14.8	0.00-14.8	0.00-14.8	U	0.00-25.2	0.00-25.2	0.00-25.2
All Land Uses [a]		0.0140-11.5	0.0200-11.5	0.0208-11.5			0.787-15.6	1.39-16.2	2.25-17.0		0.801-27.1	1.41-27.7	2.27-28.6
BEHP (kg/year)													
Commercial/Industrial	3	0.00-0.319	0.00-0.319	0.00-0.319	U	12	0.727	2.15	3.10		0.727-1.05	2.15-2.47	3.10-3.42
Residential	4	0.00-7.23	0.00-7.23	0.00-7.23	U	12	3.34	3.43	3.98	E	3.34-10.6	3.43-10.7	3.98-11.2
Agriculture	4	0.00-2.28	0.00-2.28	0.00-2.28	U	12	2.76	2.76	3.63	E	2.76-5.04	2.76-5.04	3.63-5.91
Forest/Field/Other	4	0.00-88.2	0.00-88.2	0.00-88.2	U	12	59.3	59.3	100	E	59.3-148	59.3-148	100-188
All Land Uses [a]		0.00-98.0	0.00-98.0	0.00-98.0			66.1	67.6	111		66.1-165	67.6-166	111-209
Triclopyr (kg/year)													
Commercial/Industrial	3	0.0497	0.0608	0.0720		12	0.196	0.232	0.332		0.246	0.293	0.404
Residential	4	0.00-2.72	0.00-2.72	0.00-2.72	U	12	1.30	1.33	1.41	E	1.30-4.02	1.33-4.05	1.41-4.13
Agriculture	4	0.442	0.499	5.69	E	12	1.05	1.08	1.95	E	1.49	1.58	7.64
Forest/Field/Other	4	0.00-32.2	0.00-32.2	0.00-32.2	U	12	22.5	23.1	25.2	E	22.5-54.7	23.1-55.3	25.2-57.4
All Land Uses [a]		0.492-35.4	0.560-35.5	5.76-40.7			25.0	25.7	28.9		25.5-60.5	26.3-61.2	34.7-69.6
Nonyphenol (kg/year)													
Commercial/Industrial	3	0.00-0.658	0.00-0.658	0.00-0.658	U	12	0.00-2.08	0.00-2.08	0.00-2.08	U	0.00-2.74	0.00-2.74	0.00-2.74
Residential	4	0.00-14.0	0.00-14.0	0.00-14.0	U	12	0.00-14.1	0.00-14.1	0.00-14.1	U	0.00-28.1	0.00-28.1	0.00-28.1
Agriculture	4	0.00-4.70	0.00-4.70	0.00-4.70	U	12	0.00-11.4	0.00-11.4	0.00-11.4	U	0.00-16.1	0.00-16.1	0.00-16.1
Forest/Field/Other	4	0.00-171	0.00-171	0.00-171	U	12	0.00-275	0.00-275	0.00-275	U	0.00-446	0.00-446	0.00-446
All Land Uses [a]		0.00-190	0.00-190	0.00-190			0.00-303	0.00-303	0.00-303		0.00-493	0.00-493	0.00-493
Total DDTs (kg/year)													
Commercial/Industrial	3	0.000964	0.00325	0.00436		12	0.00791	0.0129	0.0480	E	0.00887	0.0162	0.0524
Residential	4	0.00-0.00849	0.00-0.00849	0.00-0.00849	U	12	0.00-0.111	0.00-0.111	0.00-0.111	U	0.00-0.119	0.00-0.119	0.00-0.119
Agriculture	4	0.00-0.00314	0.00-0.00314	0.00-0.00314	U	12	0.00-0.0901	0.00-0.0901	0.00-0.0901	U	0.00-0.0932	0.00-0.0932	0.00-0.0932
Forest/Field/Other	4	0.00-0.104	0.00-0.104	0.00-0.104	U	12	0.0739	0.925	0.962	E	0.0739-0.178	0.925-1.03	0.962-1.07
All Land Uses [a]		0.000964-0.117	0.00325-0.119	0.00436-0.12			0.0818-0.283	0.938-1.14	1.01-1.21		0.0828-0.399	0.941-1.26	1.01-1.33

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Table 14 (continued). Puyallup watershed total loading rates for priority parameters identified for the Phase 3 study of toxics in surface runoff to Puget Sound.

	Baseflow					Storm Event					Total [b]		
	n	25th Percentile	Median	75th Percentile	Flag	n	25th Percentile	Median	75th Percentile	Flag	25th Percentile	Median	75th Percentile
Oil and Grease (MT/year)													
Commercial/Industrial	3	0.400	0.400	0.698	E	12	1.27	1.27	1.90	E	1.67	1.67	2.60
Residential	4	8.49	12.7	17.0	E	12	8.55	8.55	8.55	E	17.0	21.3	25.6
Agriculture	4	2.85	2.85	5.69	E	12	6.90	6.90	6.90	E	9.75	9.75	12.6
Forest/Field/Other	4	104	156	492	E	12	0.00-370	0.00-370	0.00-370	U	104-474	156-526	492-862
All Land Uses [a]		116	172	515			16.7-387	16.7-387	17.4-387		132-502	189-559	533-903
TPH-DOG (MT/year)													
Commercial/Industrial	3	0.00-0.0698	0.00-0.0698	0.00-0.0698	U	12	0.101	0.291	0.651		0.101-0.171	0.291-0.361	0.651-0.721
Residential	4	0.00-1.79	0.00-1.79	0.00-1.79	U	12	0.00-1.41	0.00-1.41	0.00-1.41	U	0.00-3.20	0.00-3.20	0.00-3.20
Agriculture	4	0.00-0.499	0.00-0.499	0.00-0.499	U	12	0.553	0.553	0.559	E	0.553-1.05	0.553-1.05	0.559-1.06
Forest/Field/Other	4	0.00-18.1	0.00-18.1	0.00-18.1	U	12	0.00-35.5	0.00-35.5	0.00-35.5	U	0.00-53.6	0.00-53.6	0.00-53.6
All Land Uses [a]		0.00-20.5	0.00-20.5	0.00-20.5			0.654-37.6	0.844-37.8	1.21-38.1		0.654-58	0.844-58.2	1.21-58.6
Total Suspended Solids (MT/year)													
Commercial/Industrial	3	1.76	4.00	4.00		12	47.4	63.3	104		49.2	67.3	108
Residential	4	149	191	382		12	257	557	876		406	748	1260
Agriculture	4	28.5	42.7	49.9		12	104	241	725		133	284	775
Forest/Field/Other	4	1040	1040	2330		12	3330	5930	18500		4370	6970	20800
All Land Uses [a]		1220	1280	2770			3740	6790	20200		4960	8070	22900
Total Phosphorus (MT/year)													
Commercial/Industrial	3	0.0663	0.0985	0.125		12	0.274	0.343	0.436		0.340	0.442	0.561
Residential	4	1.61	3.64	9.61		12	2.18	3.95	5.57		3.79	7.59	15.2
Agriculture	4	2.24	2.84	3.09		12	8.04	9.33	19.4		10.3	12.2	22.5
Forest/Field/Other	4	10.6	13.2	14.7		12	19.6	24.4	54.1		30.2	37.6	68.8
All Land Uses [a]		14.5	19.8	27.5			30.1	38.0	79.5		44.6	57.8	107
Nitrate+Nitrite Nitrogen (MT/year)													
Commercial/Industrial	3	0.166	0.402	0.487		12	0.512	0.841	1.38		0.678	1.24	1.87
Residential	4	37.0	108	198		12	25.2	64.4	150		62.2	172	348
Agriculture	4	1.09	1.95	3.96		12	18.5	89.3	253		19.6	91.3	257
Forest/Field/Other	4	25.8	148	399		12	62.2	177	394		88.0	325	793
All Land Uses [a]		64.1	258	601			106	332	798		170	590	1400

[a] Values calculated by summing loading rates for all four land use types.

[b] Values calculated by summing baseflow and storm-event loading rates.

Flag:
E = 50 percent or more of the data are non-detect values; reported values are considered estimates with relatively low accuracy.
U = All of the data are non-detect values. The low value in range was calculated by assuming a zero for nondetect values; the high value in range was calculated assuming the maximum method reporting limit for non-detect values.

kg/yr = kilograms per year

g/yr = grams per year

MT/yr = metric tons per year

BEHP = Bis(2-ethylhexyl) phthalate

cPAHs = carcinogenic polycyclic aromatic hydrocarbons

DDT = dichlorodiphenyltrichloroethane

HPAHs = high molecular weight polycyclic aromatic hydrocarbons

LPAHs = low molecular weight polycyclic aromatic hydrocarbons

PAHs = polycyclic aromatic hydrocarbons

PBDE = polybrominated diphenyl ethers

PCBs = polychlorinated biphenyls

TPH-DOG = total petroleum hydrocarbons, extract of oil and grease (lube oil)

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Table 15. Toxic chemical loading rates for Puget Sound based on the Phase 3 study of toxics in surface runoff to Puget Sound.

	Baseflow					Storm Event					Total [b]		
	n	25th Percentile	Median	75th Percentile	Flag	n	25th Percentile	Median	75th Percentile	Flag	25th Percentile	Median	75th Percentile
Dissolved Arsenic (kg/year)													
Commercial/Industrial	6	42.7	56.4	68.5		24	81.6	93.5	127		124	150	196
Residential	8	564	634	2360		24	675	766	960		1240	1400	3320
Agriculture	8	223	394	471		24	340	635	824		563	1030	1300
Forest/Field/Other	8	5990	6790	8000		24	3940	4860	6370		9930	11700	14400
All Land Uses [a]		6820	7870	10900			5040	6350	8280		11900	14300	19200
Total Arsenic (kg/year)													
Commercial/Industrial	6	46.5	56.9	63.4		24	117	134	175		164	191	238
Residential	8	527	626	2170		24	791	1090	1470		1320	1720	3640
Agriculture	8	214	410	568		24	317	652	1120		531	1060	1690
Forest/Field/Other	8	6400	7200	8800		24	5070	6940	8980		11500	14100	17800
All Land Uses [a]		7190	8290	11600			6300	8820	11700		13500	17100	23400
Dissolved Cadmium (kg/year)													
Commercial/Industrial	6	0.430	0.862	1.29		24	4.38	4.38	8.75		4.81	5.24	10.0
Residential	8	0.00 - 19.9	0.00 - 19.9	0.00 - 19.9	U	24	0.00 - 25.6	0.00 - 25.6	0.00 - 25.6	U	0.00 - 45.5	0.00 - 45.5	0.00 - 45.5
Agriculture	8	0.00 - 6.00	0.00 - 6.00	0.00 - 6.00	U	24	5.57	5.57	11.1	E	5.57 - 11.6	5.57 - 11.6	11.1 - 17.1
Forest/Field/Other	8	0.00 - 400	0.00 - 400	0.00 - 400	U	24	0.00 - 373	0.00 - 373	0.00 - 373	U	0.00 - 773	0.00 - 773	0.00 - 773
All Land Uses [a]		0.430 - 426	0.862 - 427	1.29 - 427			9.95 - 409	9.95 - 409	19.9 - 418		10.4 - 835	10.8 - 835	21.1 - 846
Total Cadmium (kg/year)													
Commercial/Industrial	6	0.00 - 4.30	0.00 - 4.30	0.00 - 4.30	U	24	7.28	7.28	21.9	E	7.28 - 11.6	7.28 - 11.6	21.9 - 26.2
Residential	8	0.00 - 99.3	0.00 - 99.3	0.00 - 99.3	U	24	0.00 - 128	0.00 - 128	0.00 - 128	U	0.00 - 227	0.00 - 227	0.00 - 227
Agriculture	8	0.00 - 30.1	0.00 - 30.1	0.00 - 30.1	U	24	0.00 - 55.7	0.00 - 55.7	0.00 - 55.7	U	0.00 - 85.8	0.00 - 85.8	0.00 - 85.8
Forest/Field/Other	8	0.00 - 2000	0.00 - 2000	0.00 - 2000	U	24	0.00 - 1870	0.00 - 1870	0.00 - 1870	U	0.00 - 3870	0.00 - 3870	0.00 - 3870
All Land Uses [a]		0.00 - 2130	0.00 - 2130	0.00 - 2130			7.28 - 2060	7.28 - 2060	21.9 - 2080		7.28 - 4190	7.28 - 4190	21.9 - 4210
Dissolved Copper (kg/year)													
Commercial/Industrial	6	38.7	62.6	76.3		24	298	333	416		337	396	492
Residential	8	416	626	725		24	1010	1450	2410		1430	2080	3140
Agriculture	8	298	441	1470		24	1740	2270	3720		2040	2710	5190
Forest/Field/Other	8	7410	9400	13400		24	7680	8800	17000		15100	18200	30400
All Land Uses [a]		8160	10500	15700			10700	12900	23500		18900	23400	39200
Total Copper (kg/year)													
Commercial/Industrial	6	55.1	81.1	95.6		24	486	561	709		541	642	805
Residential	8	675	873	964		24	1830	2830	4490		2510	3700	5450
Agriculture	8	357	507	1710		24	2000	2880	5070		2360	3390	6780
Forest/Field/Other	8	10600	12600	15600		24	11600	15400	37100		22200	28000	52700
All Land Uses [a]		11700	14100	18400			15900	21700	47400		27600	35700	65700
Dissolved Lead (kg/year)													
Commercial/Industrial	6	1.29	6.90	9.91		24	24.8	33.6	49.7		26.1	40.5	59.6
Residential	8	39.7	39.7	79.5		24	89.4	153	204		129	193	284
Agriculture	8	9.00	15.0	21.1		24	44.6	61.2	78.0		53.6	76.2	99.1
Forest/Field/Other	8	200	400	800	E	24	563	937	1310		763	1340	2110
All Land Uses [a]		250	462	911			722	1180	1640		972	1650	2550
Total Lead (kg/year)													
Commercial/Industrial	6	2.15	11.6	21.1		24	163	245	379		165	257	400
Residential	8	129	159	178		24	474	663	1290		603	822	1470
Agriculture	8	15.0	27.0	48.1	E	24	100	172	311		115	199	359
Forest/Field/Other	8	999	999	1800	E	24	937	2440	3560		1940	3440	5360
All Land Uses [a]		1150	1200	2050			1670	3520	5540		2820	4720	7590
Dissolved Mercury (kg/year)													
Commercial/Industrial	6	0.0430	0.0862	0.172	E	24	0.438	0.438	0.583		0.481	0.524	0.755
Residential	8	0.993	1.99	1.99	E	24	2.56	6.38	7.66		3.55	8.37	9.65
Agriculture	8	0.600	0.900	1.80		24	3.34	3.89	5.57		3.94	4.79	7.37
Forest/Field/Other	8	20.0	20.0	40.0	E	24	18.7	37.3	75.0		38.7	57.3	115
All Land Uses [a]		21.6	23.0	44.0			25.0	48.0	88.8		46.7	71.0	133
Total Mercury (kg/year)													
Commercial/Industrial	6	0.0862	0.0862	0.215		24	0.728	1.02	1.31		0.814	1.11	1.53
Residential	8	1.99	2.97	3.97		24	6.38	10.2	12.8		8.37	13.2	16.8
Agriculture	8	1.20	1.20	2.40		24	5.00	6.12	7.23		6.20	7.32	9.63
Forest/Field/Other	8	20.0	40.0	59.9		24	56.3	75.0	150		76.3	115	210
All Land Uses [a]		23.3	44.3	66.5			68.4	92.3	171		91.7	137	238
Dissolved Zinc (kg/year)													
Commercial/Industrial	6	443	494	663		24	3090	4240	6100		3530	4730	6760
Residential	8	1490	1680	2280		24	3450	4320	7410		4940	6000	9690
Agriculture	8	450	1170	2820		24	2230	3740	7800		2680	4910	10600
Forest/Field/Other	8	9990	24000	45900		24	9370	43000	63700		19400	67000	110000
All Land Uses [a]		12400	27300	51700			18100	55300	85000		30600	82600	137000
Total Zinc (kg/year)													
Commercial/Industrial	6	516	685	800		24	4940	5420	7360		5460	6110	8160
Residential	8	2480	2480	4280	E	24	3200	9350	11400		5680	11800	15700
Agriculture	8	751	2640	4100		24	3780	5000	9190		4530	7640	13300
Forest/Field/Other	8	50100	50100	50100	E	24	46800	46800	46800		96900	96900	96900
All Land Uses [a]		53800	55900	59300			58700	66600	74800		113000	122000	134000

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Table 15 (continued). Toxic chemical loading rates for Puget Sound based on the Phase 3 study of toxics in surface runoff to Puget Sound.

	Baseflow					Storm Event					Total [b]		
	n	25th Percentile	Median	75th Percentile	Flag	n	25th Percentile	Median	75th Percentile	Flag	25th Percentile	Median	75th Percentile
Total PCBs (g/year)													
Commercial/Industrial	6	9.91	14.7	58.3		12	115	295	1300		125	310	1360
Residential	8	17.3	178	360	E	12	91.0	166	634		108	344	994
Agriculture	8	21.1	71.9	121		4	58.7	154	298		79.8	226	419
Forest/Field/Other	8	1260	2420	6940		12	928	1970	6140		2190	4390	13100
All Land Uses [a]		1310	2680	7480			1190	2590	8370		2500	5270	15900
Total PBDEs (g/year)													
Commercial/Industrial	6	13.0	18.8	21.8		16	197	478	2870		210	497	2890
Residential	8	70.0	124	217	E	16	26.9	139	161		96.9	263	378
Agriculture	9	10.3	37.5	39.1	E	16	18.0	69.6	108		28.3	107	147
Forest/Field/Other	8	2500	2500	2550	E	16	2340	2340	3760	E	4840	4840	6310
All Land Uses [a]		2590	2680	2830			2580	3030	6900		5180	5710	9730
Total PAHs (kg/year)													
Commercial/Industrial	6	0.408	0.430	0.685	E	24	16.3	25.6	34.6		16.7	26.0	35.3
Residential	8	0.00 - 19.9	0.00 - 19.9	0.00 - 19.9	U	24	6.67	12.5	13.3	E	6.67 - 26.6	12.5 - 32.4	13.3 - 33.2
Agriculture	8	0.00 - 6.00	0.00 - 6.00	0.00 - 6.00	U	24	2.75	4.87	5.57	E	2.75 - 8.75	4.87 - 10.9	5.57 - 11.6
Forest/Field/Other	8	0.00 - 400	0.00 - 400	0.00 - 400	U	24	93.1	180	187	E	93.1 - 493	180 - 580	187 - 587
All Land Uses [a]		0.408 - 426	0.430 - 426	0.685 - 427			119	223	240		119 - 545	223 - 649	241 - 667
cPAHs (kg/year)													
Commercial/Industrial	6	0.00 - 0.422	0.00 - 0.422	0.00 - 0.422	U	24	8.75	12.3	16.1		8.75 - 9.17	12.3 - 12.7	16.1 - 16.5
Residential	8	0.00 - 10.9	0.00 - 10.9	0.00 - 10.9	U	24	6.30	9.60	12.8	E	6.30 - 17.2	9.60 - 20.5	12.8 - 23.7
Agriculture	8	0.00 - 3.01	0.00 - 3.01	0.00 - 3.01	U	24	2.73	2.76	5.29	E	2.73 - 5.74	2.76 - 5.77	5.29 - 8.30
Forest/Field/Other	8	0.00 - 198	0.00 - 198	0.00 - 198	U	24	0.00 - 373	0.00 - 373	0.00 - 373	U	0.00 - 571	0.00 - 571	0.00 - 571
All Land Uses [a]		0.00 - 212	0.00 - 212	0.00 - 212			17.8 - 391	24.7 - 398	34.2 - 407		17.8 - 603	24.7 - 610	34.2 - 620
LPAHs (kg/year)													
Commercial/Industrial	6	0.211	0.211	0.427	E	24	1.21	1.97	3.57		1.42	2.18	4.00
Residential	8	0.00 - 10.9	0.00 - 10.9	0.00 - 10.9	U	24	6.22	6.34	12.4	E	6.22 - 17.1	6.34 - 17.2	12.4 - 23.3
Agriculture	8	0.00 - 3.01	0.00 - 3.01	0.00 - 3.01	U	24	2.73	2.76	4.18	E	2.73 - 5.74	2.76 - 5.77	4.18 - 7.19
Forest/Field/Other	8	0.00 - 198	0.00 - 198	0.00 - 198	U	24	91.9	93.1	166	E	91.9 - 290	93.1 - 291	166 - 364
All Land Uses [a]		0.211 - 212	0.211 - 212	0.427 - 212			102	104	186		102 - 314	104 - 316	187 - 398
HPAHs (kg/year)													
Commercial/Industrial	6	0.258	0.419	0.430	E	24	15.6	22.1	31.7		15.9	22.5	32.1
Residential	8	0.00 - 19.9	0.00 - 19.9	0.00 - 19.9	U	24	6.22	10.5	12.8	E	6.22 - 26.1	10.5 - 30.4	12.8 - 32.7
Agriculture	8	0.00 - 6.00	0.00 - 6.00	0.00 - 6.00	U	24	2.73	2.76	5.29	E	2.73 - 8.73	2.76 - 8.76	5.29 - 11.3
Forest/Field/Other	8	0.00 - 400	0.00 - 400	0.00 - 400	U	24	0.00 - 373	0.00 - 373	0.00 - 373	U	0.00 - 773	0.00 - 773	0.00 - 773
All Land Uses [a]	30	0.258 - 426	0.419 - 426	0.430 - 426			24.6 - 398	35.4 - 408	49.8 - 423		24.9 - 824	35.8 - 835	50.2 - 849
BEHP (kg/year)													
Commercial/Industrial	6	0.00 - 6.90	0.00 - 6.90	0.00 - 6.90	U	24	21.6	49.7	113		21.6 - 28.5	49.7 - 56.6	113 - 120
Residential	8	79.5	84.4	84.4	E	24	102	102	115	E	182	186	199
Agriculture	8	0.00 - 51.0	0.00 - 51.0	0.00 - 51.0	U	24	44.6	44.6	49.0	E	44.6 - 95.6	44.6 - 95.6	49.0 - 100
Forest/Field/Other	8	0.00 - 3410	0.00 - 3410	0.00 - 3410	U	24	1500	1500	1540	E	1500 - 4910	1500 - 4910	1540 - 4950
All Land Uses [a]		79.5 - 3550	84.4 - 3550	84.4 - 3550			1670	1700	1820		1750 - 5220	1780 - 5250	1900 - 5370
Triclopyr (kg/year)													
Commercial/Industrial	6	1.12	1.31	1.31	E	24	4.51	4.70	6.12	E	5.63	6.01	7.43
Residential	8	0.00 - 64.7	0.00 - 64.7	0.00 - 64.7	U	24	38.6	39.6	49.0		38.6 - 103	39.6 - 104	49.0 - 114
Agriculture	8	9.15	9.22	10.5	E	24	16.9	17.2	18.6	E	26.1	26.4	29.1
Forest/Field/Other	8	0.00 - 1240	0.00 - 1240	0.00 - 1240	U	24	572	581	599	E	572 - 1810	581 - 1820	599 - 1840
All Land Uses [a]		10.3 - 1310	10.5 - 1320	11.8 - 1320			632	643	673		642 - 1940	653 - 1960	685 - 1990
Nonyphenol (kg/year)													
Commercial/Industrial	6	0.00 - 14.2	0.00 - 14.2	0.00 - 14.2	U	24	22.6	23.3	23.6	E	22.6 - 36.8	23.3 - 37.5	23.6 - 37.8
Residential	8	0.00 - 327	0.00 - 327	0.00 - 327	U	24	0.00 - 420	0.00 - 420	0.00 - 420	U	0.00 - 747	0.00 - 747	0.00 - 747
Agriculture	8	0.00 - 99.0	0.00 - 99.0	0.00 - 99.0	U	24	0.00 - 183	0.00 - 183	0.00 - 183	U	0.00 - 282	0.00 - 282	0.00 - 282
Forest/Field/Other	8	0.00 - 6790	0.00 - 6790	0.00 - 6790	U	24	0.00 - 6940	0.00 - 6940	0.00 - 6940	U	0.00 - 13700	0.00 - 13700	0.00 - 13700
All Land Uses [a]		0.00 - 7230	0.00 - 7230	0.00 - 7230			22.6 - 7570	23.3 - 7570	23.6 - 7570		22.6 - 14800	23.3 - 14800	23.6 - 14800
Total DDTs (kg/year)													
Commercial/Industrial	6	0.00430	0.00430	0.0701	E	24	0.112	0.182	0.312	E	0.116	0.186	0.382
Residential	8	0.00 - 0.208	0.00 - 0.208	0.00 - 0.208	U	24	0.00 - 3.32	0.00 - 3.32	0.00 - 3.32	U	0.00 - 3.53	0.00 - 3.53	0.00 - 3.53
Agriculture	8	0.00 - 0.0661	0.00 - 0.0661	0.00 - 0.0661	U	24	0.0668	0.696	0.696	E	0.0668 - 0.133	0.696 - 0.762	0.696 - 0.762
Forest/Field/Other	8	0.00 - 4.00	0.00 - 4.00	0.00 - 4.00	U	24	2.02	23.4	24.4	E	2.02 - 6.02	23.4 - 27.4	24.4 - 28.4
All Land Uses [a]		0.00430 - 4.28	0.00430 - 4.28	0.0701 - 4.34			2.20 - 5.52	24.3 - 27.6	25.4 - 28.7		2.20 - 9.80	24.3 - 31.9	25.5 - 33.1
Oil and Grease (MT/year)													
Commercial/Industrial	6	8.62	8.62	8.62	E	24	29.3	29.3	58.3	E	37.9	37.9	66.9
Residential	8	199	199	297	E	24	256	256	256	E	455	455	553
Agriculture	8	60.0	60.0	60.0	E	24	111	111	111	E	171	171	171
Forest/Field/Other	8	4000	4000	5990	E	24	3730	3730	3730	E	7730	7730	9720
All Land Uses [a]		4270	4270	6360			4130	4130	4160		8390	8390	10500
TPH-DOG (MT/year)													
Commercial/Industrial	6	0.00 - 1.55	0.00 - 1.55	0.00 - 1.55	U	24	3.79	10.9	17.5		3.79 - 5.34	10.9 - 12.5	17.5 - 19.1
Residential	8	0.00 - 41.6	0.00 - 41.6	0.00 - 41.6	U	24	19.8	20.4	21.1	E	19.8 - 61.4	20.4 - 62.0	21.1 - 62.7
Agriculture	8	4.81	4.81	6.15	E	24	8.64	8.91	9.02	E	13.5	13.7	15.2
Forest/Field/Other	8	0.00 - 700	0.00 - 700	0.00 - 700	U	24	285	299	308	E	285 - 985	299 - 999	308 - 1010
All Land Uses [a]		4.81 - 748	4.81 - 748	6.15 - 749			317	339	356		322 - 1070	344 - 1090	362 - 1110

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Table 15 (continued). Toxic chemical loading rates for Puget Sound based on the Phase 3 study of toxics in surface runoff to Puget Sound.

	Baseflow					Storm Event					Total [b]		
	n	25th Percentile	Median	75th Percentile	Flag	n	25th Percentile	Median	75th Percentile	Flag	25th Percentile	Median	75th Percentile
Total Suspended Solids (MT/year)													
Commercial/Industrial	6	21.5	21.5	86.2	E	24	1020	1460	2060		1040	1480	2150
Residential	8	1990	2970	4450		24	8320	17900	32000		10300	20900	36500
Agriculture	8	600	900	1200		24	1660	3070	8500		2260	3970	9700
Forest/Field/Other	8	40000	40000	59900		24	46800	131000	247000		86800	171000	307000
All Land Uses [a]		42600	43900	65600			57800	153000	290000		100000	197000	355000
Total Phosphorus (MT/year)													
Commercial/Industrial	6	1.20	2.51	3.28		24	4.97	6.39	8.65		6.17	8.90	11.9
Residential	8	27.4	32.3	85.3		24	54.8	86.1	146		82.2	118	231
Agriculture	8	24.6	39.4	59.8		24	70.2	115	150		94.8	154	210
Forest/Field/Other	8	190	299	507		24	227	454	676		417	753	1180
All Land Uses [a]		243	373	655			357	661	981		600	1030	1630
Nitrate+Nitrite Nitrogen (MT/year)													
Commercial/Industrial	6	1.85	9.91	38.7		24	16.2	25.4	40.0		18.1	35.3	78.7
Residential	8	832	1020	2770		24	947	1270	2190		1780	2290	4960
Agriculture	8	33.9	64.8	111		24	182	571	1430		216	636	1540
Forest/Field/Other	8	999	1780	6340		24	2250	4270	5720		3250	6050	12100
All Land Uses [a]		1870	2870	9260			3400	6140	9380		5260	9010	18700

[a] Values calculated by summing loading rates for all four land use types.

[b] Values calculated by summing baseflow and storm-event loading rates.

Flag:
E = 50 percent or more of the data are non-detect values; reported values are considered estimates with relatively low accuracy.
U = All of the data are non-detect values. The low value in range was calculated by assuming a zero for nondetect values; the high value in range was calculated assuming the maximum method reporting limit for non-detect values.

kg/yr = kilograms per year

g/yr = grams per year

MT/yr = metric tons per year

BEHP = Bis(2-ethylhexyl) phthalate

cPAHs = carcinogenic polycyclic aromatic hydrocarbons

DDT = dichlorodiphenyltrichloroethane

HPAHs = high molecular weight polycyclic aromatic hydrocarbons

LPAHs = low molecular weight polycyclic aromatic hydrocarbons

PAHs = polycyclic aromatic hydrocarbons

PBDE = polybrominated diphenyl ethers

PCBs = polychlorinated biphenyls

TPH-DOG = total petroleum hydrocarbons, extract of oil and grease (lube oil)

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Table 16. Comparison of Phase 2 addendum and Phase 3 Puget Sound loading rates.

Parameter	Units	Phase 2			Phase 3				% Difference [a]
		25th	Median	75th	25th	Median	75th	Flag	
Metals									
Total Copper	kg/year	31,100	66,800	144,000	27,600	35,700	65,700		-47%
Total Zinc	kg/year	102,000	211,000	439,000	113,000	122,000	134,000		-42%
Organics									
Total PCBs	g/year	27,100	118,000	525,000	2,500	5,270	15,900		-96%
Total PBDEs	g/year	146	516	1,860	5,180	5,710	9,730		1007%
Oil and Grease	MT/year	5,960	15,200	41,700	8,390	8,390	10,500	E	-45%

[a] Percent difference in loading rates was calculated by subtracting the Phase 2 median loading rate from the Phase 3 median loading rate and dividing by the Phase 2 median loading rate.

25th = 25th percentile

75th = 75th percentile

Diff. = difference

E = 50 percent or more of the data are non-detect values; reported values are considered estimates with relatively low accuracy.

kg/yr = kilograms per year

g/yr = grams per year

MT/yr = metric tons per year

PBDE = polybrominated diphenyl ethers

PCBs = polychlorinated biphenyls

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Table 17. Comparison of Phase 2 addendum and Phase 3 total loading rates by land use for Puget Sound.

		Commercial/Industrial							Residential							Agricultural							Forest/Field/Other						
		Phase 2			Phase 3			Diff. (%)[a]	Phase 2			Phase 3			Diff. (%)[a]	Phase 2			Phase 3			Diff. (%)[a]	Phase 2			Phase 3			Diff. (%)[a]
Parameter	**Units**	**25th**	**Median**	**75th**	**25th**	**Median**	**75th**		**25th**	**Median**	**75th**	**25th**	**Median**	**75th**		**25th**	**Median**	**75th**	**25th**	**Median**	**75th**		**25th**	**Median**	**75th**	**25th**	**Median**	**75th**	
Total Copper	kg/yr	2,060	3,780	6,930	541	642	805	-83%	5,960	11,700	23,000	2,510	3,700	5,450	-68%	1,800	4,050	9,100	2,360	3,390	6,780	-16%	20,700	46,400	104,000	22,200	28,000	52,700	-40%
Total Zinc	kg/yr	9,880	18,100	33,300	5,460	6,110	8,160	-66%	44,700	87,800	172,000	5,680	11,800	15,700	-87%	3,610	8,100	18,200	4,530	7,640	1,3300	-6%	41,300	92,800	209,000	96,900	96,900	96,900	4%
Total PCBs	g/yr	1,180	4,530	17,500	125	310	1,360	-93%	15,200	58,500	226,000	108	344	994	-99%	2,100	8,100	31,200	79.8	2,26	419	-97%	8,600	46,400	251,000	2,190	4,390	13,100	-91%
Total PBDEs	g/yr	0.784	3.02	11.6	210	497	2,890	16,357%	42.6	117	322	96.9	263	378	125%	6.31	24.3	93.7	28.3	107	147	340%	96.3	371	1,430	4,840	4,840	6,310	1,205%
Oil and Grease	MT/yr	494	907	1,660	37.9	37.9	66.9	-96%	3,910	8,780	19,700	455	455	553	-95%	295	810	2,230	171	171	171	-79%	1,200	4,640	17,900	7,730	7,730	9,720	67%

[a] Percent difference in loading rates was calculated by subtracting the Phase 2 median loading rate from the Phase 3 median loading rate and dividing by the Phase 2 median loading rate.

25th = 25th percentile

75th = 75th percentile

Diff. = difference

kg/yr = kilograms per year

g/yr = grams per year

MT/yr = metric tons per year

PBDE = polybrominated diphenyl ethers

PCBs = polychlorinated biphenyls

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Table 18. Grab sample timing relative to hydrograph position.

Monitoring Location ID	Number of Storm Events with Single Grab Sample	Number of Storm Events with 2 Grab Samples	Average Percent of Storm Volume Passed Before Sample(s) Collected [a]	Number of Grab Samples Occurring Before 10 Percent Of Storm Passed [a]	Number of Grab Samples Occurring After 90 Percent of Storm Passed
Snohomish Watershed					
CB335	6	0	20.2	3	0
CBX	5	1	19.8	2	0
RB111	2	4	22.6	2	0
RB202	4	2	24.3	2	0
AG174	3	3	22.4	3	0
AGG	2	4	21.7	1	0
FB200	4	2	19.5	1	0
FB203	1	5	22.7	2	0
Puyallup Watershed					
CBA	2	4	17.2	2	0
CBB	1	5	15.6	1	0
RB53	2	4	18.3	0	0
RB209	4	2	20.2	2	0
AG143	2	4	18.7	1	0
AG62	1	5	18	1	0
FB130	2	4	20.8	0	0
FB372	1	5	19.1	1	0

[a] For storms with 2 grab samples the average collection time between the two samples was used in this calculation.

Table 19. Analyzed parameters that were not detected in any of the 126 study samples.

Herbicides	4,6-Dinitro-2-Methylphenol	trans-Chlordane	PCB-094
2,4,5-T	4-Bromophenyl phenyl ether	Trans-Nonachlor	PCB-096
2,4,5-TP (Silvex)	4-Chloro-3-Methylphenol	**Petroleum and Oil**	PCB-100
2,4-DB	4-Chloroaniline	#2 Diesel	PCB-104
Acifluorfen (Blazer)	4-Chlorophenyl-Phenylether	Gasoline	PCB-112
Bentazon	4-Nitroaniline	**Phthalates**	PCB-113
Bromoxynil	Bis(2-Chloroethoxy)Methane	Di-N-Butylphthalate	PCB-115/116
Clopyralid	Bis(2-Chloroethyl)Ether	**Polybrominated Diphenyl Ethers (Congeners)**	PCB-122
Dichlorprop	Hexachlorobutadiene	PBDE-010	PCB-140
Diclofop-Methyl	Hexachlorocyclopentadiene	PBDE-077	PCB-145
Dinoseb	Hexachloroethane	PBDE-119	PCB-148
Ioxynil	Isophorone	PBDE-126	PCB-150
Picloram	m-Nitroaniline	PBDE-156/169	PCB-152
LPAHs	Nitrobenzene	PBDE-184	PCB-154
Acenaphthylene	N-Nitrosodimethylamine	PBDE-205	PCB-155
Metals	N-Nitrosodi-n-propylamine	**Polychlorinated Biphenyls (Congeners)**	PCB-159
Beryllium Dissolved	**Pesticides**	PCB-002	PCB-161
Beryllium Total	Aldrin	PCB-007/009	PCB-162
Selenium Dissolved	Alpha-BHC	PCB-012/013	PCB-166
Selenium Total	Beta-BHC	PCB-014	PCB-169
Thallium Dissolved	Chlordane, technical	PCB-023	PCB-173
Tin Dissolved	cis-Chlordane	PCB-029	PCB-175
Tin Total	Cis-Nonachlor	PCB-030	PCB-181
Other Base/Neutral/Acid Extractables	DDMU	PCB-034	PCB-186
1,2,4-Trichlorobenzene	Delta-BHC	PCB-039	PCB-188
1,2-Dichlorobenzene	Endosulfan I	PCB-050	PCB-191
1,2-Diphenylhydrazine	Endosulfan II	PCB-054	PCB-197
1,3-Dichlorobenzene	Endrin	PCB-055	PCB-198
1,4-Dichlorobenzene	Endrin Aldehyde	PCB-057	PCB-199
2,3,4,5-Tetrachlorophenol	Endrin Ketone	PCB-058	PCB-200
2,4,6-Trichlorophenol	Gamma-BHC (Lindane)	PCB-062	PCB-204
2,4-Dinitrotoluene	Heptachlor	PCB-063	PCB-205
2,6-Dinitrotoluene	Heptachlor Epoxide	PCB-065	PCB-207
2-Chloronaphthalene	Methoxychlor	PCB-067	PCB-208
2-Chlorophenol	Mirex	PCB-069	
2-Nitroaniline	Oxychlordane	PCB-072	
2-Nitrophenol	Total Chlordane	PCB-078	
3,3'-Dichlorobenzidine	Toxaphene	PCB-088/121	

Table 20. Storm-event to baseflow concentration ratios for the 21 priority parameters.

Parameter	Storm/Base Median Concentration Ratio			
	Commercial/Industrial	Residential	Agricultural	Forested
Arsenic Dissolved	*0.49*	*0.94*	*0.87*	*0.77*
Arsenic Total	*0.70*	1.33	*0.86*	1.01
Cadmium Dissolved	1.32	ND	storm > base	ND
Cadmium Total	storm > base	ND	ND	ND
Copper Dissolved	1.57	1.78	2.77	*0.99*
Copper Total	2.04	2.53	3.06	1.30
Lead Dissolved	1.42	2.96	2.14	2.77
Lead Total	6.24	3.35	3.39	2.70
Mercury Dissolved	1.94	2.91	2.46	2.00
Mercury Total	2.77	2.70	2.49	1.43
Zinc Dissolved	2.54	2.00	1.73	2.04
Zinc Total	2.34	2.94	1.03	1.00
Total PCBs	5.92	*0.73*	1.15	*0.87*
Total PBDEs	7.51	*0.87*	1.00	1.00
Total PAHs	17.56	storm > base	storm > base	storm > base
Total cPAHs	storm > base	storm > base	storm > base	
Total LPAHs	2.76	storm > base	storm > base	storm > base
Total HPAHs	15.55	storm > base	storm > base	
Bis(2-Ethylhexyl) Phthalate	storm > base	*0.94*	storm > base	storm > base
Triclopyr	1.06	storm > base	1.01	storm > base
Nonylphenol	storm > base	ND	ND	ND
Total DDT	12.50	ND	storm > base	storm > base
Oil and Grease	1.00	1.00	1.00	1.00
Lube Oil (TPH-DOG)	storm > base	storm > base	1.00	storm > base
Total Suspended Solids	20.00	4.67	1.83	3.50
Total Phosphorus	*0.75*	2.07	1.57	1.61
Nitrate+Nitrite Nitrogen	*0.75*	*0.97*	4.73	2.55

Red italics text indicates that baseflow concentrations were greater than storm event.

ND indicates that the parameter was not detected during baseflow or during storm events.

"storm>base" indicates that the ratio could not be computed because the parameter was not detected in baseflow, but was detected in storm events.

Blue bars indicate relative magnitude of the storm-to-base ratio when storm concentrations were greater than baseflow concentrations.

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Table 21. Comparison of unit-area loading rates (kg/km^2/yr) for select parameters from this study to literature and Green-Duwamish values.

Units: kg/km^2/yr	Total Suspended Solids	Nitrate+ Nitrite Nitrogen	Total Phosphorus	Dissolved Copper	Total Copper	Dissolved Mercury	Total Mercury	Dissolved Zinc	Total Zinc
Forest									
Green [a]	10,960	775	31	0.5	0.8	0.002	0.0031	0.69	1.37
Literature [b]	300	30	3	NA	3	NA	NA	NA	2
This Study	5,770	200	25	0.62	0.95	0.0019	0.0041	2.26	3.27
Agricultural									
Green	5,040	1300	97	1.4	1.7	0.0018	0.0029	1.64	2.88
Literature	34,300	60	58	NA	3	NA	NA	NA	10
This Study	2,600	412	101	1.78	2.22	0.0031	0.0048	3.22	5.01
Residential									
Green	15,787	593	33	0.77	1.83	0.0023	0.0088	2.06	6.84
Literature	1,000	10	4	NA	1	NA	NA	NA	4
This Study	5,060	560	29	0.5	0.9	0.002	0.0032	1.46	2.87
Commercial/Industrial									
Green	17,195	755	67	2.4	4.65	0.0045	0.0248	17.54	33.01
Literature	42,000	200	100	NA	3	NA	NA	NA	70
This Study	5,510	131	33	1.47	2.39	0.0019	0.0041	17.64	22.75

Colored bars indicate relative magnitude in each column.

[a] Green-Duwamish Watershed Water Quality Assessment (Herrera 2007)

[b] Burton and Pitt (2002); Horner et al. (1994); Madison et al. (1979)

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Table 22. Comparison of land use-based median concentrations from other regional studies.

		Embrey and Frans (2003) [b]			Herrera (2005) [c]			River Mouths		This Study					
		Springbrook	Thornton	Fishtrap	Springbrook	Big Soos Creek	Newaukum			4 sites Commercial/Industrial		4 sites Residential		4 sites Agricultural	
Analyte [a]	Units	Commercial/ Industrial	Residential	Agricultural	Commercial/ Industrial	Residential	Agricultural	Snohomish	Puyallup	Storm	Base	Storm	Base	Storm	Base
TSS	mg/L	17	8	21	16.9	3.8	7.7	13.6	38.7	10	0.5	14	3	5.5	3
TP	mg/L	0.17	0.05	0.06	0.1	0.03	0.08	0.03	0.08	0.044	0.058	0.067	0.033	0.206	0.131
Nitrate+Nitrite	mg/L	0.43	1.26	2.8	0.395	0.89	2.33	0.28	0.31	0.174	0.23	0.994	1.027	1.025	0.216
Chlorpyrifos	mg/L	–	0.015	–	ND	ND	ND	0.0001	0.000105	0.000125	0.000165	0.000125	ND	ND	ND
2,4-D	mg/L	–	–	NC	0.235	ND	0.085	–	–	0.0333	0.0305	0.0312	ND	0.031	0.0305
Dicamba	mg/L	–	–	NC	ND	ND	ND	–	–	0.031	0.0305	0.0307	0.0307	0.0305	0.0305
MCPA	mg/L	–	NC	–	ND	ND	ND	–	–	0.0315	0.0305	0.031	ND	0.031	ND
Triclopyr	mg/L	–	NC	–	–	–	–	–	–	0.0323	0.0305	0.031	ND	0.031	0.0307

[a] Parameter list chosen based on available data in Embrey and Frans (2003) and Herrera (2005).

[b] Springbrook Creek (Duwamish River) drains a 23.4 mi^2 basin that is majority commercial/industrial. Thornton Creek (Lake Washington) drains a 12.1 mi^2 basin that is majority residential. Fishtrap Creek (Nooksack River) drains 38.1 mi^2 of predominately agricultural land.

[c] Springbrook Creek (Duwamish River) drains a 23.4 mi^2 basin that is majority commercial/industrial. Big Soos (Green River) drains a 65.6 mi^2 basin that is majority residential. Newaukum Creek (Green River) drains 27.5 mi^2 of predominately agricultural land.

MCPA = 2-methyl-4-chlorophenoxyacetic acid

ND = analyte not detected in any samples

NC = not enough data to calculate median

TSS = total suspended solids

TP = total phosphorus

mg/L = milligrams per liter

– = no data available

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Appendices

Appendices A through S are available only on the web and on CD.

On the web, they are linked to this report at www.ecy.wa.gov/biblio/1103010.html.

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PHASE I MUNICIPAL STORMWATER PERMIT

National Pollutant Discharge Elimination System and
State Waste Discharge General Permit
for Discharges from
Large and Medium Municipal Separate Storm Sewer Systems

State of Washington
Department of Ecology
Olympia, WA 98504-7600

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1251 et seq.

Until this Permit expires, is modified, or revoked, Permittees that have properly obtained coverage under this Permit are authorized to discharge to waters of the State in accordance with the special and general conditions which follow.

Water Quality Program Manager
Department of Ecology

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SPECIAL CONDITIONS

S1. Permit Coverage and Permittees

A. Geographic Area of Permit Coverage

This Permit covers discharges from large and medium Municipal Separate Storm Sewer Systems (MS4s), as established at Title 40 CFR 122.26, except for the Washington State Department of Transportation's MS4s.

For Secondary Permittees required to obtain coverage under this Permit, the minimum geographic area of coverage includes the portion of the MS4 which is located within the unincorporated areas of Clark, King, Snohomish, and Pierce Counties and the incorporated areas of the cities of Seattle and Tacoma. The Washington State Department of Ecology (Ecology) may establish additional geographic areas of coverage specific to an individual Secondary Permittee.

B. The following cities and counties have submitted a Duty to Reapply-Notice of Intent (NOI) for coverage to Ecology prior to February 1, 2018, and have coverage as Permittees beginning on the effective date of the Permit:

1. The City of Tacoma and the City of Seattle

2. Clark, King, Pierce, and Snohomish Counties

C. The following entities have submitted a Duty to Reapply-Notice of Intent (NOI) for coverage to Ecology prior to February 1, 2018, and have coverage as Secondary Permittees, beginning on the effective date of the Permit:

1. Port of Seattle, excluding Seattle-Tacoma International Airport

2. Port of Tacoma

3. The University of Washington, Seattle; Seattle School District #1; Metropolitan Park District of Tacoma; Washington State Military Department; Tacoma Community College; Washington State Department of Corrections: Larch Corrections Center, and Washington Corrections Center for Women.

D. Unless otherwise noted, the term "Permittee" includes city, county, or town Permittee, port Permittee, Co-Permittee, Secondary Permittee, and New Secondary Permittee.

E. Coverage for New Secondary Permittees

1. Entities meeting the requirements in S1.E.1.a-b, below, are required to apply for and obtain coverage under this Permit. Upon application and coverage, the following entities will have coverage under this Permit as New Secondary Permittees:

a. Active drainage, diking, flood control, or diking and drainage districts located in the Cities or unincorporated portions of the Counties listed in S1.B above, which own or operate MS4s serving non-agricultural land uses; and were not covered by the Permit prior to August 1, 2019.

b. Other owners or operators of MS4s located in the Cities or unincorporated portions of the Counties listed in S1.B above; and were not covered by the Permit prior to August 1, 2019.

2. Application Requirements

a. Submit a Notice of Intent (NOI) for Coverage under National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater General Permit provided on Ecology's website and provide public notice of the application for coverage in accordance with WAC 173-226-130. The NOI shall constitute the application for coverage. Ecology will notify applicants in writing of their status concerning coverage under this Permit within 90 days of Ecology's receipt of a complete NOI.

b. Each Permittee applying as Co-Permittee shall submit a NOI provided on Ecology's website. The NOI shall clearly identify the areas of the MS4 for which the Co-Permittee is responsible.

F. All MS4s owned or operated by Permittees named in S1.B and located in another city or county area requiring coverage under this Permit or either the *Western Washington Phase II Municipal Stormwater Permit* or the *Eastern Washington Phase II Municipal Stormwater Permit* are also covered under this Permit.

S2. AUTHORIZED DISCHARGES

A. This Permit authorizes the discharge of stormwater to surface waters and to groundwaters of the State from MS4s owned or operated by each Permittee covered under this Permit in the geographic area covered by this Permit pursuant to S1.A subject to the following limitations:

1. Discharges to groundwaters of the State through facilities regulated under the Underground Injection Control (UIC) program, Chapter 173-218 WAC, are not authorized under this Permit.

2. Discharges to groundwaters not subject to regulation under the federal Clean Water Act are authorized in this Permit only under state authorities, Chapter 90.48 RCW, the Water Pollution Control Act.

B. This Permit authorizes discharges of non-stormwater flows to surface waters and groundwaters of the State from MS4s owned or operated by each Permittee covered under this Permit, in the geographic area covered pursuant to S1.A, only under one or more of the following conditions:

1. The discharge is authorized by a separate National Pollutant Discharge Elimination System (NPDES) or State Waste Discharge Permit.

2. The discharge is from emergency firefighting activities.

3. The discharge is from another illicit or non-stormwater discharge that is managed by the Permittee as provided in Special Condition S5.C.9., S6.D.3, or S6.E.3.

These discharges are also subject to the limitations in S2.A.1 and S2.A.2, above.

C. This Permit does not relieve entities that cause illicit discharges, including spills of oil or hazardous substances, from responsibilities and liabilities under state and federal laws and regulations pertaining to those discharges.

D. Discharges from MS4s constructed after the effective date of this Permit shall receive all applicable state and local permits and use authorizations, including compliance with Chapter 43.21C RCW (the State Environmental Policy Act).

E. This Permit does not authorize discharges of stormwater to waters within Indian Country as defined in 18 U.S.C. §1151 or to waters subject to water quality standards of Indian Tribes, including portions of the Puyallup River and other waters on trust or restricted lands within the 1873 Survey Area of the Puyallup Tribe of Indians Reservation, except where authority has been specifically delegated to Ecology by the U.S. Environmental Protection Agency. The exclusion of such discharges from this Permit does not waive any rights the State may have with respect to the regulation of the discharges.

S3. RESPONSIBILITIES OF PERMITTEES

A. Each Permittee, Co-Permittee and Secondary Permittee is responsible for compliance with the terms of this Permit for the MS4s that they own or operate.

1. Each Permittee, as listed in S1.B, is required to comply with all conditions of this Permit, except for S6 – *Stormwater Management Program for Secondary Permittees*.
2. The Port of Tacoma and Port of Seattle are required to comply with all conditions of this Permit except for S5 – *Stormwater Management Program* and S6.D – *Stormwater Management Program for Secondary Permittees*.
3. All Secondary Permittees, except for the Port of Tacoma and the Port of Seattle, are required to comply with all conditions of this Permit except for conditions S5 – *Stormwater Management Program*, S6.E – *Stormwater Management Program for the Port of Seattle and Port of Tacoma*, and S8 – *Monitoring and Assessment*.

B. Permittees may rely on another entity to satisfy one or more of the requirements of this Permit. Permittees that are relying on another entity to satisfy one or more or their permit obligations remain responsible for permit compliance if the other entity fails to implement the permit conditions. Where permit responsibilities are shared they shall be documented as follows:

1. Permittees and Co-Permittees that are continuing coverage under this Permit shall submit a statement that describes the permit requirements that will be implemented by other entities. The statement shall be signed by all participating entities. There is no deadline for submitting such a statement, provided that this does not alter implementation deadlines. Permittees and Co-Permittees may amend their statement during the term of the Permit to establish, terminate, or amend their shared responsibilities statement, and submit the amended statements to Ecology.
2. Secondary Permittees shall submit an NOI that describes which requirements they will implement and identify the entities that will implement the other permit requirements in the area served by the Secondary Permittee's MS4. A statement confirming the shared responsibilities, signed by all participating entities, shall accompany the NOI.

Secondary Permittees may amend their NOI, during the term of the Permit, to establish, terminate, or amend shared responsibility arrangements, provided this does not alter implementation deadlines.

C. Unless otherwise noted, all appendices to this Permit are incorporated by this reference as if set forth fully within this Permit.

S4. COMPLIANCE WITH STANDARDS

A. In accordance with RCW 90.48.520, the discharge of toxicants to waters of the State of Washington which would violate any water quality standard, including toxicant standards, sediment criteria, and dilution zone criteria is prohibited. The required response to such discharges is defined in Section S4.F, below.

B. This Permit does not authorize a discharge which would be a violation of Washington State Surface Water Quality Standards (Chapter 173-201A WAC), Groundwater Quality Standards (Chapter 173-200 WAC), Sediment Management Standards (Chapter 173-204 WAC), or human health-based criteria in the National Toxics Rule (40 CFR 131.45). The required response to such discharges is defined in Section S4.F, below.

C. The Permittee shall reduce the discharge of pollutants to the Maximum Extent Practicable (MEP).

D. The Permittee shall use All Known, Available, and Reasonable methods of prevention, control and Treatment (AKART) to prevent and control pollution of waters of the State of Washington.

E. In order to meet the goals of the Clean Water Act (CWA), and comply with S4.A, S4.B, S4.C, and S4.D, each Permittee shall comply with all of the applicable requirements of this Permit as defined in S3 – *Responsibilities of Permittees*.

F. A Permittee remains in compliance with S4 despite any discharges prohibited by S4.A or S4.B, when the Permittee undertakes the following response toward long-term water quality improvement:

1. A Permittee shall notify Ecology in writing within 30 days of becoming aware, based on credible site-specific information that a discharge from the MS4 owned or operated by the Permittee is causing or contributing to a known or likely violation of water quality standards in the receiving water. Written notification provided under this subsection shall, at a minimum, identify the source of the site-specific information, describe the nature and extent of the known or likely violation in the receiving water, and explain the reasons why the MS4 discharge is believed to be causing or contributing to the problem. For ongoing or continuing violations, a single written notification to Ecology will fulfill this requirement.

2. In the event that Ecology determines, based on a notification provided under S4.F.1 or through any other means, that a discharge from a MS4 owned or operated by the Permittee is causing or contributing to a violation of water quality standards in a receiving water, Ecology will notify the Permittee in writing that an adaptive management response outlined in S4.F.3, below, is required unless:

a. Ecology also determines that the violation of water quality standards is already being addressed by a Total Maximum Daily Load (TMDL) or other enforceable water quality cleanup plan; or

b. Ecology concludes the MS4 contribution to the violation will be eliminated through implementation of other permit requirements.

3. Adaptive Management Response

a. Within 60 days of receiving a notification under S4.F.2, or by an alternative date established by Ecology, the Permittee shall review its Stormwater Management Program (SWMP) and submit a report to Ecology. The report shall include:

i. A description of the operational and/or structural Best Management Practices (BMPs) that are currently being implemented to prevent or reduce any pollutants that are causing or contributing to the violation of water quality standards, including a qualitative assessment of the effectiveness of each BMP.

ii. A description of potential additional operational and/or structural BMPs that will or may be implemented in order to apply AKART on a site-specific basis to prevent or reduce any pollutants that are causing or contributing to the violation of water quality standards.

iii. A description of the potential monitoring or other assessment and evaluation efforts that will or may be implemented to monitor, assess, or evaluate the effectiveness of the additional BMPs.

iv. A schedule for implementing the additional BMPs including, as appropriate: funding, training, purchasing, construction, monitoring, and other assessment and evaluation components of implementation.

b. Ecology will, in writing, acknowledge receipt of the report within a reasonable time and notify the Permittee when it expects to complete its review of the report. Ecology will either approve the additional BMPs and implementation schedule or require the Permittee to modify the report as needed to meet AKART on a site-specific basis. If modifications are required, Ecology will specify a reasonable time frame in which the Permittee shall submit and Ecology will review the revised report.

c. The Permittee shall implement the additional BMPs, pursuant to the schedule approved by Ecology, beginning immediately upon receipt of written notification of approval; or, as specified in Appendix 13.

d. The Permittee shall include with each subsequent Annual Report a summary of the status of implementation, and the results of any monitoring, assessment or evaluation efforts conducted during the reporting period. If, based on the information provided under this subsection, Ecology determines that modification of the BMPs or implementation schedule is necessary to meet AKART on a site-specific basis, the Permittee shall make such modifications as Ecology directs. In the event there are ongoing violations of water quality standards despite the implementation of the BMP approach of this Section, the Permittee may be subject to compliance schedules to eliminate the violation under WAC 173-201A-510(4) and

WAC 173-226-180 or other enforcement orders as Ecology deems appropriate during the term of this Permit.

e. A TMDL or other enforceable water quality cleanup plan that has been approved and is being implemented to address the MS4's contribution to the water quality standards violation supersedes and terminates the S4.F.3 implementation plan.

f. Provided the Permittee is implementing the approved adaptive management response under this Section, the Permittee remains in compliance with Condition S4, despite any on-going violations of water quality standards identified under S4.A or B, above.

g. The adaptive management process provided under Section S4.F, is not intended to create a shield for the Permittee from any liability it may face under 42 U.S.C. 9601 *et seq*. or RCW 70.105D.

G. Ecology may modify or revoke and reissue this General Permit in accordance with G14 – *General Permit Modification and Revocation,* if Ecology becomes aware of additional control measures, management practices or other actions beyond what is required in this Permit, that are necessary to:

1. Reduce the discharge of pollutants to the MEP;

2. Comply with the state AKART requirements; or

3. Control the discharge of toxicants to waters of the State of Washington.

S5. STORMWATER MANAGEMENT PROGRAM

A. Each Permittee listed in S1.B shall implement a Stormwater Management Program (SWMP) during the term of this Permit. A SWMP is a set of actions and activities comprising the components listed in S5, and additional actions necessary, to meet the requirements of applicable TMDLs pursuant to S7 – *Compliance with TMDL Requirements* and S8 – *Monitoring and Assessment*.

1. Each Permittee shall prepare written documentation of their SWMP, called the SWMP Plan. The SWMP Plan shall be organized according to the program components in S5.C, or a format approved by Ecology, and shall be updated at least annually for submittal with the Permittee's Annual Report to Ecology (S9 – *Reporting Requirements*). The SWMP Plan shall be written to inform the public of the planned SWMP activities for the upcoming calendar year, and include a description of:

a. Planned activities for each of the program components included in S5.C.

b. Any additional planned actions to meet the requirements of applicable TMDLs pursuant to S7 – *Compliance with TMDL Requirements*.

c. Any additional planned actions to meet the requirements of S8 – *Monitoring and Assessment*.

2. Each Permittee shall track the cost or estimated cost of development and implementation of each component of the SWMP. This information shall be provided to Ecology upon request.

3. Each Permittee shall track the number of inspections, follow-up actions as a result of inspections, official enforcement actions and types of public education activities as required by the respective program component. This information shall be included in the Annual Report.

B. The SWMP shall be designed to reduce the discharge of pollutants from MS4s to the MEP, meet state AKART requirements, and protect water quality.

Permittees are to continue implementation of existing Stormwater Management Programs until they begin implementation of the updated Stormwater Management Program, in accordance with the terms of this Permit, including implementation schedules.

C. The SWMP shall include the components listed below. The requirements of the SWMP shall apply to MS4s, and areas served by MS4s owned or operated by the Permittee. To the extent allowable under state and federal law, all SWMP components are mandatory.

1. Legal Authority

Minimum performance measures:

a. Each Permittee shall be able to demonstrate that they can operate pursuant to legal authority which authorizes or enables the Permittee to control discharges to and from MS4s owned or operated by the Permittee.

b. This legal authority, which may be a combination of statute, ordinance, permit, contracts, orders, interagency agreements, or similar means, shall authorize or enable the Permittee, at a minimum, to:

   i. Control through ordinance, order, or similar means, the contribution of pollutants to MS4s owned or operated by the Permittee from stormwater discharges associated with industrial activity, and control the quality of stormwater discharged from sites of industrial activity;

   ii. Prohibit through ordinance, order, or similar means, illicit discharges to the MS4 owned or operated by the Permittee;

   iii. Control through ordinance, order, or similar means, the discharge of spills and disposal of materials other than stormwater into the MS4s owned or operated by the Permittee;

   iv. Control through interagency agreements among co-applicants, the contribution of pollutants from one portion of the MS4 to another portion of the MS4;

   v. Require compliance with conditions in ordinances, permits, contracts, or orders; and

   vi. Within the limitations of state law, carry out all inspection, surveillance, and monitoring procedures necessary to determine compliance and non-compliance with permit conditions, including the prohibition on illicit discharges to the MS4 and compliance with local ordinances.

2. MS4 Mapping and Documentation

The SWMP shall include an ongoing program for mapping and documenting the MS4. ***Minimum performance measures:***

a. *Ongoing Mapping*. Each Permittee shall maintain mapping data for the features listed below.

i. Known MS4 outfalls and known MS4 discharge points.

ii. Receiving waters, other than groundwater.

iii. Stormwater treatment and flow control BMPs/facilities owned or operated by the Permittee, including all connections between these BMPs/facilities and tributary conveyances (mapped in accordance with this Section) and all associated emergency overflows.

iv. Geographic areas served by the Permittee's MS4 that do not discharge stormwater to surface water.

v. Tributary conveyances to all known outfalls and discharge points with a 24-inch nominal diameter or larger, or an equivalent cross-sectional area for non-pipe systems. For counties, this requirement applies to urban/higher density rural sub-basins. For cities, this requirement applies throughout the city. The following features or attributes (or both) shall be mapped:

(a) Tributary conveyance type, material, and size where known

(b) Associated drainage areas

(c) Land uses

vi. Connections between the MS4 owned or operated by the Permittee and other municipalities or other public entities.

vii. All connections to the MS4 authorized or allowed by the Permittee after February 16, 2007. [1]

viii. Existing, known connections greater than or equal to 8 inches in nominal diameter to tributary conveyances mapped in accordance with S5.C.2.a.v. For Counties, this requirement applies to the area of the county within urban/higher density rural sub-basins mapped under the previous Permit. For cities, this requirement applies throughout the city.

b. *New Mapping*. Each Permittee shall:

i. No later than January 1, 2020, begin to collect size and material for all known MS4 outfalls during normal course of business (e.g. during field screening, inspection, or maintenance) and update records.

ii. No later than August 1, 2023, complete mapping of all known connections from the MS4 to a privately-owned stormwater system.

[1] Permittees do not need to map the following residential connections: individual driveways, sump pumps, or roof downspouts.

iii. No later than December 31, 2023, counties shall complete mapping tributary conveyances, as described in S5.C.2.a.v, for 50% of the areas outside the previously mapped urban/higher density rural sub-basins.

c. The required format for mapping is electronic with fully described mapping standards.

d. To the extent consistent with national security laws and directives, each Permittee shall make available to Ecology, upon request, available maps depicting the information required in S5.C.2.a and b, above.

e. Upon request, and to the extent appropriate, Permittees shall provide mapping information to federally recognized Indian Tribes, municipalities, and other Permittees. This Permit does not preclude Permittees from recovering reasonable costs associated with fulfilling mapping information requests by federally recognized Indian Tribes, municipalities, and other Permittees.

3. Coordination

The SWMP shall include coordination mechanisms among departments within each jurisdiction to eliminate barriers to compliance with the terms of this Permit.

The SWMP shall also include coordination mechanisms among entities covered under a municipal stormwater NPDES permit to encourage coordinated stormwater-related policies, programs, and projects within a watershed. Permittees shall document their efforts to establish the required coordination mechanisms.

Minimum performance measures:

a. Update, if needed, and implement an intra-governmental (internal) coordination agreement(s) or Executive Directive(s) to facilitate compliance with the terms of this Permit. Permittees shall include a written description of internal coordination mechanisms in the Annual Report, due no later than March 31, 2020.

b. The SWMP shall include, when needed, coordination mechanisms among entities covered under a municipal stormwater NPDES permit to encourage coordinated stormwater-related policies, programs and projects within adjoining or shared areas, including:

   i. Coordination mechanisms clarifying roles and responsibilities for the control of pollutants between physically interconnected MS4s covered by a municipal stormwater permit.

   ii. Coordinating stormwater management activities for shared water bodies, or watersheds among Permittees to avoid conflicting plans, policies, and regulations.

c. Implement; and within 2 years following the addition of a new Secondary Permittee, establish and implement:

   i. Coordination mechanisms clarifying roles and responsibilities for the control of pollutants between physically interconnected MS4s of the Permittee and any other Permittee covered by a municipal stormwater permit.

ii. Coordinating stormwater management activities for shared waterbodies, among Permittees and Secondary Permittees, as necessary to avoid conflicting plans, policies, and regulations.

4. Public Involvement and Participation

Permittees shall provide ongoing opportunities for public involvement and participation in the Permittee's SWMP and implementation priorities.

Minimum performance measures:

a. Permittees shall create opportunities for the public, including overburdened communities, to participate in the decision-making processes involving the development, implementation, and update of the Permittee's SWMP and SMAP (SMAP applies to counties).

b. Each Permittee shall post on their website their SWMP Plan, and the Annual Report required under S9.A no later than May 31 each year. All other submittals shall be available to the public upon request.

5. Controlling Runoff from New Development, Redevelopment, and Construction Sites

The SWMP shall include a program to prevent and control the impacts of runoff from new development, redevelopment, and construction activities. Refer to Appendix 10 for a list of approved manuals and ordinances. The program shall apply to private and public development, including transportation projects.

Minimum performance measures:

a. Each Permittee shall continue to implement existing programs approved under the *2013 Phase I Municipal Stormwater Permit* until the program required in S5.C.5.b.iv applies. The program required in S5.C.5.b.iv applies to applications[2] submitted prior to July 1, 2021, which have not started construction[3] by July 1, 2026, and:

i. For Clark County, applications submitted prior to January 8, 2016, which have not started construction by July 1, 2021.

ii. For Pierce County, applications submitted prior to December 5, 2015, which have not started construction by July 1, 2021.

iii. For King County, applications submitted prior to April 24, 2016, which have not started construction by July 1, 2021.

iv. For Snohomish County, applications submitted prior to January 22, 2016, which have not started construction by July 1, 2021.

v. For the City of Seattle, applications submitted prior to January 1, 2016, which have not started construction by July 1, 2021.

[2] In this context, "application" means, at a minimum a complete project description, site plan, and, if applicable, SEPA checklist. Permittees may establish additional elements of a completed application.

[3] In this context "started construction" means the site work associated with, and directly related to the approved project has begun. For example: grading the project site to final grade or utility installation. Simply clearing the project site does not constitute the start of construction. Permittees may establish additional requirements related to the start of construction.

vi. For the City of Tacoma, applications submitted prior to November 24, 2015, which have not started construction by July 1, 2021.

b. Site and subdivision scale requirements

i. The minimum requirements, thresholds, and definitions in Appendix 1, or minimum requirements, thresholds, and definitions determined by Ecology to be equivalent to Appendix 1, for new development, redevelopment, and construction sites shall be included in ordinances or other enforceable documents adopted by the local government. Adjustment and variance criteria equivalent to those in Appendix 1 shall be included. More stringent requirements may be used, and/or certain requirements may be tailored to local circumstances through the use of Ecology-approved basin plans or other similar water quality and quantity planning efforts. Such local requirements and thresholds shall provide equal or similar protection of receiving waters and equal or similar levels of pollutant control as compared to Appendix 1.

ii. The local requirements shall include the following requirements, limitations, and criteria that, when used to implement the minimum requirements in Appendix 1, will protect water quality, reduce the discharge of pollutants to the MEP, and satisfy the State requirement under Chapter 90.48 RCW to apply AKART prior to discharge:

(a) Site planning requirements

(b) BMP selection criteria

(c) BMP design criteria

(d) BMP infeasibility criteria

(e) LID competing needs criteria

(f) BMP limitations

Permittees shall document how the criteria and requirements will protect water quality, reduce the discharge of pollutants to the maximum extent practicable, and satisfy the state AKART requirements.

Permittees who choose to use the requirements, limitations, and criteria in the *Stormwater Management Manual for Western Washington* (SWMMWW), or an equivalent manual approved by Ecology, may cite this choice as their sole documentation to meet this requirement.

iii. Ecology review and approval of the local manuals and ordinances is required. The Permittee shall submit draft enforceable requirements, technical standards, and manuals that correspond to updates identified in Appendix 10, Part 2 to Ecology no later than July 1, 2020. Ecology will review and provide written response to the Permittee. If Ecology takes longer than 120 days to provide a written response, the required deadline for adoption and effective date will be automatically extended by the number of calendar days that Ecology exceeds a 120-day period for written response.

(a) The Permittee shall submit the required significant changes to the local programs as required in Appendix 10, Part 2, and in the format described in Table 3.

(b) Additional significant changes shall be submitted for equivalency review with the rationale, and any tests, or documentation to demonstrate that the proposal meets AKART and MEP. Incomplete submittals will not be reviewed. Permittees shall follow the submittal format in Appendix 10, Part 2, Table 4.

iv. No later than July 1, 2021, each Permittee shall adopt and make effective a local program that meets the requirements in S5.C.5.b.i through ii, above. Manuals and ordinances approved under this Section will be listed in Appendix 10, Part 3, following a permit modification.

(a) In the case of circumstances beyond the Permittee's control, such as litigation or administrative appeals that may result in noncompliance with the requirements of this Section, the Permittee shall promptly notify Ecology and submit a written request for an extension.

v. The program shall include the legal authority to inspect private stormwater facilities and enforce maintenance standards for all new development and redevelopment approved under the provisions of this Section.

vi. The program shall include a permitting process with site plan review, inspection, and enforcement capability to meet the following standards for both private and public projects, using qualified personnel:

(a) Review all stormwater site plans submitted to the Permittee for proposed development that meet the thresholds in S5.C.5.b.i, above.

(b) Inspect prior to clearing and construction, all permitted development sites that meet the thresholds in S5.C.5.b.i, and that have a high potential for sediment transport as determined through plan review based on definitions and requirements in Appendix 7. As an alternative to evaluating each site according to Appendix 7, Permittees may choose to inspect all construction sites that meet the minimum thresholds in S5.C.5.b.i.

(c) Inspect all permitted development sites that meet the thresholds in S5.C.5.b.i, above, during construction to verify proper installation and maintenance of required erosion and sediment controls. Enforce as necessary based on the inspection.

(d) Each Permittee shall manage maintenance activities to inspect all permanent stormwater treatment and flow control BMPs/facilities, and catch basins, in new residential developments every six months, until 90% of the lots are constructed (or when construction has stopped and the site is fully stabilized), to identify maintenance needs and enforce compliance with maintenance standards as needed.

(e) Inspect all permitted development sites that meet the thresholds in S5.C.5.b.i upon completion of construction and prior to final approval or occupancy to ensure proper installation of permanent stormwater facilities. Verify that a maintenance plan is completed and responsibility for maintenance is assigned for stormwater treatment and flow control BMPs/facilities. Enforce as necessary based on the inspection.

(f) Compliance with the inspection requirements in (b)-(e) above shall be determined by the presence of an established inspection program designed to inspect all sites that meet the thresholds in S5.C.5.b.i and ii. Compliance during this Permit term shall be determined by achieving at least 80% of required inspections. The inspections may be combined with other inspections provided they are performed using qualified personnel.

(g) The program shall include a procedure for keeping records of inspections and enforcement actions by staff, including inspection reports, warning letters, notices of violations, and other enforcement records. Records of maintenance inspections and maintenance activities shall be maintained.

(h) The program shall include an enforcement strategy to respond to issues of non-compliance.

vii. The program shall make available, as applicable, the link to the electronic *Construction Stormwater General Permit* Notice of Intent (NOI) form for construction activity and, as applicable, a link to the electronic *Industrial Stormwater General Permit* NOI form for industrial activity to representatives of proposed new development and redevelopment. Permittees shall continue to enforce local ordinances controlling runoff from sites that are also covered by stormwater permits issued by Ecology.

viii. Each Permittee shall ensure that all staff whose primary job duties are implementing the program to *Control Stormwater Runoff from New Development, Redevelopment, and Construction Sites*, including permitting, plan review, construction site inspections, and enforcement, are trained to conduct these activities. As determined necessary by the Permittee, follow-up training shall be provided to address changes in procedures, techniques or staffing. Permittees shall document and maintain records of the training provided and the staff trained.

6. Stormwater Planning

Each Permittee shall implement a Stormwater Planning program to inform and assist in the development of policies and strategies as water quality management tools to protect receiving waters.

Minimum performance measures:

a. By August 1, 2020, each Permittee shall convene an inter-disciplinary team to inform and assist in the development, progress, and influence of this program.

b. Coordination with long-range plan updates.

i. Each Permittee shall describe how stormwater management needs and protection/improvement of receiving water health are (or are not) informing the planning update processes and influencing policies and implementation strategies in their jurisdiction. The reporting shall describe the water quality and watershed protection policies, strategies, codes, and other measures intended to protect and improve local receiving water health through planning, or taking into account stormwater management needs or limitations.

(a) On or before March 31, 2021, the Permittee shall respond to the series of Stormwater Planning Annual Report questions that describe how anticipated stormwater impacts on water quality were addressed, if at all, during the 2013-2019 permit term in updates to the Comprehensive Plan (or equivalent) and in other locally initiated or state-mandated long-range land use plans that are used to accommodate growth or transportation.

(b) On or before March 31, 2022, the Permittee shall submit a report, responding to the same questions included in (a) above, describing how water quality is being addressed, if at all, during this permit term in updates to the Comprehensive Plan (or equivalent) and in other locally initiated or state-mandated, long-range land use plans that are used to accommodate growth or transportation.

c. Low impact development code-related requirements

i. Permittees shall continue to require LID Principles and LID BMPs when updating, revising, and developing new local development-related codes, rules, standards, or other enforceable documents, as needed.

The intent shall be to make LID the preferred and commonly-used approach to site development. The local development-related codes, rules, standards, or other enforceable documents shall be designed to minimize impervious surfaces, native vegetation loss, and stormwater runoff in all types of development situations, where feasible.

(a) Annually, each Permittee shall assess and document any newly identified administrative or regulatory barriers to implementation of LID Principles or LID BMPs since local codes were updated in accordance with the 2013 Permit, and the measures developed to address the barriers. If applicable, the report shall also describe mechanisms adopted to encourage or require implementation of LID Principles or LID BMPs.

d. Stormwater Management Action Planning

i. Each county Permittee shall describe in their SWMP how the watershed-scale stormwater plans developed during the 2013 Permit term are being used to inform their S5.C.7 project prioritization and selection.

ii. No later than December 31, 2022, each county Permittee shall develop a Stormwater Management Action Plan (SMAP) for a single sub-basin or catchment area located within the geographic areas for which watershed-scale stormwater plans were developed in the 2013 Permit. The required SMAP content is described in the *Stormwater Management Action Planning Guidance* (Ecology, 2019. Publication 19-10-010). The SMAP shall identify:

(a) Specific short-term actions (*i.e.*, actions or projects to be accomplished within six years).

(b) Specific long-term actions (*i.e.*, actions or projects to be accomplished within seven to 20 years).

(c) Land management/development strategies and/or actions needed for water quality management, if these were not articulated in the watershed-scale stormwater plans. Include these in (a) and (b).

(d) Targeted, enhanced, or customized implementation of stormwater management actions related to permit sections within S5, including:

- IDDE field screening,
- Prioritization of Source Control inspections,
- O&M inspections or enhanced maintenance, or
- Public Education and Outreach behavior change programs

Identified actions shall support other specifically identified stormwater management strategies and actions for the basin overall, or for the catchment area in particular.

(a) A revised and updated implementation schedule and budget sources.

(b) A county Permittee may choose to prepare a SMAP for a catchment area in an alternative watershed by conducting a similar process and considering the range of issues outlined in S5.C.6.d.iii-v and as described in the *Stormwater Management Action Planning Guidance* (Ecology, 2019. Publication 19-10-010).

iii. This Section applies only to a county Permittee that is selecting an alternative watershed pursuant to S5.C.6.d.ii.(f).

Receiving Water Assessment. The Permittee shall document and assess existing information related to their local receiving waters and contributing area conditions to identify which receiving waters are most likely to benefit from stormwater management planning.

By March 31, 2022, the Permittee shall submit a watershed inventory and include a brief description of the relative conditions of the receiving waters and the contributing areas. The watershed inventory shall be submitted as a table with each receiving water name, its total watershed area, the percent of the total watershed area that is in the Permittee's jurisdiction, and the findings of the stormwater influence assessment for each basin. Indicate which receiving waters will be included in the S5.C.6.d.iv prioritization process. Include a map of the delineated basins with references to the watershed inventory table.

(a) Identify which basins are expected to have a relatively low expected Stormwater Management Influence for SMAP. See the guidance document for definition and description of this assessment.

Basins having relatively low expected Stormwater Management Influence for SMAP do not need to be included in S5.C.6.d.iv-v.

iv. This Section applies only to a county Permittee that is selecting an alternative watershed pursuant to S5.C.6.d.ii.(f).

Receiving Water Prioritization. Informed by the assessment of receiving water conditions in (iii), above, and other local and regional information, the

Permittee shall develop and implement a prioritization method and process to determine which receiving waters will receive the most benefit from implementation of stormwater facility retrofits, tailored implementation of SWMP actions, and other land/development management actions (different than the existing new and redevelopment requirements). The retrofits and actions shall be designed to: 1) conserve, protect, or restore receiving waters through stormwater and land management strategies that act as water quality management tools, 2) reduce pollutant loading, and 3) address hydrologic impacts from existing development as well as planned and expected future buildout conditions.

No later than June 30, 2022, document the prioritized and ranked list of receiving waters.

(a) The Permittee shall document the priority ranking process used to identify high priority receiving waters. The Permittee may reference existing local watershed management plan(s) as source(s) of information or rationale for the prioritization.

(b) The ranking process shall include the identification of high priority catchment area(s) for focus of the Stormwater Management Action Plan (SMAP) in S5.C.6.d.v.

v. This Section applies only to a county Permittee that is selecting an alternative watershed pursuant to S5.C.6.d.ii.(f).

Stormwater Management Action Plan (SMAP). No later than December 31, 2022, the Permittee shall develop a SMAP for at least one high priority catchment area from S5.C.6.d.iv that identifies all of the following:

(a) A description of the stormwater facility retrofits needed for the area including the BMP types and preferred locations.

(b) Land management/development strategies and/or actions identified for water quality management.

(c) Targeted, enhanced, or customized implementation of stormwater management actions related to permit sections within S5, including:

- IDDE field screening,
- Prioritization of Source Control inspections,
- O&M inspections or enhanced maintenance, or
- Public Education and Outreach behavior change program.

Actions identified shall be used to support other specifically identified stormwater management strategies and actions for the basin overall, or for the catchment area in particular.

(d) Identification of needed changes to local long-range plans to address SMAP priorities, if applicable.

(e) A proposed implementation schedule and budget sources for:

- Short-term actions (*i.e.*, actions to be accomplished within six years), and
- Long-term actions (*i.e.*, actions to be accomplished within seven to 20 years).

(f) A process and schedule to provide future assessment and feedback to improve the planning process and implementation of procedures or projects.

vi. Permittees selecting an alternative watershed pursuant to S5.C.6.d.ii.(f) may rely on another jurisdiction to meet all or part of SMAP requirements at a watershed scale, provided a SMAP is completed for at least one priority catchment located within the Permittee's jurisdiction.

7. Structural Stormwater Controls

Each Permittee shall implement a Structural Stormwater Control Program to prevent or reduce impacts to waters of the State caused by discharges from the MS4. Impacts that shall be addressed include disturbances to watershed hydrology and stormwater pollutant discharges.

The program shall consider impacts caused by stormwater discharges from areas of existing development; including runoff from highways, streets and roads owned or operated by the Permittee; and areas of new development, where impacts are anticipated as development occurs.

Minimum performance measures:

a. The program shall address impacts that are not adequately controlled by the other required actions of the SWMP.

i. The program shall consider the following projects:

(a) New flow control facilities.

(b) New treatment (or treatment and flow control) facilities.

(c) New LID BMPs.

(d) Retrofit of existing treatment and/or flow control facilities.

(e) Property acquisition for water quality and/or flow control benefits (not associated with future facilities).

(f) Maintenance with capital construction costs ≥ $25,000.

ii. Permittees should consider other projects to address impacts, such as:

(a) Restoration of riparian buffers

(b) Restoration of forest cover.

(c) Floodplain reconnection projects on water bodies that are not flow control exempt per Appendix 1.

(d) Permanent removal of impervious surfaces.

(e) Other actions to address stormwater runoff into or from the MS4 not otherwise required in S5.C.

iii. Permittees may not use in-stream culvert replacement or channel restoration projects for compliance with this requirement.

iv. The Structural Stormwater Control Program may also include a program designed to implement small-scale projects that are not planned in advance.

b. Each Permittee's SWMP Plan shall describe the Structural Stormwater Control Program, including the following:

i. The Structural Stormwater Control Program goals.

ii. The planning process used to develop the Structural Stormwater Control Program, including:

(a) The geographic scale of the planning process.

(b) Issues and regulations addressed.

(c) Steps in the planning process.

(d) Types of characterization information considered.

(e) Amount budgeted for implementation.

(f) The public involvement process.

(g) A description of the prioritization process, procedures and criteria used to select the Structural Stormwater Control projects.

c. With each Annual Report, each Permittee shall provide a list of planned, individual projects scheduled for implementation during this Permit term for the purpose of meeting S5.C.7.d. This list shall include at a minimum the information and formatting specified in Appendix 12.

d. No later than December 31, 2022, each Permittee shall achieve 300 SSC Program Points, calculated per Appendix 12, as follows:

i. 225 design-stage retrofit incentive points, and

ii. 75 complete or maintenance stage incentive points.

A minimum of 75 incentive points is required for complete or maintenance stage projects, additional incentive points for complete or maintenance stage projects may substitute for design-stage incentive points.

8. Source Control Program for Existing Development

a. The Permittee shall implement a program to reduce pollutants in runoff from areas that discharge to the MS4. The program shall include:

i. Application of operational source control BMPs, and if necessary, structural source control BMPs or treatment BMPs/facilities, or both, to pollution generating sources associated with existing land uses and activities.

ii. Inspections of pollutant generating sources at publicly and privately owned institutional, commercial, and industrial sites to enforce implementation of required BMPs to control pollution discharging into the MS4.

iii. Application and enforcement of local ordinances at sites, identified pursuant to S5.C.8.b.ii, including sites with discharges authorized by a separate NPDES permit. Permittees that are in compliance with the terms of this Permit will not be held liable by Ecology for water quality standard violations or receiving water impacts caused by industries and other Permittees covered, or which should be covered under an NPDES permit issued by Ecology.

iv. Practices to reduce polluted runoff from the application of pesticides, herbicides, and fertilizers from the sites identified in the inventory.

b. ***Minimum performance measures***

i. Permittees shall enforce ordinance(s), or other enforceable documents, requiring the application of source control BMPs for pollutant generating sources associated with existing land uses and activities.

Permittees shall update and make effective the ordinance(s), or other enforceable documents, as necessary to meet the requirements of this Section no later than August 1, 2021.

The requirements of this subsection are met by using the source control BMPs in Volume IV of the *Stormwater Management Manual for Western Washington*, or a functionally equivalent manual approved by Ecology. In cases where the manual(s) lack guidance for a specific source of pollutants, the Permittee shall work with the owner/operator to implement or adapt BMPs based on the best professional judgement of the Permittee.

Applicable operational source control BMPs shall be required for all pollutant generating sources. Structural source control BMPs , or treatment BMPs/facilities, or both, shall be required for pollutant generating sources if operational source control BMPs do not prevent illicit discharges or violations of surface water, groundwater, or sediment management standards because of inadequate stormwater controls. Implementation of source control requirements may be done through education and technical assistance programs, provided that formal enforcement authority is available to the Permittee and is used as determined necessary by the Permittee, in accordance with S5.C.8.b.iv, below.

ii. Permittees shall implement a program to identify publicly and privately owned institutional, commercial, and industrial sites which have the potential to generate pollutants to the MS4. The Permittee shall update the inventory at least once every 5 years. The program shall include a source control inventory which lists:

(a) Businesses and/or sites identified based on the presence of activities that are pollutant generating (refer to Appendix 8).

(b) Other pollutant generating sources, based on complaint response, such as home-based businesses and multifamily sites.

iii. Permittees shall implement an inspection program for sites identified pursuant to S5.C.8.b.ii, above.

(a) All identified sites with a business address shall be provided, by mail, telephone, electronic communications, or in-person information about activities that may generate pollutants and the source control requirements applicable to those activities. This information may be provided all at one time or spread out over the permit term to allow for some tailoring and distribution of the information during site inspections.

(b) The Permittee shall annually complete the number of inspections equal to 20% of the businesses and/or sites listed in their source control inventory to assess BMP effectiveness and compliance with source control requirements. The Permittee may count follow up compliance inspections at the same site toward the 20% inspection rate. The Permittee may select which sites to inspect each year and is not required to inspect 100% of sites over a 5-year period. Sites may be prioritized for inspection based on their land use category, potential for pollution generation, proximity to receiving waters, or to address an identified pollution problem within a specific geographic area or sub-basin.

(c) Each Permittee shall inspect 100% of sites identified through credible complaints.

(d) Permittees may count inspections conducted based on complaints, or when the property owner denies entry, to the 20% inspection rate.

iv. Each Permittee shall implement a progressive enforcement policy to require sites to come into compliance with stormwater requirements within a reasonable time period as specified below:

(a) If the Permittee determines, through inspections or otherwise, that a site has failed to adequately implement required BMPs, the Permittee shall take appropriate follow-up action(s), which may include: phone calls, letters, emails, or follow-up inspections.

(b) When a Permittee determines that a site has failed to adequately implement BMPs after a follow-up inspection(s), the Permittee shall take enforcement action as established through authority in its municipal code or ordinances, or through the judicial system.

(c) Each Permittee shall maintain records, including documentation of each site visit, inspection reports, warning letters, notices of violations, and other enforcement records, demonstrating an effort to bring sites into compliance. Each Permittee shall also maintain records of sites that are not inspected because the property owner denies entry.

(d) A Permittee may refer non-emergency violations of local ordinances to Ecology, provided, the Permittee also makes a documented effort of progressive enforcement. At a minimum, a Permittee's enforcement effort shall include documentation of inspections and warning letters or notices of violation.

v. Permittees shall train staff who are responsible for implementing the Source Control Program to conduct these activities. The ongoing training program shall cover the legal authority for source control, source control BMPs and their proper application, inspection protocols, lessons learned, typical cases, and enforcement procedures. Follow-up training shall be provided as needed to address changes in procedures, techniques, requirements, or staff. Permittees shall document and maintain records of the training provided and the staff trained.

9. Illicit Connections and Illicit Discharges Detection and Elimination

The SWMP shall include an ongoing program designed to prevent, detect, characterize, trace, and eliminate illicit connections and illicit discharges into the MS4.

Minimum performance measures:

a. The program shall include procedures for reporting and correcting or removing illicit connections, spills, and other illicit discharges when they are suspected or identified. The program shall also include procedures for addressing pollutants entering the MS4 from an interconnected, adjoining MS4.

   Illicit connections and illicit discharges shall be identified through field screening, inspections, complaints/reports, construction inspections, maintenance inspections, source control inspections, and/or monitoring information, as appropriate.

b. Permittees shall continue to implement an ordinance or other regulatory mechanism to effectively prohibit non-stormwater, illicit discharges, including spills, into the Permittee's MS4.

   i. ***Allowable Discharges***: The ordinance or other regulatory mechanism does not need to prohibit the following categories of non-stormwater discharges:

      (a) Diverted stream flows

      (b) Rising groundwaters

      (c) Uncontaminated groundwater infiltration (as defined at 40 CFR 35.2005(b)(20))

      (d) Uncontaminated pumped groundwater

      (e) Foundation drains

      (f) Air conditioning condensation

      (g) Irrigation water from agricultural sources that is commingled with urban stormwater

      (h) Springs

      (i) Uncontaminated water from crawl space pumps

      (j) Footing drains

      (k) Flows from riparian habitats and wetlands

      (l) Non-stormwater discharges authorized by another NPDES or State Waste Discharge permit

(m) Discharges from emergency firefighting activities in accordance with S2 – Authorized *Discharges*

ii. ***Conditionally Allowable Discharges:*** The ordinance or other regulatory mechanism, may allow the following categories of non-stormwater discharges only if the stated conditions are met:

(a) Discharges from potable water sources including, but not limited to, water line flushing, hyperchlorinated water line flushing, fire hydrant system flushing, and pipeline hydrostatic test water. Planned discharges shall be de-chlorinated to a total residual chlorine concentration of 0.1 ppm or less, pH-adjusted if necessary, and volumetrically and velocity controlled to prevent resuspension of sediments in the MS4.

(b) Discharges from lawn watering and other irrigation runoff. These discharges shall be minimized through, at a minimum, public education activities (see S5.C.11) and water conservation efforts.

(c) Dechlorinated swimming pool, spa, and hot tub discharges. The discharges shall be dechlorinated to a total residual chlorine concentration of 0.1 ppm or less, pH-adjusted and reoxygenated if necessary, and volumetrically and velocity controlled to prevent resuspension of sediments in the MS4. Discharges shall be thermally controlled to prevent an increase in temperature of the receiving water. Swimming pool cleaning wastewater and filter backwash shall not be discharged to the MS4.

(d) Street and sidewalk wash water, water used to control dust, and routine external building washdown that does not use detergents. The Permittee shall reduce these discharges through, at a minimum, public education activities (see S5.C.11) and/or water conservation efforts. To avoid washing pollutants into the MS4, Permittees shall minimize the amount of street wash and dust control water used.

(e) Other non-stormwater discharges shall be in compliance with the requirements of a pollution prevention plan reviewed by the Permittee which addresses control of such discharges.

iii. The Permittee shall further address any category of discharges in S5.C.9.b.i or ii, above, if the discharges are identified as significant sources of pollutants to waters of the State.

c. Each Permittee shall implement an ongoing program designed to detect and identify non-stormwater discharges and illicit connections into the Permittee's MS4. The program shall include the following components:

i. Procedures for conducting investigations of the Permittees MS4, including field screening and methods for identifying potential sources. These procedures may also include source control inspections.

The Permittee shall implement a field screening methodology appropriate to the characteristics of the MS4 and water quality concerns. Screening for illicit connections may be conducted using the *Illicit Connection and Illicit Discharge*

Field Screening and Source Tracing Guidance Manual (Herrera Environmental Consultants, Inc., May 2013.); or another method of comparable or improved effectiveness. The Permittee shall document the field screening methodology in the Annual Report.

(a) Each Permittee shall implement an ongoing field screening program of, on average, 12% of the Permittee's known MS4 each year. Permittees shall annually track the total percentage of the MS4 screened beginning August 1, 2019.

ii. A publicly-listed and publicized hotline or other telephone number for public reporting of spills and other illicit discharges.

iii. An ongoing training program for all municipal field staff, who, as part of their normal job responsibilities might come into contact with or otherwise observe an illicit discharge or illicit connection to the MS4, on the identification of an illicit discharge and/or connection, and on the proper procedures for reporting and responding to the illicit discharge and/or connection. Follow-up training shall be provided as needed to address changes in procedures, techniques, requirements, or staffing. Permittees shall document and maintain records of the trainings provided and the staff trained.

d. Each Permittee shall implement an ongoing program designed to address illicit discharges, including spills and illicit connections, into the Permittee's MS4. The program shall include:

i. Procedures for characterizing the nature of, and potential public or environmental threat posed by, any illicit discharges found by or reported to the Permittee. Procedures shall address the evaluation of whether the discharge shall be immediately contained and steps to be taken for containment of the discharge.

ii. Procedures for tracing the source of an illicit discharge; including visual inspections, and when necessary, opening manholes, using mobile cameras, collecting and analyzing water samples, and/or other detailed inspection procedures.

iii. Procedures for eliminating the discharge; including notification of appropriate owners or operators of interconnected MS4s; notification of the property owner; technical assistance; follow-up inspections; and use of the compliance strategy developed pursuant to S5.C.9.d.iv, including escalating enforcement and legal actions if the discharge is not eliminated.

iv. Compliance with the provisions in S5.C.9.d.i, ii, and iii, above, shall be achieved by meeting the following timelines:

(a) Immediately respond to all illicit discharges, including spills, which are determined to constitute a threat to human health, welfare, or the environment consistent with General Condition G3.

(b) Investigate (or refer to the appropriate agency with authority to act) within 7 days, on average, any complaints, reports or monitoring information that indicates a potential illicit discharge.

(c) Initiate an investigation within 21 days of any report or discovery of a suspected illicit connection to determine the source of the connection, the nature and volume of discharge through the connection, and the party responsible for the connection.

(d) Upon confirmation of an illicit connection, use enforcement authority in a documented effort to eliminate the illicit connection within 6 months. All known illicit connections to the MS4 shall be eliminated.

e. Permittees shall train staff who are responsible for identification, investigation, termination, cleanup, and reporting of illicit discharges, including spills and illicit connections, to conduct these activities. Follow-up training shall be provided as needed to address changes in procedures, techniques, requirements, or staff. Permittees shall document and maintain records of the training provided and the staff trained.

f. Each Permittee shall either participate in a regional emergency response program, or develop and implement procedures to investigate and respond to spills and improper disposal into the MS4 owned or operated by the Permittee.

g. Recordkeeping: Each Permittee shall track and maintain records of the activities conducted to meet the requirements of this Section. In the Annual Report, each Permittee shall submit data for all of the illicit discharges, spills, and illicit connections, including those that were found by, reported to, or investigated by the Permittee during the previous calendar year. The data shall include the information specified in Appendix 14 and WQWebIDDE. Each Permittee may either use their own system or WQWebIDDE for recording this data. Final submittals shall follow the instructions, timelines, and format as described in Appendix 14.

10. Operation and Maintenance Program

Each Permittee shall implement and document a program to regulate maintenance activities and to conduct maintenance activities by the Permittee to prevent or reduce stormwater impacts.

Minimum performance measures:

a. Maintenance Standards. Each Permittee shall implement maintenance standards that are as protective, or more protective, of facility function than those specified in the *Stormwater Management Manual for Western Washington* (SWMMWW) or a Phase I program approved by Ecology. For facilities which do not have maintenance standards, the Permittee shall develop a maintenance standard. No later than July 1, 2021[4] each Permittee shall update their maintenance standards as necessary to meet the requirements in this Section.

i. The purpose of the maintenance standard is to determine if maintenance is required. The maintenance standard is not a measure of the facility's required condition at all times between inspections. Exceeding the maintenance standard between inspections and/or maintenance is not a permit violation.

[4] If Ecology takes longer than 120 days to provide a written response as outlined in S.5.C.5.b.3, the required deadline for adoption and effective date will be automatically extended by the number of calendar days that Ecology exceeds a 120-day period for written response.

ii. Unless there are circumstances beyond the Permittee's control, when an inspection identifies an exceedance of the maintenance standard, maintenance shall be performed:

(a) Within 1 year for typical maintenance of facilities, except catch basins.

(b) Within 6 months for catch basins.

(c) Within 2 years for maintenance that requires capital construction of less than $25,000.

Circumstances beyond the Permittee's control include denial or delay of access by property owners, denial or delay of necessary permit approvals, and unexpected reallocations of maintenance staff to perform emergency work. For each exceedance of the required timeframe, the Permittee shall document the circumstances and how they were beyond the Permittee's control.

b. Maintenance of stormwater facilities regulated by the Permittee

i. Each Permittee shall evaluate and, if necessary, update existing ordinances or other enforceable documents requiring maintenance of all stormwater treatment and flow control BMPs/facilities regulated by the Permittee (including catch basins that are part of the facilities regulated by the Permittee), in accordance with maintenance standards established under S5.C.10.a, above.

ii. Each Permittee shall implement an on-going inspection program to annually inspect all stormwater treatment and flow control BMPs/facilities regulated by the Permittee to enforce compliance with adopted maintenance standards as needed based on inspection. The inspection program is limited to facilities to which the Permittee can legally gain access, provided the Permittee shall seek access to all stormwater treatment and flow control BMPs/facilities regulated by the Permittee.

Permittees may reduce the inspection frequency based on maintenance records of double the length of time of the proposed inspection frequency. In the absence of maintenance records, the Permittee may substitute written statements to document a specific less frequent inspection schedule. Written statements shall be based on actual inspection and maintenance experience and shall be certified in accordance with G19 – *Certification and Signature*.

iii. Compliance with the inspection requirements of S5.C.10.b.ii, above, shall be determined by the presence of an established inspection program designed to inspect all facilities, and achieving at least 80% of required inspections.

iv. The Permittee shall require cleaning of catch basins regulated by the Permittee if they are found to be out of compliance with established maintenance standards in the course of inspections conducted at facilities under the requirements of S5.C.8 – *Source Control Program for Existing Development*, and S5.C.9 – *Illicit Connections and Illicit Discharges Detection and Elimination*, or if the catch basins are part of the stormwater facilities inspected under the requirements of S5.C.10 – *Operation and Maintenance Program*.

c. Maintenance of stormwater facilities owned or operated by the Permittee

i. Each Permittee shall implement a program to annually inspect all stormwater treatment and flow control BMPs/facilities owned or operated by the Permittee. Permittees shall implement appropriate maintenance action(s) in accordance with adopted maintenance standards.

Permittees may reduce the inspection frequency based on maintenance records of double the length of time of the proposed inspection frequency. In the absence of maintenance records, the Permittee may substitute written statements to document a specific less frequent inspection schedule. Written statements shall be based on actual inspection and maintenance experience and shall be certified in accordance with G19 – *Certification and Signature*.

ii. Each Permittee shall implement a program to conduct spot checks of potentially damaged stormwater treatment and flow control BMPs/facilities after major storm events (24-hour storm event with a 10-year or greater recurrence interval). If spot checks indicate widespread damage/maintenance needs, inspect all stormwater treatment and flow control BMPs/facilities that may be affected. Conduct repairs or take appropriate maintenance action in accordance with maintenance standards established under S5.C.10.a, above, based on the results of the inspections.

iii. Compliance with the inspection requirements of S5.C.10.c.i, and ii, above, shall be determined by the presence of an established inspection program designed to inspect all sites and achieving at least 95% of required inspections.

d. Maintenance of Catch Basins Owned or Operated by the Permittee

i. Each Permittee shall annually inspect all catch basins and inlets owned or operated by the Permittee, or implement alternatives below.

Alternatives to the standard approach of inspecting all catch basins annually: Permittees may apply the following alternatives to all or portions of their system.

(a) The annual catch basin inspection schedule may be changed as appropriate to meet the maintenance standards based on maintenance records of double the length of time of the proposed inspection frequency. In the absence of maintenance records for catch basins, the Permittee may substitute written statements to document a specific, less frequent inspection schedule. Written statements shall be based on actual inspection and maintenance experience and shall be certified in accordance with G19 – *Certification and Signature*.

(b) Annual inspections may be conducted on a "circuit basis" whereby 25% of catch basins and inlets within each circuit are inspected to identify maintenance needs. Include an inspection of the catch basin immediately upstream of any MS4 outfall, discharge point, or connections to public or private storm systems if applicable. Clean all catch basins within a given circuit for which the inspection indicates cleaning is needed to comply with maintenance standards established under S5.C.10.a, above.

(c) The Permittee may clean all pipes, ditches, catch basins, and inlets within a circuit once during the permit term. Circuits selected for this alternative shall drain to a single point.

ii. The disposal of decant water shall be in accordance with the requirements in Appendix 6 – *Street Waste Disposal*.

iii. Compliance with the inspection requirements of S5.C.10.d.i, above, shall be determined by the presence of an established inspection program designed to inspect all catch basins and inlets, or implemented alternative, and achieving at least 95% of required inspections.

e. Each Permittee shall implement practices, policies, and procedures to reduce stormwater impacts associated with runoff from all lands owned or maintained by the Permittee, and road maintenance activities under the functional control of the Permittee. No later than December 31, 2022, document the practices, policies, and procedures. Lands owned or maintained by the Permittee include, but are not limited to: parking lots, streets, roads, highways, buildings, parks, open space, road right-of-way, maintenance yards, and stormwater treatment and flow control BMPs/facilities.

The following activities shall be addressed:

i. Pipe cleaning

ii. Cleaning of culverts that convey stormwater in ditch systems

iii. Ditch maintenance

iv. Street cleaning

v. Road repair and resurfacing, including pavement grinding

vi. Snow and ice control

vii. Utility installation

viii. Maintaining roadside areas, including vegetation management

ix. Dust control

x. Pavement striping maintenance

xi. Application of fertilizers, pesticides, and herbicides according to the instructions for their use, including reducing nutrients and pesticides using alternatives that minimize environmental impacts

xii. Sediment and erosion control

xiii. Landscape maintenance and vegetation disposal

xiv. Trash and pet waste management

xv. Building exterior cleaning and maintenance

f. Implement an ongoing training program for employees of the Permittee who have primary construction, operations, or maintenance job functions that may impact stormwater quality. The training program shall address the importance of protecting water quality, operation and maintenance standards, inspection procedures, relevant SWPPPs, selecting appropriate BMPs, ways to perform their job activities to prevent or minimize impacts to water quality, and procedures for reporting water quality concerns. Follow-up training shall be provided as needed to address changes in procedures, techniques, requirements, or staffing. Permittees shall document and maintain records of the training provided. The staff training records to be kept include dates, activities or course descriptions, names and positions of staff in attendance.

g. Implement a Stormwater Pollution Prevention Plan (SWPPP) for all heavy equipment maintenance or storage yards, and material storage facilities owned or operated by the Permittee in areas subject to this Permit that are not required to have coverage under the General NPDES Permit for Stormwater Discharges Associated with Industrial Activities or another NPDES permit that authorizes stormwater discharges associated with the activity. As necessary, update SWPPPs no later than December 31, 2022, to include the following information. The SWPPP shall include periodic visual observation of discharges from the facility to evaluate the effectiveness of BMPs. At a minimum, the SWPPP shall include:

   i. A detailed description of the operational and structural BMPs in use at the facility and a schedule for implementation of additional BMPs when needed. BMPs selected shall be consistent with the *Stormwater Management Manual for Western Washington*, or Phase I program approved by Ecology. The SWPPP shall be updated as needed to maintain relevancy with the facility.

   ii. At the minimum, annual inspections of the facility, including visual observations of discharges, to evaluate the effectiveness of the BMPs, identify maintenance needs, and determine if additional or different BMPs are needed. The results of these inspections shall be documented in an inspection report or check list.

   iii. An inventory of the materials and equipment stored on-site, and the activities conducted at the facility which may be exposed to precipitation or runoff and could result in stormwater pollution.

   iv. A site map showing the facility's stormwater drainage, discharge points, and areas of potential pollutant exposure.

   v. A plan for preventing and responding to spills at the facility which could result in an illicit discharge.

   vi. A training plan for all personnel responsible for implementing any components of the SWPPP.

h. Maintain records of the activities conducted to meet the requirements of this Section.

11. Education and Outreach Program

The SWMP shall include an education and outreach program designed to:

- Build general awareness about methods to address and reduce stormwater runoff.
- Effect behavior change to reduce or eliminate behaviors and practices that cause or contribute to adverse stormwater impacts.
- Create stewardship opportunities that encourages community engagement in addressing the impacts from stormwater runoff.

Permittees may choose to meet these requirements individually or as a member of a regional group. Regional collaboration on general awareness or behavior change programs, or both, includes Permittees developing a consistent message, determining best methods for communicating the message, and when appropriate, creating strategies to effect behavior change. If a Permittee chooses to adopt one or more elements of a regional program, the Permittee should participate in the regional group and shall implement the adopted element(s) of the regional program in the local jurisdiction

Minimum performance measures:

a. Each Permittee shall implement an education and outreach program for the area served by the MS4. The program design shall be based on local water quality information and target audience characteristics to identify high priority target audiences, subject areas, and/or BMPs. Based on the target audience's demographic, the Permittee shall consider delivering its selected messages in language(s) other than English, as appropriate for the target audience.

   i. ***General awareness***: To build general awareness, Permittees shall target the following audiences and subject areas:

      (a) *Target Audiences*: General Public (including school age children and overburdened communities), and businesses (including home-based and mobile business)

      Subject areas:

      - General impacts of stormwater on surface waters, including impacts from impervious surfaces and of the hazards associated with illicit discharges and improper disposal of waste.
      - LID principles and LID BMPs.

      (b) *Target audiences*: Engineers, contractors, developers, and land use planners.

      Subject areas: Technical standards for stormwater site and erosion control plans.

      - LID principles and LID BMPs.
      - Stormwater treatment and flow control BMPs/facilities.

      (c) Permittees shall provide subject area information to the target audience on an ongoing or strategic schedule.

   ii. ***Behavior change***: To effect behavior change, Permittees shall select, at a minimum, one target audience and one BMP:

      (a) *Target audiences*: Residents, landscapers, and property managers/owners, school-age children, and businesses (including home-based and mobile businesses).

      BMPs

      - Use and storage of automotive chemicals, hazardous cleaning supplies, carwash soaps, and other hazardous materials.

- Prevention of illicit discharges.
- Yard care techniques protective of water quality.
- Use and storage of pesticides and fertilizers and other household chemicals.
- Carpet cleaning.
- Repair and maintenance BMPs for vehicles, equipment, and/or home buildings.
- Pet waste management and disposal.
- LID principles and LID BMPs.
- Stormwater facility maintenance, including LID facilities
- Dumpster and trash compactor maintenance.
- Litter and debris prevention.
- (Audience specific) Source Control BMPs.
- (Audience specific) Locally important, stormwater-related subject area.

iii. No later than July 1, 2020, each Permittee shall conduct a new evaluation of the effectiveness of the ongoing behavior change program (required under S5.C.10.a.ii of the 2013 Permit). Permittees shall document lessons learned and recommendations for which option to select from S5.C.11.a.iv.

Permittees that select option S5.C.11.a.iv.c, below, may forgo this evaluation if it will not add value to the overall behavior change program.

iv. Based on the recommendation from S5.C.11.a.iii, by February 1, 2021, each Permittee shall follow social marketing practices and methods, similar to Community-Based Social Marketing, and develop a campaign that is tailored to the community, including the development of a program evaluation plan. Each Permittee shall:

(a) Develop a strategy and schedule to more effectively implement the existing campaign, or

(b) Develop a strategy and schedule to expand the existing campaign to a new target audience or BMPs, or

(c) Develop a strategy and schedule for a new target audience and BMP behavior change campaign.

v. No later than April 1, 2021, begin to implement the strategy developed in S5.C.11.a.iv.

vi. No later than March 31, 2024, evaluate and report on:

(a) The changes in understanding and adoption of targeted behaviors resulting from the implementation of the strategy; and

(b) Any changes to the campaign in order to be more effective; describe the strategies and process to achieve the results.

vii. Permittees shall use results of the evaluation to continue to direct effective methods for implementation of the ongoing behavior change program.

b. Each Permittee shall provide and advertise stewardship opportunities and/or partner with existing organizations (including non-permittees) to encourage residents to participate in activities or events planned and organized within the community, such as: stream teams, storm drain marking, volunteer monitoring, riparian plantings and education activities.

S6. STORMWATER MANAGEMENT PROGRAM FOR SECONDARY PERMITTEES

A. Secondary Permittees and New Secondary Permittees Coverage

This Section applies to all Secondary Permittees and all New Secondary Permittees whether coverage under this Permit is obtained individually, or as a Co-Permittee with a city, town, county, and/or another Secondary Permittee.

New Secondary Permittees subject to this Permit shall fully meet the requirements of this Section as modified in footnotes in S6.D below, or as established as a condition of coverage by Ecology.

1. To the extent allowable under state, federal and local law, all components are mandatory for each Secondary Permittee covered under this Permit, whether covered as an individual Permittee or as a Co-Permittee.

2. Each Secondary Permittee shall develop and implement a Stormwater Management Program (SWMP). A SWMP is a set of actions and activities comprising the components listed in S6 and any additional actions necessary to meet the requirements of applicable TMDLs pursuant to S7 – *Compliance with TMDL Requirements*, and S8 – *Monitoring and Assessment*. The SWMP shall be designed to reduce the discharge of pollutants from MS4s to the Maximum Extent Practicable (MEP) and protect water quality.

3. Unless an alternate implementation schedule is established by Ecology as a condition of permit coverage, the SWMP shall be developed and implemented in accordance with the schedules contained in this Section and shall be fully developed and implemented no later than four and one-half years from initial permit coverage date. Secondary Permittees that are already implementing some or all of the required SWMP components shall continue implementation of those components.

4. Secondary Permittees may implement parts of their SWMP in accordance with the schedule for cities, towns and counties in S5, provided they have signed a memorandum of understanding or other agreement to jointly implement the activity or activities with one or more jurisdictions listed in S1.B, and submitted a copy of the agreement to Ecology.

5. Each Secondary Permittee shall prepare written documentation of the SWMP, called the SWMP Plan. The SWMP Plan shall include a description of program activities for the upcoming calendar year.

6. Conditions S6.A, S6.B, and S6.C are applicable to all Secondary Permittees covered under this Permit. In addition:

   a. S6.D is applicable to all Secondary Permittees, except the Port of Seattle and the Port of Tacoma.

   b. S6.E is applicable only to the Port of Seattle and the Port of Tacoma.

B. Coordination

Secondary Permittees shall coordinate stormwater-related policies, programs and projects within a watershed and interconnected MS4s. Where relevant and appropriate, the SWMP shall coordinate among departments of the Secondary Permittee to ensure compliance with the terms of this Permit.

C. Legal Authority

To the extent allowable under state law and federal law, each Secondary Permittee shall be able to demonstrate that it can operate pursuant to legal authority which authorizes or enables the Secondary Permittee to control discharges to and from MS4s owned or operated by the Secondary Permittee.

This legal authority may be a combination of statutes, ordinances, permits, contracts, orders, interagency agreements, or similar instruments.

D. Stormwater Management Program for Secondary Permittees

The SWMP for Secondary Permittees shall include the following components.

1. Public Education and Outreach

Each Secondary Permittee shall implement the following stormwater education strategies:

a. Storm drain inlets owned or operated by the Secondary Permittee that are located in maintenance yards, in parking lots, along sidewalks, and at pedestrian access points shall be clearly labeled with the message similar to "Dump no waste – Drains to water body." [5]

   As identified during visual inspection and regular maintenance of storm drain inlets per the requirements of S6.D.3.d and S6.D.6.a.i, below, or as otherwise reported to the Secondary Permittee, any inlet having a label that is no longer clearly visible and/or easily readable shall be re-labeled within 90 days.

b. Each year, beginning no later than three years from the initial date of Permit coverage, public ports, colleges, and universities shall distribute educational information to tenants and residents on the impact of stormwater discharges on receiving waters, and steps that can be taken to reduce pollutants in stormwater runoff. Distribution may be by hard copy or electronic means. Appropriate topics may include, but are not limited to:

   i. How stormwater runoff affects local waterbodies.

   ii. Proper use and application of pesticides and fertilizers.

   iii. Benefits of using well-adapted vegetation.

   iv. Alternative equipment washing practices, including cars and trucks that minimize pollutants in stormwater.

   v. Benefits of proper vehicle maintenance and alternative transportation choices; proper handling and disposal of vehicle wastes, including the location of hazardous waste collection facilities in the area.

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[5] New Secondary Permittees shall label all inlets as described in S6.D.1.a no later than four years from the initial date of permit coverage.

vi. Hazards associated with illicit connections and illicit discharges.

vii. Benefits of litter control and proper disposal of pet waste.

2. Public Involvement and Participation

Each year, no later than May 31, each Secondary Permittee shall:

a. Make the Annual Report available on the Permittee's website.

b. Make available on the Permittee's website the latest updated version of the SWMP Plan.

c. A Secondary Permittee that does not maintain a website may submit their updated SWMP Plan in electronic format to Ecology for posting on Ecology's website.

3. Illicit Discharge Detection and Elimination

Each Secondary Permittee shall:

a. From the initial date of permit coverage, comply with all relevant ordinances, rules, and regulations of the local jurisdiction(s) in which the Secondary Permittee is located that govern non-stormwater discharges.

b. Implement appropriate policies prohibiting illicit discharges[6] and an enforcement plan to ensure compliance with illicit discharge policies.[7] These policies shall address, at a minimum: illicit connections; non-stormwater discharges, including spills of hazardous materials; and improper disposal of pet waste and litter.

i. ***Allowable discharges***: The policies do not need to prohibit the following categories of non-stormwater discharges:

(a) Diverted stream flows

(b) Rising groundwaters

(c) Uncontaminated groundwater infiltration (as defined at 40 CFR 35.2005(b)(20))

(d) Uncontaminated pumped groundwater

(e) Foundation drains

(f) Air conditioning condensation

(g) Irrigation water from agricultural sources that is commingled with urban stormwater

(h) Springs

(i) Uncontaminated water from crawl space pumps

(j) Footing drains

(k) Flows from riparian habitats and wetlands

[6] New Secondary Permittees shall develop and implement appropriate policies prohibiting illicit discharges, and identify possible enforcement mechanisms as described in S6.D.3.b, no later than one year from initial date of permit coverage.

[7] New Secondary Permittees shall develop and implement an enforcement plan as described in S6.D.3.b no later than 18 months from the initial date of permit coverage.

(l) Discharges from emergency firefighting activities in accordance with S2 – *Authorized Discharges*

(m) Non-stormwater discharges authorized by another NPDES or State Waste Discharge permit

ii. ***Conditionally allowable discharges***: The policies may allow the following categories of non-stormwater discharges only if the stated conditions are met and such discharges are allowed by local codes:

(a) Discharges from potable water sources, including but not limited to water line flushing, hyperchlorinated water line flushing, fire hydrant system flushing, and pipeline hydrostatic test water. Planned discharges shall be de-chlorinated to a total residual chlorine concentration of 0.1 ppm or less, pH-adjusted if necessary, and volumetrically and velocity controlled to prevent resuspension of sediments in the MS4.

(b) Discharges from lawn watering and other irrigation runoff. These discharges shall be minimized through, at a minimum, public education activities and water conservation efforts conducted by the Secondary Permittee and/or the local jurisdiction.

(c) Dechlorinated swimming pool, spa, and hot tub discharges. The discharges shall be dechlorinated to a total residual chlorine concentration of 0.1 ppm or less, pH-adjusted and reoxygenated if necessary, and volumetrically and velocity controlled to prevent resuspension of sediments in the MS4. Discharges shall be thermally controlled to prevent an increase in temperature of the receiving water. Swimming pool cleaning wastewater and filter backwash shall not be discharged to the MS4.

(d) Street and sidewalk wash water, water used to control dust, and routine external building washdown that does not use detergents. The Secondary Permittee shall reduce these discharges through, at a minimum, public education activities and/or water conservation efforts conducted by the Secondary Permittee and/or the local jurisdiction. To avoid washing pollutants into the MS4, the Secondary Permittee shall minimize the amount of street wash and dust control water used.

(e) Other non-stormwater discharges shall be in compliance with the requirements of a pollution prevention plan reviewed by the Permittee which addresses control of such discharges.

iii. The Secondary Permittee shall address any category of discharges in S6.D.3.b.i or ii, above, if the discharge is identified as a significant source of pollutants to waters of the State.

c. Maintain a storm sewer system map showing the locations of all known storm drain outfalls and discharge points, labeling the receiving waters (other than groundwater), and delineating the areas contributing runoff to each outfall and discharge point. Make the map (or completed portions of the map) available on request to Ecology and to the extent appropriate to other Permittees. The preferred format for mapping is an electronic format with fully described mapping standards.[8]

d. Conduct field inspections and visually inspect for illicit discharges at all known MS4 outfalls and discharge points. Visually inspect at least one third (on average) of all known outfalls and discharge points each year, beginning no later than two years from the initial date of permit coverage. Implement procedures to identify and remove illicit discharges. Keep records of inspections and follow-up activities.

e. Implement a spill response plan that includes coordination with a qualified spill responder.[9]

f. No later than two years from initial date of permit coverage, provide staff training or coordinate with existing training efforts to educate staff on proper BMPs for preventing illicit discharges, including spills. Train all Permittee staff who, as part of their normal job responsibilities, have a role in preventing such illicit discharges.

4. Construction Site Stormwater Runoff Control

From the initial date of permit coverage, each Secondary Permittee shall:

a. Comply with all relevant ordinances, rules, and regulations of the local jurisdiction(s) in which the Secondary Permittee is located that govern construction phase stormwater pollution prevention measures.

b. Ensure that all construction projects under the functional control of the Secondary Permittee which require a construction stormwater permit obtain coverage under the NPDES General Permit for Stormwater Discharges Associated with Construction Activities, or an individual NPDES permit prior to discharging construction related stormwater.

c. Coordinate with the local jurisdiction regarding projects owned or operated by other entities which discharge into the Secondary Permittee's MS4, to assist the local jurisdiction with achieving compliance with all relevant ordinances, rules, and regulations of the local jurisdiction(s).

d. Provide training or coordinate with existing training efforts to educate relevant staff in erosion and sediment control BMPs and requirements, or hire trained contractors to perform the work.

e. Coordinate, as requested, with Ecology or the local jurisdiction to provide access for inspection of construction sites or other land disturbances, which are under the functional control of the Secondary Permittee during land disturbing activities and/or the construction period.

5. Post-Construction Stormwater Management for New Development and Redevelopment

From the initial date of permit coverage, each Secondary Permittee shall:

[8] New Secondary Permittees shall meet the requirements of S6.D.3.c no later than four and one-half years from the initial date of permit coverage.

[9] New Secondary Permittees shall develop and implement a spill response plan as described in S6.D.3.e no later than four and one-half years from the initial date of permit coverage.

a. Comply with all relevant ordinances, rules, and regulations of the local jurisdiction(s) in which the Secondary Permittee is located that govern post-construction stormwater pollution prevention measures.

b. Coordinate with the local jurisdiction regarding projects owned or operated by other entities which discharge into the Secondary Permittee's MS4, to assist the local jurisdiction with achieving compliance with all relevant ordinances, rules, and regulations of the local jurisdiction(s).

6. Pollution Prevention and Good Housekeeping for Municipal Operations

Each Secondary Permittee shall:

a. Implement a municipal Operation and Maintenance (O&M) Plan to minimize stormwater pollution from activities conducted by the Secondary Permittee. The O&M Plan shall include appropriate pollution prevention and good housekeeping procedures for all of the following operations, activities, and/or types of facilities that are present within the Secondary Permittee's boundaries and under the functional control of the Secondary Permittee.[10]

   i. *Stormwater collection and conveyance systems*, including catch basins, stormwater pipes, open channels, culverts, and stormwater treatment and flow control BMPs/facilities. The O&M Plan shall address, at a minimum: scheduled inspections and maintenance activities, including cleaning and proper disposal of waste removed from the system. Secondary Permittees shall properly maintain stormwater collection and conveyance systems owned or operated by the Secondary Permittee and annually inspect and maintain all stormwater facilities to ensure facility function.

   Secondary Permittees shall establish maintenance standards that are as protective, or more protective, of facility function than those specified in Chapter 4, Volume V of the *Stormwater Management Manual for Western Washington*.

   Secondary Permittees shall review their maintenance standards to ensure they are consistent with the requirements of this Section.

   Secondary Permittees shall conduct spot checks of potentially damaged permanent stormwater treatment and flow control BMPs/facilities following major storm events (24-hour storm event with a 10-year or greater recurrence interval).

   ii. *Roads, highways, and parking lots*. The O&M Plan shall address, but is not limited to: deicing, anti-icing, and snow removal practices; snow disposal areas; material (e.g., salt, sand, or other chemical) storage areas; all-season BMPs to reduce road and parking lot debris and other pollutants from entering the MS4.

   iii. *Vehicle fleets*. The O&M Plan shall address, but is not limited to: storage, washing, and maintenance of Secondary Permittee vehicle fleets; and fueling facilities. Secondary Permittees shall conduct all vehicle and equipment washing

[10] New Secondary Permittees shall develop and implement the Operation and Maintenance Plan described in S6.D.6.a no later than three and a half years from the initial date of permit coverage.

and maintenance in a self-contained covered building or in designated wash and/or maintenance areas.

iv. *External building maintenance*. The O&M Plan shall address, building exterior cleaning and maintenance including cleaning, washing, painting; maintenance and management of dumpsters; other maintenance activities.

v. *Parks and open space*. The O&M Plan shall address, but is not limited to: proper application of fertilizer, pesticides, and herbicides; sediment and erosion control; BMPs for landscape maintenance and vegetation disposal; and trash and pet waste management.

vi. *Material storage facilities, and heavy equipment maintenance or storage yards*. Secondary Permittees shall develop and implement a Stormwater Pollution Prevention Plan to protect water quality at each of these facilities owned or operated by the Secondary Permittee and not covered under the *Industrial Stormwater General Permit* or under another NPDES permit that authorizes stormwater discharges associated with the activity.

vii. *Other facilities* that would reasonably be expected to discharge contaminated runoff. The O&M Plan shall address proper stormwater pollution prevention practices for each facility.

b. From the initial date of permit coverage, Secondary Permittees shall also have permit coverage for all facilities operated by the Secondary Permittee that are required to be covered under the General NPDES Permit for Stormwater Discharges Associated with Industrial Activities or another NPDES permit that authorizes discharges associated with the activity.

c. The O&M Plan shall include sufficient documentation and records as necessary to demonstrate compliance with the O&M Plan requirements in S6.D.6.a.i through vii above.

d. No later than three years from the initial date of permit coverage, Secondary Permittees shall implement a program designed to train all employees whose primary construction, operations, or maintenance job functions may impact stormwater quality. The training shall address:

i. The importance of protecting water quality.

ii. The requirements of this Permit.

iii. Operation and maintenance requirements.

iv. Inspection procedures.

v. Ways to perform their job activities to prevent or minimize impacts to water quality.

vi. Procedures for reporting water quality concerns, including potential illicit discharges (including spills).

E. Stormwater Management Program for the Port of Seattle and Port of Tacoma

Permittees that are already implementing some or all of the Stormwater Management Program (SWMP) components in this Section shall continue implementation of those components of their SWMP.

The SWMP for the Port of Seattle and the Port of Tacoma shall include the following components:

1. **Education Program**
   The SWMP shall include an education program aimed at tenants and Permittee employees. The goal of the education program is to reduce or eliminate behaviors and practices that cause or contribute to adverse stormwater impacts.

   Minimum performance measure:

   a. The Permittee shall make educational materials available to tenants and Permittee employees whose job duties could impact stormwater.

2. **Public Involvement and Participation**
   Each Permittee shall make the latest updated version of the SWMP Plan available to the public. The most recent SWMP Plan and Annual Report shall be posted on the Permittee's website.

3. **Illicit Discharge Detection and Elimination**
   The SWMP shall include a program to identify, detect, remove and prevent illicit connections and illicit discharges, including spills, into the MS4s owned or operated by the Permittee.

   Minimum performance measures:

   a. Comply with all relevant ordinances, rules, and regulations of the local jurisdiction(s) in which the Permittee's MS4 is located that govern non-stormwater discharges.

   b. Implement appropriate policies prohibiting illicit discharges and an enforcement plan to ensure compliance with illicit discharge policies. These policies shall address, at a minimum: illicit connections; non-stormwater discharges, including spills of hazardous materials; and improper disposal of pet waste and litter.

      i. ***Allowable Discharges***: The policies do not need to prohibit the following categories of non-stormwater discharges:

         (a) Diverted stream flows

         (b) Rising groundwaters

         (c) Uncontaminated groundwater infiltration (as defined at 40 CFR 35.2005(b)(20))

         (d) Uncontaminated pumped groundwater

         (e) Foundation drains

         (f) Air conditioning condensation

         (g) Irrigation water from agricultural sources that is commingled with urban stormwater

         (h) Springs

         (i) Uncontaminated water from crawl space pumps

         (j) Footing drains

(k) Flows from riparian habitats and wetlands

(l) Discharges from emergency firefighting activities in accordance with S2 – *Authorized Discharges*

(m) Non-stormwater discharges authorized by another NPDES permit

ii. ***Conditionally Allowable Discharges***: The policies may allow the following categories of non-stormwater discharges only if the stated conditions are met and such discharges are allowed by local codes:

(a) Discharges from potable water sources, including but not limited to, water line flushing, hyperchlorinated water line flushing, fire hydrant system flushing, and pipeline hydrostatic test water. Planned discharges shall be de-chlorinated to a total residual chlorine concentration of 0.1 ppm or less, pH-adjusted if necessary, and volumetrically and velocity controlled to prevent resuspension of sediments in the MS4.

(b) Discharges from lawn watering and other irrigation runoff. These discharges shall be minimized through, at a minimum, public education activities and water conservation efforts conducted by the Permittee and/or the local jurisdiction.

(c) Dechlorinated swimming pool, spa, and hot tub discharges. The discharges shall be dechlorinated to a total residual chlorine concentration of 0.1 ppm or less, pH-adjusted and reoxygenated if necessary, and volumetrically and velocity controlled to prevent resuspension of sediments in the MS4. Discharges shall be thermally controlled to prevent an increase in temperature of the receiving water. Swimming pool cleaning wastewater and filter backwash shall not be discharged to the MS4.

(d) Street and sidewalk wash water, water used to control dust, and routine external building wash down that does not use detergents. The Ports of Seattle and Tacoma shall reduce these discharges through, at a minimum, public education activities and/or water conservation efforts conducted by the Port and/or the local jurisdiction. To avoid washing pollutants into the MS4, the amount of street wash and dust control water used shall be minimized.

(e) Other non-stormwater discharges shall be in compliance with the requirements of a pollution prevention plan reviewed by the Permittee which addresses control of such discharges.

iii. The Permittee shall address any category of discharges in S6.E.3.b.i or ii above if the discharges are identified as significant source of pollutants to waters of the State.

c. The SWMP shall include an ongoing program for gathering, maintaining, and using adequate information to conduct planning, priority setting, and program evaluation activities for Permittee-owned properties. Permittees shall gather and maintain mapping data for the features listed below on an ongoing basis:

i. Known MS4 outfalls and discharge points, receiving waters (other than groundwater), and land uses for property owned by the Permittee, and all other properties served by MS4s known to and owned or operated by the Permittee.

ii. Tributary conveyances (including size, material, and type attributes where known), and the associated drainage areas of MS4 outfalls and discharge points with a 12 inch nominal diameter or larger, or an equivalent cross-sectional area for non-pipe systems.

iii. Known connections greater than or equal to 8 inches in nominal diameter to tributary conveyances mapped in accordance with S6.E.3.c.ii.

iv. To the extent consistent with national security laws and directives, each Permittee shall make available to Ecology upon request, available maps depicting the information required in S6.E.3.c.i through iii, above. The required format for mapping is electronic with fully described mapping standards.

v. Implement a program to document operation and maintenance records for stormwater treatment and flow control BMPs/facilities and catch basins.

vi. Upon request, and to the extent consistent with national security laws and directives, mapping information and operation and maintenance records shall be provided to the city or county in which the Permittee is located.

d. Conduct field screening of at least 20% of the MS4 each year for the purpose of detecting illicit discharges and illicit connections. Field screening methodology shall be appropriate to the characteristics of the MS4 and water quality concerns. Implement procedures to identify and remove any illicit discharges and illicit connections. Keep records of inspections and follow-up activities.

e. Implement a spill response plan that includes coordination with a qualified spill responder.

f. Provide ongoing staff training or coordinate with existing training efforts to educate staff on proper BMPs for preventing illicit discharges, including spills, and for identifying, reporting, and responding as appropriate. Train all Permittee staff who, as part of their normal job responsibilities, have a role in preventing such discharges. Keep records of training provided and staff trained.

4. Construction Site Stormwater Runoff Control

The SWMP shall include a program to reduce pollutants in stormwater runoff from construction activities under the functional control of the Permittee.

Minimum performance measures:

a. Comply with all relevant ordinances, rules, and regulations of the local jurisdiction(s) in which the Permittee is located that govern construction phase stormwater pollution prevention measures. To the extent allowed by local ordinances, rules, and regulations, comply with the applicable minimum technical requirements for new development and redevelopment contained in Appendix 1.

b. Ensure all construction projects under the functional control of the Permittee which require a construction stormwater permit obtain coverage under the NPDES General Permit for Stormwater Discharges Associated with Construction Activities or an individual NPDES permit prior to discharging construction related stormwater.

c. Coordinate with the local jurisdiction(s) regarding projects owned or operated by other entities which discharge into the Permittee's MS4, to assist the local jurisdiction(s) with achieving compliance with all relevant ordinances, rules, and regulations of the local jurisdiction(s).

d. Provide staff training or coordinate with existing training efforts to educate Permittee staff responsible for implementing construction stormwater erosion and sediment control BMPs and requirements, or hire trained contractors to perform the work.

e. Coordinate as requested with Ecology or the local jurisdiction to provide access for inspection of construction sites or other land disturbances that are under the functional control of the Permittee during active land disturbing activities and/or the construction period.

5. **Post-Construction Stormwater Management for New Development and Redevelopment**

The SWMP shall include a program to address post-construction stormwater runoff from new development and redevelopment projects. The program shall establish controls to prevent or minimize water quality impacts.

Minimum performance measures:

a. Comply with all relevant ordinances, rules, and regulations of the local jurisdiction(s) in which the Permittee is located that govern post-construction stormwater pollution prevention measures, including proper operation and maintenance of the MS4. To the extent allowed by local ordinances, rules, and regulations, comply with the applicable the minimum technical requirements for new development and redevelopment contained in Appendix 1.

b. Coordinate with the local jurisdiction regarding projects owned and operated by other entities which discharge into the Permittee's MS4, to assist the local jurisdiction in achieving compliance with all relevant ordinances, rules, and regulations of the local jurisdiction(s).

6. **Operation and Maintenance Program**

The SWMP shall include an operation and maintenance program for all stormwater treatment and flow control BMPs/facilities, and catch basins to ensure that BMPs continue to function properly.

Minimum performance measures:

a. Each Permittee shall implement an Operation and Maintenance (O&M) manual for all stormwater treatment and flow control BMPs/facilities and catch basins that are under the functional control of the Permittee and which discharge stormwater to its MS4, or to an interconnected MS4.

   i. Retain a copy of the O&M manual in the appropriate Permittee department and routinely update following discovery or construction of new stormwater facilities.

   ii. The operation and maintenance manual shall establish facility-specific maintenance standards that are as protective, or more protective, than those specified in the *Stormwater Management Manual for Western Washington*. For existing stormwater facilities which do not have maintenance standards, the Permittee shall develop a maintenance standard. Each Permittee shall update maintenance standards, as necessary, to meet the requirements of this Section.

iii. The purpose of the maintenance standard is to determine if maintenance is required. The maintenance standard is not a measure of the facility's required condition at all times between inspections. Exceeding the maintenance standards between inspections and/or maintenance is not a permit violation. Maintenance actions shall be performed within the time frames specified in S6.E.6.b.ii.

b. The Permittee will manage maintenance activities to inspect all stormwater facilities listed in the O&M manual annually, and take appropriate maintenance action in accordance with the O&M manual.

i. The Permittee may change the inspection frequency to less than annually, provided the maintenance standards are still met. Reducing the annual inspection frequency shall be based on maintenance records of double the length of time of the proposed inspection frequency. In the absence of maintenance records, the Permittee may substitute written statements to document a specific less frequent inspection schedule. Written statements shall be based on actual inspection and maintenance experience and shall be certified in accordance with G19 – *Certification and Signature*.

ii. Unless there are circumstances beyond the Permittees control, when an inspection identifies an exceedance of the maintenance standard, maintenance shall be performed:

(a) Within 1 year for wet pool facilities and retention/detention ponds.

(b) Within 1 year for typical maintenance of facilities, except catch basins.

(c) Within 6 months for catch basins.

(d) Within 2 years for maintenance that requires capital construction of less than $25,000.

Circumstances beyond the Permittee's control include denial or delay of access by property owners, denial or delay of necessary permit approvals, and unexpected reallocations of maintenance staff to perform emergency work. For each exceedance of the required timeframe, the Permittee shall document the circumstances and how they were beyond their control.

c. The Permittee shall provide appropriate training for Permittee maintenance staff.

d. The Permittee will maintain records of inspections and maintenance activities.

7. Source Control in Existing Developed Areas
The SWMP shall include the development and implementation of one or more Stormwater Pollution Prevention Plans (SWPPPs). A SWPPP is a documented plan to identify and implement measures to prevent and control the contamination of discharges of stormwater to surface or groundwater. SWPPP(s) shall be prepared and implemented for all Permittee-owned lands, except environmental mitigation sites owned by the Permittee, that are not covered by a NPDES permit issued by Ecology that

authorizes stormwater discharges.

Minimum performance measures:

a. SWPPP(s) shall be updated as necessary to reflect changes at the facility.

b. The SWPPP(s) shall include a facility assessment including a site plan, identification of pollutant sources, and description of the drainage system.

c. The SWPPP(s) shall include a description of the source control BMPs used or proposed for use by the Permittee. Source control BMPs shall be selected from the *Stormwater Management Manual for Western Washington* (or an equivalent manual approved by Ecology). Implementation of non-structural BMPs shall begin immediately after the pollution prevention plan is developed. Where necessary, a schedule for implementation of structural BMPs shall be included in the SWPPP(s).

d. The Permittee shall maintain a list of sites covered by the SWPPP(s) required under this Permit. At least 20% of the listed sites shall be inspected annually.

e. The SWPPP(s) shall include policies and procedures to reduce pollutants associated with the application of pesticides, herbicides and fertilizer.

f. The SWPPP(s) shall include measures to prevent, identify and respond to illicit discharges, including illicit connections, spills and improper disposal. When the Permittee submits a notification pursuant to G3, the Permittee shall also notify the city or county it is located in.

g. The SWPPP(s) shall include a component related to inspection and maintenance of stormwater facilities and catch basins that is consistent with the Permittee's O&M Program, as specified in S6.E.6 above.

8. Monitoring Program
Monitoring requirements for the Port of Seattle and Port of Tacoma are included in Special Condition S8.

S7. COMPLIANCE WITH TOTAL MAXIMUM DAILY LOAD REQUIREMENTS

The following requirements apply if an applicable Total Maximum Daily Load (TMDL) is approved for stormwater discharges from MS4s owned or operated by the Permittee. Applicable TMDLs are TMDLs which have been approved by EPA on or before the issuance date of this Permit, or prior to the date that Ecology issues coverage under this Permit, whichever is later.

A. For applicable TMDLs listed in Appendix 2, affected Permittees shall comply with the specific requirements identified in Appendix 2. Each Permittee shall keep records of all actions required by this Permit that are relevant to applicable TMDLs within their jurisdiction. The status of the TMDL implementation shall be included as part of the Annual Report submitted to Ecology. Each Annual Report shall include a summary of relevant SWMP and Appendix 2 activities conducted in the TMDL area to address the applicable TMDL parameter(s).

B. For applicable TMDLs not listed in Appendix 2, compliance with this Permit shall constitute compliance with those TMDLs.

C. For TMDLs that are approved by EPA after this Permit is issued, Ecology may establish TMDL-related permit requirements through future permit modification if Ecology determines implementation of actions, monitoring or reporting necessary to demonstrate reasonable further progress toward achieving TMDL waste load allocations, and other targets, are not occurring and shall be implemented during the term of this Permit or when this Permit is reissued. Permittees are encouraged to participate in development of TMDLs within their jurisdiction and to begin implementation.

S8. MONITORING AND ASSESSMENT

A. Regional Status and Trends Monitoring

1. King and Snohomish Counties, the Cities of Seattle and Tacoma, and the Ports of Seattle and Tacoma chose S8.B *Status and Trends Monitoring*, Option #1 in the *Phase I Municipal Stormwater Permit,* August 1, 2013 – July 31, 2018 (extended to July 31, 2019). These Permittees shall make a one-time payment into the collective fund to implement regional small streams and marine nearshore areas status and trends monitoring in Puget Sound. This payment is due on or before December 1, 2019. Submit payment according to Section S8.D.

2. King, Pierce, and Snohomish Counties, the Cities of Seattle and Tacoma, and the Ports of Seattle and Tacoma shall notify Ecology in writing which of the following two options for regional status and trends monitoring (S8.A.2.a or S8.A.2.b) the Permittee chooses to carry out during this Permit term. The written notification with G19 signature is due to Ecology no later than December 1, 2019.

a. Make annual payments into a collective fund to implement regional receiving water status and trends monitoring of small streams and marine nearshore areas in Puget Sound. The annual payments into the collective fund are due on or before August 15 each year beginning in 2020. Submit payments according to Section S8.D.

Or

b. Conduct stormwater discharge monitoring per the requirements in S8.C.

Either option will fully satisfy the Permittee’s obligations under this Section (S8.A.2). Each Permittee shall select a single option for this permit term.

3. Clark County shall:

a. Prepare to conduct regional urban streams status and trends monitoring in the Lower Columbia River Basin. No later than June 30, 2020, Clark County shall submit a completed version of the *Quality Assurance Project Plan for Status and Trends Monitoring of Urban Streams in Clark and Cowlitz Counties in the Lower Columbia River Region* – [Template for] Clark County, Lead Entity, June 30, 2019 (July 1, 2019 version 1.0, LC Urban Streams QAPP Template), to Ecology for review and approval.

i. Submit the “Site verification report and final Table 6 and Figure 2” listed in Table 2 of the LC Urban Streams QAPP Template on or before January 31, 2020, to Ecology for review and approval.

ii. Submit the “Extended monitoring report and final Tables 7 and 11” listed in Table 2 of the LC Urban Streams QAPP Template on or before March 31, 2020, to Ecology for review and approval.

b. Notify Ecology in writing which of the following two options for regional status and trends monitoring (S8.A.3.b.i or S8.A.3.b.ii) the County chooses to carry out during this permit term. The written notification with G19 signature is due to Ecology no later than December 1, 2019.

   i. Make annual payments into a collective fund to implement regional urban streams status and trends monitoring in Clark and Cowlitz Counties in the Lower Columbia River Basin. The annual payments into the collective fund are due on or before August 15 each year beginning in 2020. Submit payments according to Section S8.D below.

   Or

   ii. Conduct stormwater discharge monitoring per the requirements in S8.C.

   Either option will fully satisfy the County's obligations under this Section (S8.A.3.b). Clark County shall select a single option for the duration of this Permit.

B. Stormwater Management Program Effectiveness and Source Identification Studies

1. Clark, King, Pierce, and Snohomish Counties, the City of Seattle, and the Ports of Seattle and Tacoma chose S8.C *Effectiveness Studies,* Option #1 or Option #3 in the *Phase I Municipal Stormwater Permit* August 1, 2013 – July 31, 2018 (extended to July 31, 2019). These Permittees shall pay into the collective fund to implement effectiveness studies and source identification studies. The payment is due before on or before December 1, 2019. Submit payment according to Section S8.D.

2. Clark, King, Pierce, and Snohomish Counties, the Cities of Seattle and Tacoma, and the Ports of Seattle and Tacoma shall notify Ecology in writing which of the following three options (S8.B.2.a or S8.B.2.b or S8.B.2.c) for effectiveness and source identification studies the Permittee chooses to carry out during this permit term.

   a. Make annual payments into a collective fund to implement effectiveness and source identification studies. The annual payments into the collective fund are due on or before August 15 each year beginning in 2020. Submit payments according to Section S8.D.

   Or

   b. Conduct stormwater discharge monitoring per the requirements in S8.C.

   Or

   c. **Both:** make annual payments into a collective fund to implement regional effectiveness and source identification studies ***and*** independently conduct a Stormwater Management Program (SWMP) effectiveness study approved by Ecology.

      i. Permittees selecting this option shall make payments equal to one-half of the amounts listed in Appendix 11 for S8.B. The annual payments are due are due on or before August 15 each year beginning in 2020. Submit payments according to Section S8.D.

      ii. The SWMP effectiveness study shall be conducted in accordance with the requirements below:

(a) Write a detailed proposal describing: the purpose, objectives, design, and methods of the independent effectiveness study; anticipated outcomes including the question that will be answered; expected modifications to the Permittee's SWMP; relevance to other Permittees; and plans for sharing the findings with other Permittees. The proposal shall be prepared in accordance with the *SWMP Effectiveness Study Proposal and QAPP Template* (July 1, 2019, version 1.0) and submitted no later than February 2, 2020, to Ecology for review and approval.

(b) Within 120 days of Ecology's approval of the detailed proposal, submit a draft QAPP to Ecology. The QAPP shall be prepared in accordance with the *SWMP Effectiveness Study Proposal and QAPP template* (July 1, 2019, version 1.0). Within 60 days of receiving Ecology's comments, submit a final QAPP to Ecology for review and approval.

(c) Implement the study in accordance with the schedule in the approved final QAPP. Data and analyses shall be reported annually in accordance with the Ecology-approved QAPP.

Any of these three options (S8.B.2.a or S8.B.2.b or S8.B.2.c) will fully satisfy the Permittee's obligations under this Section (S8.B.2). Each Permittee shall select a single option for this permit term.

3. All Permittees shall provide information as requested for effectiveness and source identification studies that are under contract with Ecology as active Stormwater Action Monitoring (SAM) projects. These requests will be limited to records of SWMP activities and associated data tracked and/or maintained in accordance with S5 – *Stormwater Management Program* and/or S9 – *Reporting Requirements*. A maximum of three requests during the permit term from the SAM Coordinator will be transmitted to the Permittee's permit coordinator via Ecology's regional permit manager. The Permittee shall have 90 days to provide the requested information.

C. Stormwater Discharge Monitoring

1. No later than June 30, 2020, Clark County and the City of Tacoma shall submit data and a final report for the stormwater discharge monitoring that was conducted pursuant to S8.B.2 (Clark County) and S8.C *Effectiveness Studies*, Option #2 (Tacoma) in the *Phase I Municipal Stormwater Permit,* August 1, 2013 – July 31, 2018 (extended to July 31, 2019).

2. This Section applies only to Permittees who choose to conduct stormwater discharge monitoring per S8.A.2.b, S8.A.3.b.ii, and/or S8.B.2.b in lieu of participation in the *Regional Status and Trends Monitoring* and/or Effectiveness and Source Identification Studies. These Permittees shall conduct monitoring in accordance with Appendix 9 and an Ecology-approved QAPP as follows:

a. Cities and counties who choose the option to conduct stormwater discharge monitoring for either S8.A regional status and trends monitoring or S8.B effectiveness and source identification studies shall monitor five independent discharge locations; ports shall monitor two independent discharge locations. Permittees are encouraged to continue monitoring at locations monitored under S8.C.2 of the *Phase I Municipal Stormwater Permit* August 1, 2013 – July 31, 2018 (extended to July 31, 2019) and/or S8.D of the *Phase I Municipal Stormwater Permit,* February 16, 2007 – February 15, 2012.

i. Cities and counties who choose the option to conduct stormwater discharge monitoring for ***both*** S8.A *Regional Status and Trends Monitoring* and S8.B *Effectiveness and Source Identification Studies,* shall conduct this monitoring at a total of ten locations; at least seven locations shall be independent (up to three locations may be nested in other basins).

ii. Ports who choose the option to conduct stormwater discharge monitoring for ***both*** S8.A and S8.B shall conduct this monitoring at four independent locations.

b. No later than February 1, 2020, each Permittee shall submit a draft Stormwater Discharge Monitoring QAPP to Ecology for review and approval. The QAPP shall be prepared in accordance with the requirements in Appendix 9. The final QAPP shall be submitted to Ecology for approval as soon as possible following finalization, and before August 15, 2020, or within 60 days of receiving Ecology's comments on the draft QAPP (whichever is later).

c. Flow monitoring at new discharge monitoring locations shall begin no later than October 1, 2020, or within 30 days of receiving Ecology's approval of the final QAPP (whichever is later). Stormwater discharge monitoring shall be fully implemented no later than October 1, 2020, at previous or existing discharge monitoring locations and no later than October 1, 2021, at new discharge monitoring locations.

d. Data and analyses shall be reported annually in accordance with the Ecology-approved QAPP. Each Permittee shall enter into the Department's Environmental Information Management (EIM) database, all water and solids concentration data collected pursuant to Appendix 9.

D. Payments into the Collective Funds

1. This Section applies to all Permittees who choose to make annual payments into the collective funds for S8.A *Regional Status and Trends Monitoring* and/or S8.B *Effectiveness and Source Identification Studies*.

2. Each Permittee's S8.A and S8.B payment amounts are listed in Appendix 11.

a. For the S8.B.1 payment due on December 1, 2019, Clark County and the City of Seattle shall pay half the amount indicated for S8.B in Appendix 11.

b. For annual payments for S8.B.2 due on August 15, 2020 and thereafter, Permittees that choose option S8.B.2.c shall pay half the amount indicated for S8.B in Appendix 11.

3. Mail payments according to the instructions in the invoice sent to the Permittee approximately three months in advance of each payment due date, or via United States Postal Service to:

Department of Ecology Cashiering Unit
P.O. Box 47611
Olympia, WA 98405-7611

S9. REPORTING REQUIREMENTS

A. No later than March 31 of each year, each Permittee shall submit an Annual Report. The reporting period for the first Annual Report will be from January 1, 2019, through December 31, 2019. The reporting period for all subsequent Annual Reports shall be the previous calendar year unless otherwise specified.

Permittees shall submit Annual Reports electronically using Ecology's Water Quality Permitting Portal (WQWebPortal) available on Ecology's website unless otherwise directed by Ecology.

Permittees unable to submit electronically through Ecology's WQWebPortal shall contact Ecology to request a waiver and obtain instructions on how to submit an Annual Report in an alternative format.

B. Each Permittee is required to keep all records related to this Permit and the SWMP for at least five years.

C. Each Permittee shall make all records related to this Permit and the Permittee's SWMP available to the public at reasonable times during business hours. The Permittee will provide a copy of the most recent Annual Report to any individual or entity, upon request.

1. A reasonable charge may be assessed by the Permittee for making photocopies of records.
2. The Permittee may require reasonable advance notice of intent to review records related to this Permit.

D. The Annual Report for Permittees listed in S1.B shall include the following:

1. A copy of the Permittee's current SWMP Plan as required by S5.A.1.
2. Submittal of the Annual Report form as provided by Ecology pursuant to S9.A, describing the status of implementation of the requirements of this Permit during the reporting period.
3. Attachments to the Annual Report form including summaries, descriptions, reports, and other information as required, or as applicable, to meet the requirements of this Permit during the reporting period, or as a required submittal. Refer to Appendix 3 for Annual Report questions.
4. If applicable, notice that the MS4 is relying on another governmental entity to satisfy any of the obligations under the Permit.
5. Certification and signature pursuant to G19.D, and notification of any changes to authorization pursuant to G19.C.
6. A notification of any annexations, incorporations, or jurisdictional boundary changes resulting in an increase or decrease in the Permittee's geographic area of permit coverage during the reporting period.

E. Annual Report for Secondary Permittees, including the Port of Seattle and the Port of Tacoma. Each Annual Report shall include the following:

1. Submittal of the Annual Report as provided by Ecology pursuant to S9.A, describing the status of implementation of the requirements of this Permit during the reporting period.

2. Attachments to the Annual Report form including summaries, descriptions, reports, and other information as required, or as applicable, to meet the requirements of this Permit during the reporting period. Refer to Appendix 4 for Annual Report questions for Secondary Permittees, and Appendix 5 for Annual Report questions for the Ports of Seattle and Tacoma.
3. If applicable, notice that the MS4 is relying on another governmental entity to satisfy any of the obligations under this Permit.
4. Certification and signature pursuant to G19.D, and notification of any changes to authorization pursuant to G19.C.
5. A notification of any jurisdictional boundary changes resulting in an increase or decrease in the Permittee's geographic area of permit coverage during the reporting period.

GENERAL CONDITIONS

G1. DISCHARGE VIOLATIONS

All discharges and activities authorized by this Permit shall be consistent with the terms and conditions of this Permit.

G2. PROPER OPERATION AND MAINTENANCE

The Permittee shall at all times properly operate and maintain all facilities and systems of collection, treatment, and control (and related appurtenances) which are installed or used by the Permittee for pollution control to achieve compliance with the terms and conditions of this Permit.

G3. NOTIFICATION OF DISCHARGE INCLUDING SPILLS

If a Permittee has knowledge of a discharge, including spill(s), into or from a MS4, which could constitute a threat to human health, welfare, or the environment, the Permittee, shall:

A. Take appropriate action to correct or minimize the threat to human health, welfare and/or the environment.

B. Notify the Ecology regional office and other appropriate spill response authorities immediately but in no case later than within 24 hours of obtaining that knowledge.

C. Immediately report spills or other discharges which might cause bacterial contamination of marine waters, such as discharges resulting from broken sewer lines and failing onsite septic systems, to the Ecology regional office and to the Department of Health, Shellfish Program.

D. Immediately report spills or discharges of oils or hazardous substances to the Ecology regional office and to the Washington Emergency Management Division, (800) 258-5990.

G4. BYPASS PROHIBITED

The intentional bypass of stormwater from all or any portion of a stormwater treatment BMP whenever the design capacity of the treatment BMP is not exceeded, is prohibited unless the following conditions are met:

A. Bypass is: (1) unavoidable to prevent loss of life, personal injury, or severe property damage; or (2) necessary to perform construction or maintenance-related activities essential to meet the requirements of the Clean Water Act (CWA); *and*

B. There are no feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated stormwater, or maintenance during normal dry periods.

"Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss.

G5. RIGHT OF ENTRY

The Permittee shall allow an authorized representative of Ecology, upon the presentation of credentials and such other documents as may be required by law at reasonable times:

- **A.** To enter upon the Permittee's premises where a discharge is located or where any records shall be kept under the terms and conditions of this Permit;
- **B.** To have access to, and copy at reasonable cost and at reasonable times, any records that shall be kept under the terms of the Permit;
- **C.** To inspect at reasonable times any monitoring equipment or method of monitoring required in the Permit;
- **D.** To inspect at reasonable times any collection, treatment, pollution management, or discharge facilities; ***and***
- **E.** To sample at reasonable times any discharge of pollutants.

G6. DUTY TO MITIGATE

The Permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this Permit, which has a reasonable likelihood of adversely affecting human health or the environment.

G7. PROPERTY RIGHTS

This Permit does not convey any property rights of any sort, or any exclusive privilege.

G8. COMPLIANCE WITH OTHER LAWS AND STATUTES

Nothing in the Permit shall be construed as excusing the Permittee from compliance with any other applicable federal, state, or local statutes, ordinances, or regulations.

G9. MONITORING

- **A.** ***Representative Sampling****:* Samples and measurements taken to meet the requirements of this Permit shall be representative of the volume and nature of the monitored discharge, including representative sampling of any unusual discharge or discharge condition, including bypasses, upsets, and maintenance-related conditions affecting effluent quality.

- **B.** ***Records Retention****:* The Permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original recordings for continuous monitoring instrumentation, copies of all reports required by this Permit, and records of all data used to complete the application for this Permit, for a period of at least five years. This period of retention shall be extended during the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by Ecology. On request, monitoring data and analysis shall be provided to Ecology.

- **C.** ***Recording of Results****:* For each measurement or sample taken, the Permittee shall record the following information: (1) the date, exact place and time of sampling; (2) the individual who performed the sampling or measurement; (3) the dates the analyses were performed; (4) who performed the analyses; (5) the analytical techniques or methods used; and (6) the results of all analyses.

- **D.** ***Test Procedures****:* All sampling and analytical methods used to meet the monitoring requirements in this Permit shall conform to the Guidelines Establishing Test Procedures for the Analysis of Pollutants contained in 40 CFR Part 136, unless otherwise specified in this Permit or approved in writing by Ecology.

E. ***Flow Measurement****:* Where flow measurements are required by other conditions of this Permit, appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated, and maintained to ensure that the accuracy of the measurements are consistent with the accepted industry standard for that type of device. Frequency of calibration shall be in conformance with manufacturer's recommendations or at a minimum frequency of at least one calibration per year. Calibration records should be maintained for a minimum of three years.

F. ***Lab Accreditation****:* All monitoring data, except for flow, temperature, conductivity, pH, total residual chlorine, and other exceptions approved by Ecology, shall be prepared by a laboratory registered or accredited under the provisions of, Accreditation of Environmental Laboratories, Chapter 173-50 WAC. Soils and hazardous waste data are exempted from this requirement pending accreditation of laboratories for analysis of these media by Ecology. Quick methods of field detection of pollutants including nutrients, surfactants, salinity, and other parameters are exempted from this requirement when the purpose of the sampling is identification and removal of a suspected illicit discharge.

G. ***Additional Monitoring****:* Ecology may establish specific monitoring requirements in addition to those contained in this Permit by administrative order or permit modification.

G10. REMOVED SUBSTANCES

With the exception of decant from street waste vehicles, the Permittee shall not allow collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of stormwater to be resuspended or reintroduced to the MS4 or to waters of the State. Decant from street waste vehicles resulting from cleaning stormwater facilities may be reintroduced only when other practical means are not available and only in accordance with the *Street Waste Disposal Guidelines* in Appendix 6. Solids generated from maintenance of the MS4 may be reclaimed, recycled, or reused when allowed by local codes and ordinances. Soils that are identified as contaminated pursuant to Chapter 173-350 WAC shall be disposed at a qualified solid waste disposal facility (see Appendix 6).

G11. SEVERABILITY

The provisions of this Permit are severable, and if any provision of this Permit, or the application of any provision of this Permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this Permit shall not be affected thereby.

G12. REVOCATION OF COVERAGE

The director may terminate coverage under this General Permit in accordance with Chapter 43.21B RCW and Chapter 173-226 WAC. Cases where coverage may be terminated include, but are not limited to the following:

A. Violation of any term or condition of this General Permit.

B. Obtaining coverage under this General Permit by misrepresentation or failure to disclose fully all relevant facts.

C. A change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge.

D. A determination that the permitted activity endangers human health or the environment, or contributes significantly to water quality standards violations.

E. Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.

F. Nonpayment of permit fees assessed pursuant to RCW 90.48.465.

Revocation of coverage under this General Permit may be initiated by Ecology or requested by any interested person.

G13. TRANSFER OF COVERAGE

The director may require any discharger authorized by this General Permit to apply for and obtain an individual permit in accordance with Chapter 43.21B RCW and Chapter 173-226 WAC.

G14. GENERAL PERMIT MODIFICATION AND REVOCATION

This General Permit may be modified, revoked and reissued, or terminated in accordance with the provisions of WAC 173-226-230. Grounds for modification, revocation and reissuance, or termination include, but are not limited to, any of the following:

A. A change occurs in the technology or practices for control or abatement of pollutants applicable to the category of dischargers covered under this General Permit.

B. Effluent limitation guidelines or standards are promulgated pursuant to the CWA or Chapter 90.48 RCW, for the category of dischargers covered under this General Permit.

C. A water quality management plan containing requirements applicable to the category of dischargers covered under this General Permit is approved.

D. Information is obtained which indicates that cumulative effects on the environment from dischargers covered under this General Permit are unacceptable.

E. Changes made to State law reference this Permit.

G15. REPORTING A CAUSE FOR MODIFICATION OR REVOCATION

A Permittee who knows or has reason to believe that any activity has occurred or will occur which would constitute cause for modification or revocation and reissuance under Condition G12, G14, or 40 CFR 122.62 shall report such plans, or such information, to Ecology so that a decision can be made on whether action to modify, or revoke and reissue this Permit will be required. Ecology may then require submission of a new or amended application. Submission of such application does not relieve the Permittee of the duty to comply with this Permit until it is modified or reissued.

G16. APPEALS

A. The terms and conditions of this General Permit, as they apply to the appropriate class of dischargers, are subject to appeal within thirty days of issuance of this General Permit, in accordance with Chapter 43.21B RCW, and Chapter 173-226 WAC.

B. The terms and conditions of this General Permit, as they apply to an individual discharger, can be appealed, in accordance with Chapter 43.21B RCW, within thirty days of the effective date of coverage of that discharger. Consideration of an appeal of general permit coverage of an individual discharger is limited to the General Permit's applicability or nonapplicability to that individual discharger.

C. The appeal of general permit coverage of an individual discharger does not affect any other dischargers covered under this General Permit. If the terms and conditions of this General Permit are found to be inapplicable to any individual discharger(s), the matter shall be remanded to Ecology for consideration of issuance of an individual permit or permits.

D. Modifications of this Permit can be appealed in accordance with Chapter 43.21B RCW and Chapter 173-226 WAC.

G17. PENALTIES

40 CFR 122.41(a)(2) and (3), 40 CFR 122.41(j)(5), and 40 CFR 122.41(k)(2) are hereby incorporated into this Permit by reference.

G18. DUTY TO REAPPLY

The Permittee shall apply for permit renewal at least 180 days prior to the specified expiration date of this Permit.

G19. CERTIFICATION AND SIGNATURE

All formal submittals to Ecology shall be signed and certified.

A. All permit applications shall be signed by either a principal executive officer or ranking elected official.

B. All formal submittals required by this Permit shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

1. The authorization is made in writing by a person described above and submitted to Ecology, ***and***
2. The authorization specifies either an individual or a position having responsibility for the overall development and implementation of the Stormwater Management Program. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

C. Changes to authorization. If an authorization under General Condition G19.B.2 is no longer accurate because a different individual or position has responsibility for the overall development and implementation of the Stormwater Management Program, a new authorization satisfying the requirements of General Condition G19.B.2 shall be submitted to Ecology prior to or together with any reports, information, or applications to be signed by an authorized representative.

D. Certification. Any person signing a formal submittal under this Permit shall make the following certification:

> "I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for willful violations."

G20. NON-COMPLIANCE NOTIFICATION

In the event a Permittee is unable to comply with any of the terms and conditions of this Permit, the Permittee shall:

A. Notify Ecology of the failure to comply with the permit terms and conditions in writing within 30 days of becoming aware that the non-compliance has occurred. The written notification to Ecology shall include all of the following:

1. A description of the non-compliance, including the reference(s).
2. Beginning and ending dates of the non-compliance, or if the Permittee has not corrected the non-compliance, the anticipated date of correction.
3. Steps taken or planned to reduce, eliminate, or prevent reoccurrence of the non-compliance.

B. Take appropriate action to stop or correct the condition of non-compliance.

G21. UPSETS

Permittees shall meet the conditions of 40 CFR 122.41(n) regarding “Upsets.” The conditions are as follows:

A. ***Definition***. “Upset” means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

B. ***Effect of an upset***. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of paragraph (C) of this condition are met. Any determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, will not constitute final administrative action subject to judicial review.

C. ***Conditions necessary for demonstration of upset***. A Permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed contemporaneous operating logs, or other relevant evidence that:

1. An upset occurred and that the Permittee can identify the cause(s) of the upset;

2. The permitted facility was at the time being properly operated; and
3. The Permittee submitted notice of the upset as required in 40 CFR 122.41(l)(6)(ii)(B) (24-hour notice of noncompliance).
4. The Permittee complied with any remedial measures required under 40 CFR 122.41(d) (Duty to Mitigate).

D. ***Burden of proof***. In any enforcement proceeding, the Permittee seeking to establish the occurrence of an upset has the burden of proof.

DEFINITIONS AND ACRONYMS

This Section includes definitions for terms used in the body of the Permit and in all the appendices except Appendix 1. Terms defined in Appendix 1 are necessary to implement requirements related to Appendix 1.

40 CFR means Title 40 of the Code of Federal Regulations, which is the codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the federal government.

AKART means All Known, Available and Reasonable methods of prevention, control and Treatment. See also State Water Pollution Control Act, Chapter 90.48.010 and 90.48.520 RCW.

All Known, Available and Reasonable methods of prevention, control and Treatment refers to the State Water Pollution Control Act, Chapter 90.48.010 and 90.48.520 RCW.

Applicable TMDL means a TMDL which has been approved by EPA on or before the issuance date of this Permit, or prior to the date that Ecology issues coverage under this Permit, whichever is later.

Beneficial Uses means uses of waters of the State, which include but are not limited to: use for domestic, stock watering, industrial, commercial, agricultural, irrigation, mining, fish and wildlife maintenance and enhancement, recreation, generation of electric power and preservation of environmental and aesthetic values, and all other uses compatible with the enjoyment of the public waters of the State.

Best Management Practices are the schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices approved by Ecology that, when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to waters of Washington State.

B-IBI means Benthic Index of Biotic Integrity.

BMP means Best Management Practice.

Bypass means the diversion of stormwater from any portion of a stormwater treatment facility.

Circuit means a portion of a MS4 discharging to a single point or serving a discrete area determined by traffic volumes, land use, topography, or the configuration of the MS4.

Component or Program Component means an element of the Stormwater Management Program listed in Special Condition S5 – *Stormwater Management Program for Permittees* or S6 – *Stormwater Management Program for Secondary Permittees*, or S7 – *Compliance with Total Maximum Daily Load Requirements*, or S8 – *Monitoring and Assessment*.

Community-based social marketing is a social marketing methodology and employs a systematic way to change the behavior of communities to reduce their impact on the environment. Realizing that providing information is usually not sufficient to initiate behavior change, community-based social marketing uses tools and findings from social psychology to discover the perceived barriers to behavior change and ways of overcoming these barriers.

Conveyance System means that portion of the municipal separate storm sewer system designed or used for conveying stormwater.

Co-Permittee means an owner or operator of a MS4 which is in a cooperative agreement with at least one other applicant for coverage under this Permit. A Co-Permittee is an owner or operator of a regulated MS4 located within or in proximity to another regulated MS4. A Co-Permittee is only responsible for permit conditions relating to the discharges from the MS4 the Co-Permittee owns or operates. See also 40 CFR 122.26(b)(1).

CWA means the federal Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972) Pub.L. 92-500, as amended Pub. L. 95-217, Pub. L. 95-576, Pub. L. (6-483 and Pub. L. 97-117, 33 U.S.C. 1251 *et seq*.).

Director means the Director of the Washington State Department of Ecology, or an authorized representative.

Discharge Point means the location where a discharge leaves the Permittee's MS4 through the Permittee's MS4 facilities/BMPs designed to infiltrate.

Entity means a governmental body, or a public or private organization.

EPA means the U.S. Environmental Protection Agency.

Fully Stabilized means the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as riprap, gabions or geotextiles) which prevents erosion.

General Permit means a permit which covers multiple dischargers of a point source category within a designated geographical area, in lieu of individual permits being issued to each discharger.

Groundwater means water in a saturated zone or stratum beneath the surface of the land or below a surface water body. Refer to Chapter 173-200 WAC.

Hazardous Substance means any liquid, solid, gas, or sludge, including any material, substance, product, commodity, or waste, regardless of quantity, that exhibits any of the physical, chemical, or biological properties described in WAC 173-303-090 or WAC 173-303-100.

Heavy Equipment Maintenance or Storage Yard means an uncovered area where any heavy equipment, such as mowing equipment, excavators, dump trucks, backhoes, or bulldozers are washed or maintained, or where at least five pieces of heavy equipment are stored on a long term basis.

Highway means a main public road connecting towns and cities.

Hydraulically Near means runoff from the site discharges to the sensitive feature without significant natural attenuation of flows that allows for suspended solids removal. See Appendix 7 Determining Construction Site Sediment Damage Potential for a more detailed definition.

Hyperchlorinated means water that contains more than 10 mg/Liter chlorine.

Illicit Connection means any infrastructure connection to the MS4 that is not intended, permitted, or used for collecting and conveying stormwater or non-stormwater discharges allowed as specified in this Permit (S5.C.9, S6.D.3, and S6.E.3). Examples include sanitary sewer connections, floor drains, channels, pipelines, conduits, inlets, or outlets that are connected directly to the MS4.

Illicit Discharge means any discharge to a MS4 that is not composed entirely of stormwater or of non-stormwater discharges allowed as specified in this Permit (S5.C.9, S6.D.3 and S6.E.3).

Impervious Surface means a non-vegetated surface area that either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development. A non-vegetated surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or stormwater areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled, macadam or other surfaces which similarly impede the natural infiltration of stormwater.

Land Disturbing Activity means any activity that results in a change in the existing soil cover (both vegetative and non-vegetative) and/or the existing soil topography. Land disturbing activities include, but are not limited to clearing, grading, filling and excavation. Compaction that is associated with stabilization of structures and road construction shall also be considered land disturbing activity. Vegetation maintenance practices, including landscape maintenance and gardening, are not considered land disturbing activity. Stormwater facility maintenance is not considered land disturbing activity if conducted according to established standards and procedures.

LID means Low Impact Development.

LID BMP means Low Impact Development Best Management Practices.

LID Principles means land use management strategies that emphasize conservation, use of on-site natural features, and site planning to minimize impervious surfaces, native vegetation loss, and stormwater runoff.

Low Impact Development means a stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices that are integrated into a project design.

Low Impact Development Best Management Practices means distributed stormwater management practices, integrated into a project design, that emphasize pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration. LID BMPs include, but are not limited to, bioretention, rain gardens, permeable pavements, roof downspout controls, dispersion, soil quality and depth, vegetated roofs, minimum excavation foundations, and water re-use.

Material Storage Facilities means an uncovered area where bulk materials (liquid, solid, granular, etc.) are stored in piles, barrels, tanks, bins, crates, or other means.

Maximum Extent Practicable refers to paragraph 402(p)(3)(B)(iii) of the federal Clean Water Act which reads as follows: Permits for discharges from municipal storm sewers shall require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques, and system, design, and engineering methods, and other such provisions as the Administrator or the State determines appropriate for the control of such pollutants.

MEP means Maximum Extent Practicable.

MS4 means Municipal Separate Storm Sewer System.

Municipal Separate Storm Sewer System means a conveyance, or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains):

(i) Owned or operated by a state, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State Law) having jurisdiction over disposal of wastes, stormwater, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under Section 208 of the CWA that discharges to waters of the State.

(ii) Designed or used for collecting or conveying stormwater.

(iii) Which is not a combined sewer.

(iv) Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2.

(v) Which is defined as “large” or “medium” or “small” or otherwise designated by Ecology pursuant to 40 CFR 122.26.

National Pollutant Discharge Elimination System means the national program for issuing, modifying, revoking, and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 402, 318, and 405 of the Federal Clean Water Act, for the discharge of pollutants to surface waters of the State from point sources. These permits are referred to as NPDES permits and, in Washington State, are administered by the Washington Department of Ecology.

Native Vegetation means vegetation comprised of plant species, other than noxious weeds, that are indigenous to the coastal region of the Pacific Northwest and which reasonably could have been expected to naturally occur on the site. Examples include trees such as Douglas Fir, western hemlock, western red cedar, alder, big-leaf maple; shrubs such as willow, elderberry, salmonberry, and salal; and herbaceous plants such as sword fern, foam flower, and fireweed.

New Development means land disturbing activities, including Class IV-General Forest Practices that are conversions from timber land to other uses; structural development, including construction or installation of a building or other structure; creation of hard surfaces; and subdivision, short subdivision and binding site plans, as defined and applied in Chapter 58.17 RCW. Projects meeting the definition of redevelopment shall not be considered new development. Refer to Appendix 1 for a definition of hard surfaces.

New Secondary Permittee means a Secondary Permittee that is covered under a Municipal Stormwater General Permit and was not covered by the Permit prior to July 1, 2019.

NOI means Notice of Intent.

Notice of Intent means the application for, or a request for coverage under a General NPDES Permit pursuant to WAC 173-226-200.

Notice of Intent for Construction Activity means the application form for coverage under the Construction Stormwater General Permit.

Notice of Intent for Industrial Activity means the application form for coverage under the General Permit for Stormwater Discharges Associated with Industrial Activities.

NPDES means National Pollutant Discharge Elimination System.

O&M means operation and maintenance.

Outfall means point source as defined by 40 CFR 122.2 at the point where a discharge means a point source as defined by 40 CFR 122.2 at the point where a discharge leaves the Permittee’s MS4 and enters a surface receiving waterbody or surface receiving waters. Outfall does not include pipes, tunnels, or other conveyances which connect segments of the same stream or other surface waters and are used to convey primarily surface waters (i.e., culverts).

Overburdened Community means minority, low-income, tribal, or indigenous populations or geographic locations in Washington State that potentially experience disproportionate environmental harms and risks. This disproportionality can be as a result of greater vulnerability to environmental hazards, lack of opportunity for public participation, or other factors. Increased vulnerability may be attributable to an accumulation of negative or lack of positive environmental, health, economic, or social conditions within these populations or places. The term describes situations where multiple factors, including both environmental and socio-economic stressors, may act cumulatively to affect health and the environment and contribute to persistent environmental health disparities.

Permittee unless otherwise noted, includes city, town, or county Permittee, port Permittee, Co-Permittee, Secondary Permittee, and New Secondary Permittee.

Physically Interconnected means that one MS4 is connected to another storm sewer system in such a way that it allows for direct discharges to the second system. For example, the roads with drainage systems and municipal streets of one entity are physically connected directly to a storm sewer system belonging to another entity.

Project Site means that portion of a property, properties, or right-of-ways subject to land disturbing activities, new hard surfaces, or replaced hard surfaces. Refer to Appendix 1 for a definition of hard surfaces.

QAPP means Quality Assurance Project Plan.

Qualified Personnel means someone who has had professional training in the aspects of stormwater management for which they are responsible and are under the functional control of the Permittee. Qualified Personnel may be staff members, contractors, or volunteers.

Quality Assurance Project Plan means a document that describes the objectives of an environmental study and the procedures to be followed to achieve those objectives.

RCW means the Revised Code of Washington State.

Receiving Waterbody or **Receiving Waters** means naturally and/or reconstructed naturally occurring surface water bodies, such as creeks, streams, rivers, lakes, wetlands, estuaries, and marine waters, or groundwater, to which a MS4 discharges.

Redevelopment means, on a site that is already substantially developed (i.e., has 35% or more of existing hard surface coverage), the creation or addition of hard surfaces; the expansion of a building footprint or addition or replacement of a structure; structural development including construction, installation or expansion of a building or other structure; replacement of hard surface that is not part of a routine maintenance activity; and land disturbing activities. Refer to Appendix 1 for a definition of hard surfaces.

Runoff is water that travels across the land surface and discharges to water bodies either directly or through a collection and conveyance system. See also "Stormwater."

SAM means Stormwater Action Monitoring

Secondary Permittee is an operator of a MS4 which is not a city, town, or county. Secondary Permittees include special purpose districts and other public entities that meet the criteria inS1.E.1.

Sediment/Erosion-Sensitive Feature means an area subject to significant degradation due to the effect of construction runoff, or areas requiring special protection to prevent erosion. See Appendix 7 Determining Construction Site Sediment Transport Potential for a more detailed definition.

Shared Waterbodies means waterbodies, including downstream segments, lakes and estuaries, that receive discharges from more than one Permittee.

Significant Contributor means a discharge that contributes a loading of pollutants considered to be sufficient to cause or exacerbate the deterioration of receiving water quality or instream habitat conditions.

Source Control BMP means a structure or operation that is intended to prevent pollutants from coming into contact with stormwater through physical separation of areas or careful management of activities that are sources of pollutants. The SWMMWW separates source control BMPs into two types. Structural Source Control BMPs are physical, structural, or mechanical devices, or facilities that are intended to prevent pollutants from entering stormwater. Operational BMPs are non-structural practices that prevent or reduce pollutants from entering stormwater.

Stormwater means runoff during and following precipitation and snowmelt events, including surface runoff, drainage, and interflow.

Stormwater Action Monitoring is the regional stormwater monitoring program for western Washington. This means, for all of western Washington, a stormwater-focused monitoring and assessment program consisting of: status and trends monitoring in small streams and marine nearshore areas, Stormwater Management Program effectiveness studies, and source identification projects. The priorities and scope for SAM are set by a formal stakeholder group that selects the studies and oversees the program's administration.

Stormwater Associated with Industrial and Construction Activity means the discharge from any conveyance which is used for collecting and conveying stormwater, which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant, or associated with clearing, grading and/or excavation, and is required to have an NPDES permit in accordance with 40 CFR 122.26.

Stormwater Facilities Regulated by the Permittee means permanent stormwater treatment and flow control BMPs/facilities located in the geographic area covered by the Permit and which are not owned by the Permittee, and are known by the Permittee to discharge into MS4 owned or operated by the Permittee.

Stormwater facility retrofits means both: projects that retrofit existing treatment and/or flow control facilities; and new flow control or treatment facilities or BMPs that will address impacts from existing development.

Stormwater Management Program means a set of actions and activities designed to reduce the discharge of pollutants from the MS4 to the MEP and to protect water quality, and comprising the components listed in S5 or S6 of this Permit and any additional actions necessary to meet the requirements of applicable TMDLs pursuant to S7 Compliance with TMDL Requirements, and S8 Monitoring and Assessment.

Stormwater Treatment and Flow Control BMPs/Facilities means detention facilities, permanent treatment BMPs/facilities; and bioretention, vegetated roofs, and permeable pavements that help meet minimum requirement #6 (treatment), #7 (flow control), or both.

Surface Waters includes lakes, rivers, ponds, streams, inland waters, salt waters, and all other surface waters and water courses within the jurisdiction of the State of Washington.

SWMMWW and ***Stormwater Management Manual for Western Washington*** means the technical manual (Publication No. 04-10-055) published by the Department of Ecology in 2019.

SWMP means Stormwater Management Program.

TMDL means Total Maximum Daily Load.

Total Maximum Daily Load means a water cleanup plan. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation shall include a margin of safety to ensure that the water body can be used for the purposes the state has designated. The calculation shall also account for seasonable variation in water quality. Water quality standards are set by states, territories, and tribes. They identify the uses for each water body, for example, drinking water supply, contact recreation (swimming), and aquatic life support (fishing), and the scientific criteria to support that use. The Clean Water Act, Section 303, establishes the water quality standards and TMDL programs.

Tributary Conveyance means pipes, ditches, catch basins, and inlets owned or operated by the Permittee and designed or used for collecting and conveying stormwater.

UGA means Urban Growth Area.

Urban Growth Area means those areas designated by a county pursuant to RCW 36.70A.110.

Urban/Higher Density Rural Sub-Basins means all areas within or proposed to be within the UGA, or any sub-basin outside the UGA with 50% or more area comprised of lots less than 5 acres.

Vehicle Maintenance or Storage Facility means an uncovered area where any vehicles are regularly washed or maintained, or where at least 10 vehicles are stored.

Water Quality Standards means Surface Water Quality Standards, Chapter 173-201A WAC, Groundwater Quality Standards, Chapter 173-200 WAC, and Sediment Management Standards, Chapter 173-204 WAC.

Waters of the State includes those waters as defined as *Waters of the United States* in 40 CFR Subpart 122.2 within the geographic boundaries of Washington State and *Waters of the State* as defined in Chapter 90.48 RCW which includes lakes, rivers, ponds, streams, inland waters, underground waters, salt waters, and all other surface waters and water courses within the jurisdiction of the State of Washington.

Waters of the United States refers to the definition in 40 CFR 122.2.

Updating EPA's Guidelines for Deriving National Recommended Water Quality Criteria

Lars Wilcut

Wade Lehmann

Mike Elias

US EPA, Office of Water

Office of Science and Technology

Health and Ecological Criteria Division

Presentation Layout

Lars Wilcut *Standards Health Protection Division*

– Regulatory basis of aquatic life criteria

Wade Lehmann *Health and Ecological Criteria Division*

– History and technical approach to criteria derivation

Mike Elias *Health and Ecological Criteria Division*

– Ongoing work and future focus

Regulatory basis of aquatic life criteria

Lars Wilcut
Standards Health Protection Division

Federal 304(a) Criteria Recommendations

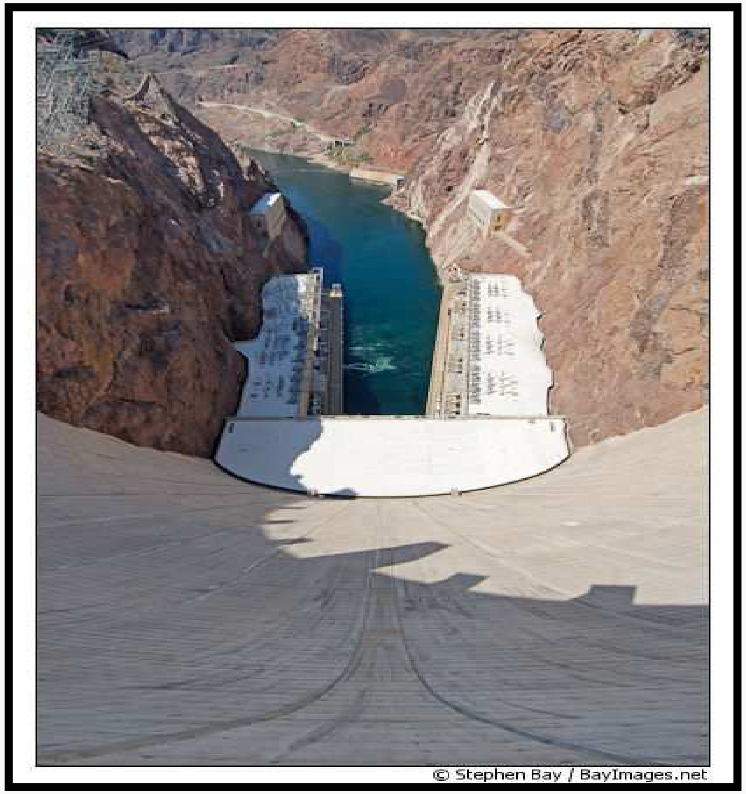
- *CWA Section 304(a) Criteria*: Recommendations developed by EPA based on the latest scientific knowledge, issued periodically as guidance to states/tribes for use in developing their own criteria.

- Basis for Federal promulgation if necessary (i.e., if a state/tribe fails to adopt adequately protective criteria on their own).

Pyramid Lake

What else does the CWA say about Criteria?

- *CWA 303(c)(1):* States/Tribes shall adopt criteria to protect designated uses into their WQS.
- *CWA 303 (c)(2)(b):* States/Tribes shall adopt criteria for “priority pollutants” (a list of ‘toxic pollutants’ from a Congressional committee report referenced in *CWA 307(a)*).



Hoover Dam

State Water Quality Criteria

- The term '*criteria*' is defined in regulations at 40 CFR 131.3(b) as:
  - Elements of state/tribe WQS, expressed as constituent concentration, levels, or narrative statements, representing a quality of water that supports a particular use. <u>When criteria are met, water quality will generally protect the designated use.</u>

Purpose of Criteria

WQS

Designated Use

Reflect the state/tribe's management goals for their water bodies, including CWA 101(a)(2) goals.
40 CFR 131.10

Criteria

To protect uses
40 CFR 131.11

Antidegradation

To protect existing uses, high quality waters, outstanding national resource waters
40 CFR 131.12

Implementation*

Permit Limit

NPDES permit limits must derive from and comply with WQS
40 CFR 122.44(d)(vii)(A)

** NPDES is just one example of implementation*

What do the WQS Regulations require for Criteria? (40 CFR 131.11)

- States/Tribes must adopt those water quality criteria that protect the designated use.
  - Such criteria must be based on sound <u>scientific rationale.</u>
  - Such criteria must contain <u>sufficient parameters or constituents</u> to protect the designated use.
  - For waters with multiple use designations, the criteria shall support the <u>*most sensitive use.*</u>

What do the WQS Regulations require for Criteria? (40 CFR 131.11)

- 40 CFR 131.11(b) states that in establishing criteria states/tribes should establish numerical values based on:

1) 304(a) guidance

2) 304(a) guidance modified to reflect site-specific conditions

3) Other scientifically defensible methods

History and technical approach to criteria derivation

Wade Lehmann, PhD
Health and Ecological Criteria Division

What are the Current Guidelines?

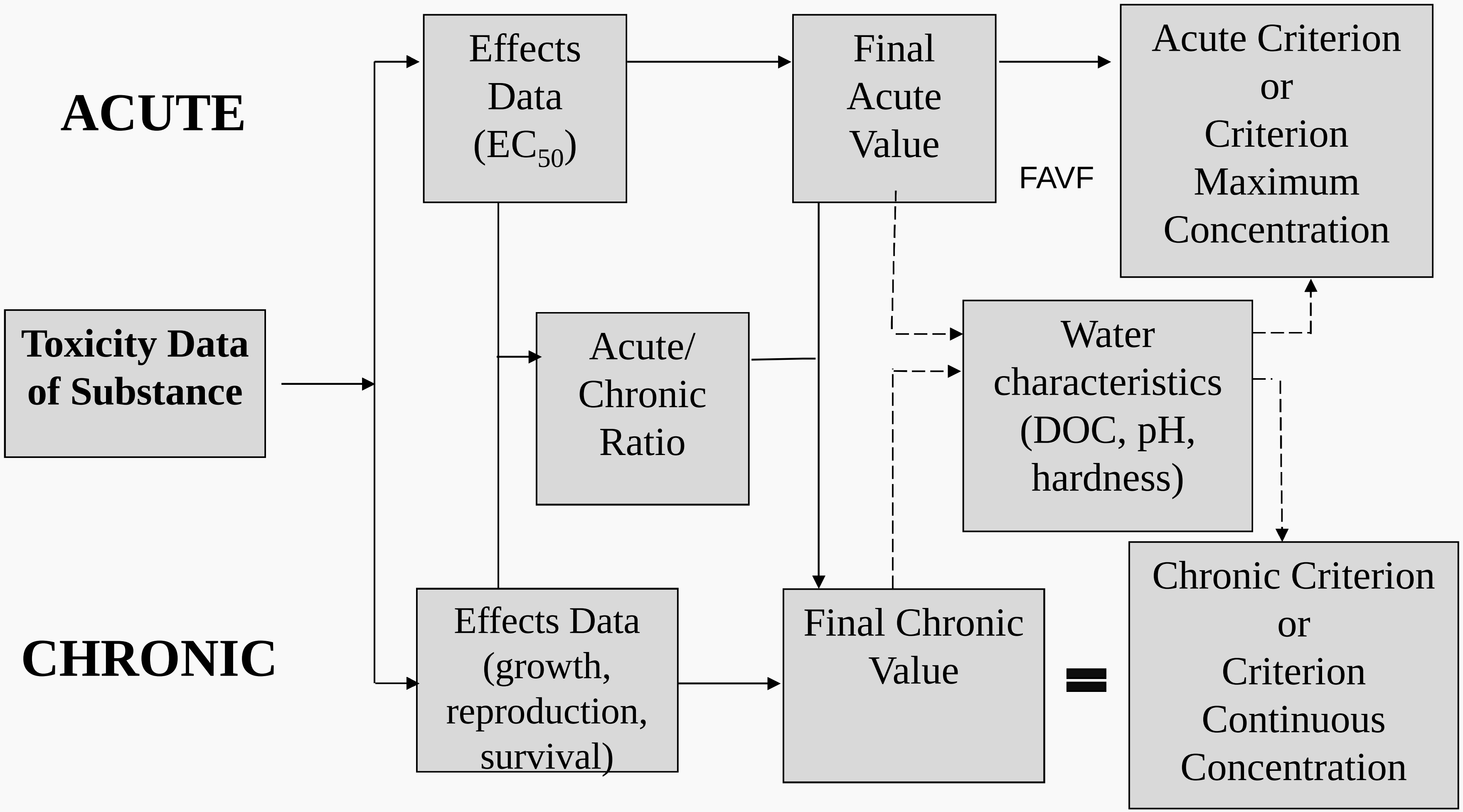
- Applicable to aquatic life (not human health) designated uses
- Generated as outlined in *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses,* Stephen et al. 1985

"Aquatic organisms and their uses should not be affected unacceptably if the four-day average concentration of the pollutant does not exceed [CCC] and if the one-hour average concentration does not exceed [CMC] more than once every three years on average."

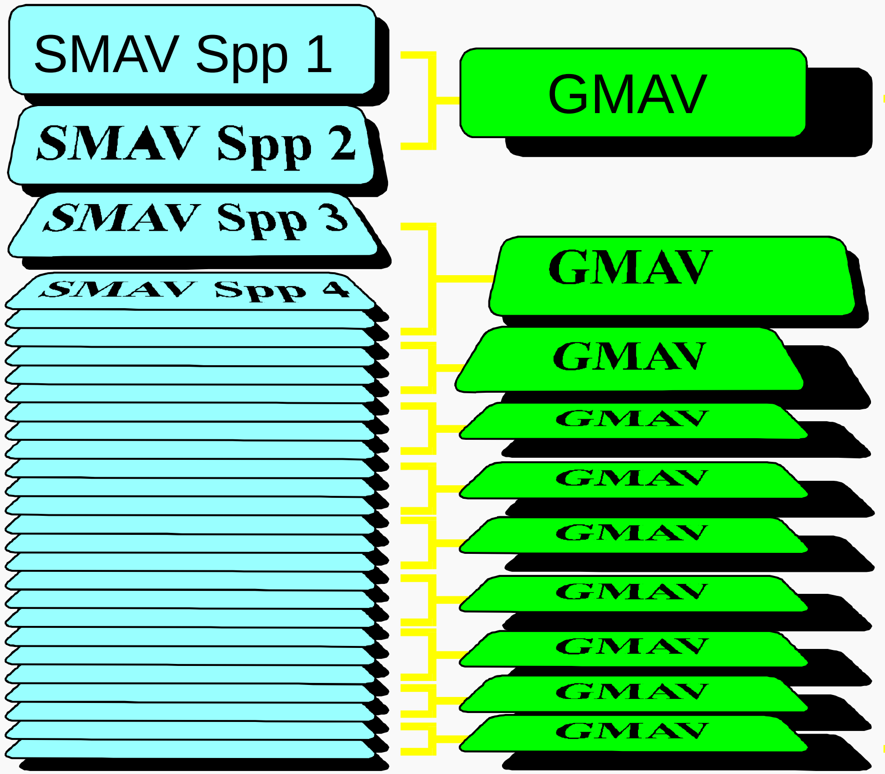
Need for Re-evaluation

- Reviews, workshops and recommendations in 1990, 1995, 1998, 2001, 2003, 2005
- A need to address the state of the science and guidance put forth by EPA and NRC
- Need to consider current areas of focus that cut across Agency offices such as MOA/AOP, weight of evidence, uncertainty

Current Process Summary



Data Compilation Summary

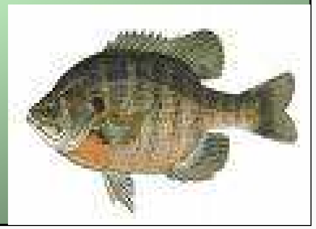


Have the minimum data requirements been met? (8 taxonomic groupings)

Eight Taxa (MDRs)

SALMONID

SECOND FISH FAMILY



CHORDATA

PLANKTONIC CRUSTACEAN

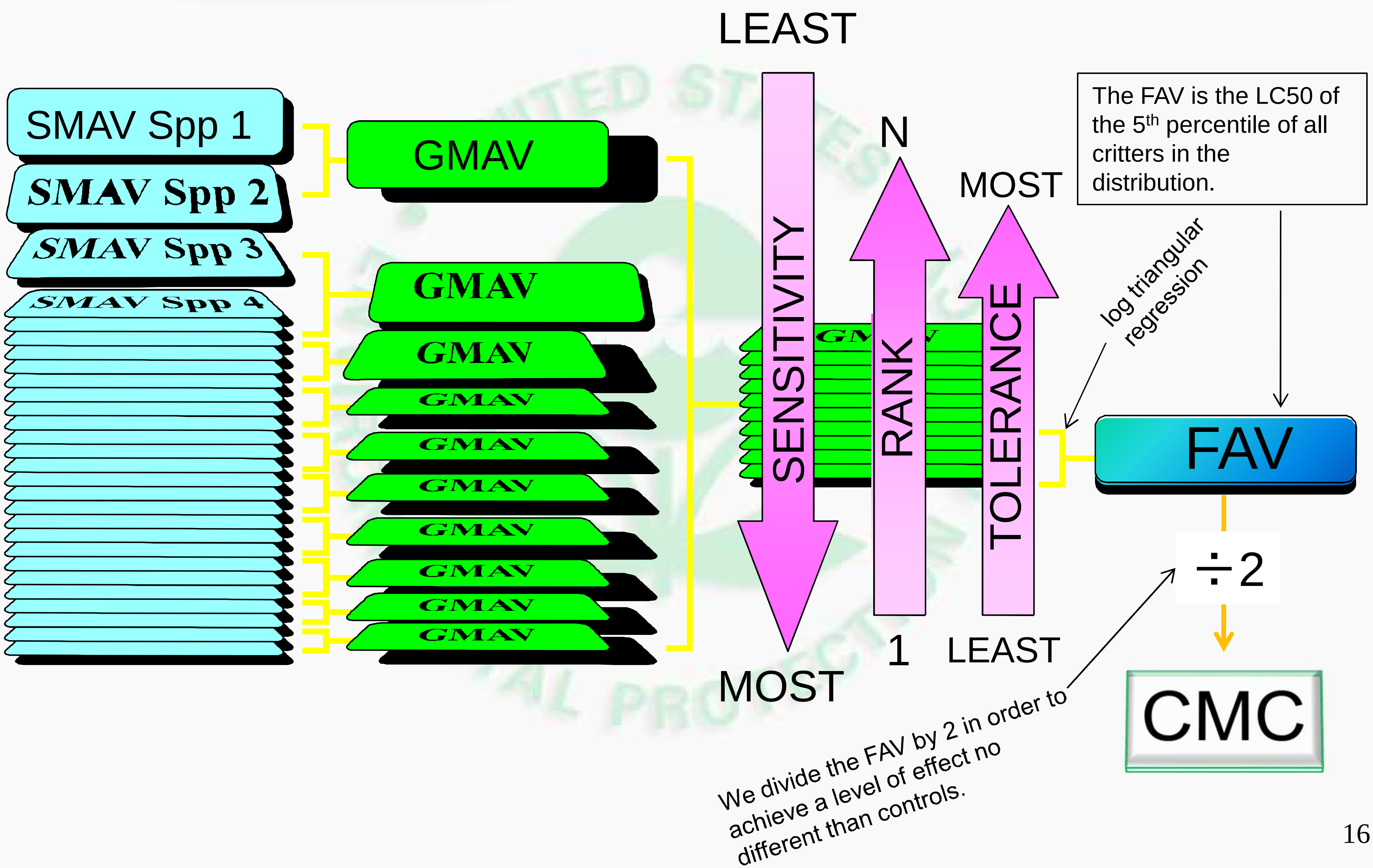
BENTHIC CRUSTACEAN

INSECT

ROTIFERA, ANNELIDA, MOLLUSCA

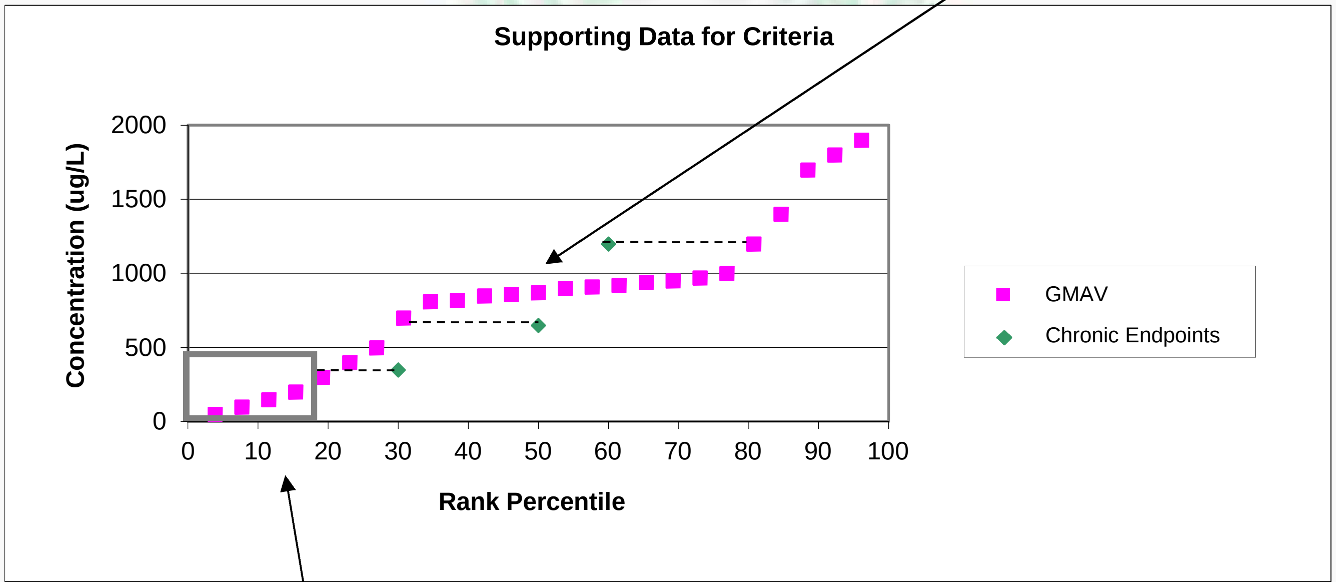
OTHER INSECT OR MOLLUSC

FAV Calculation Overview



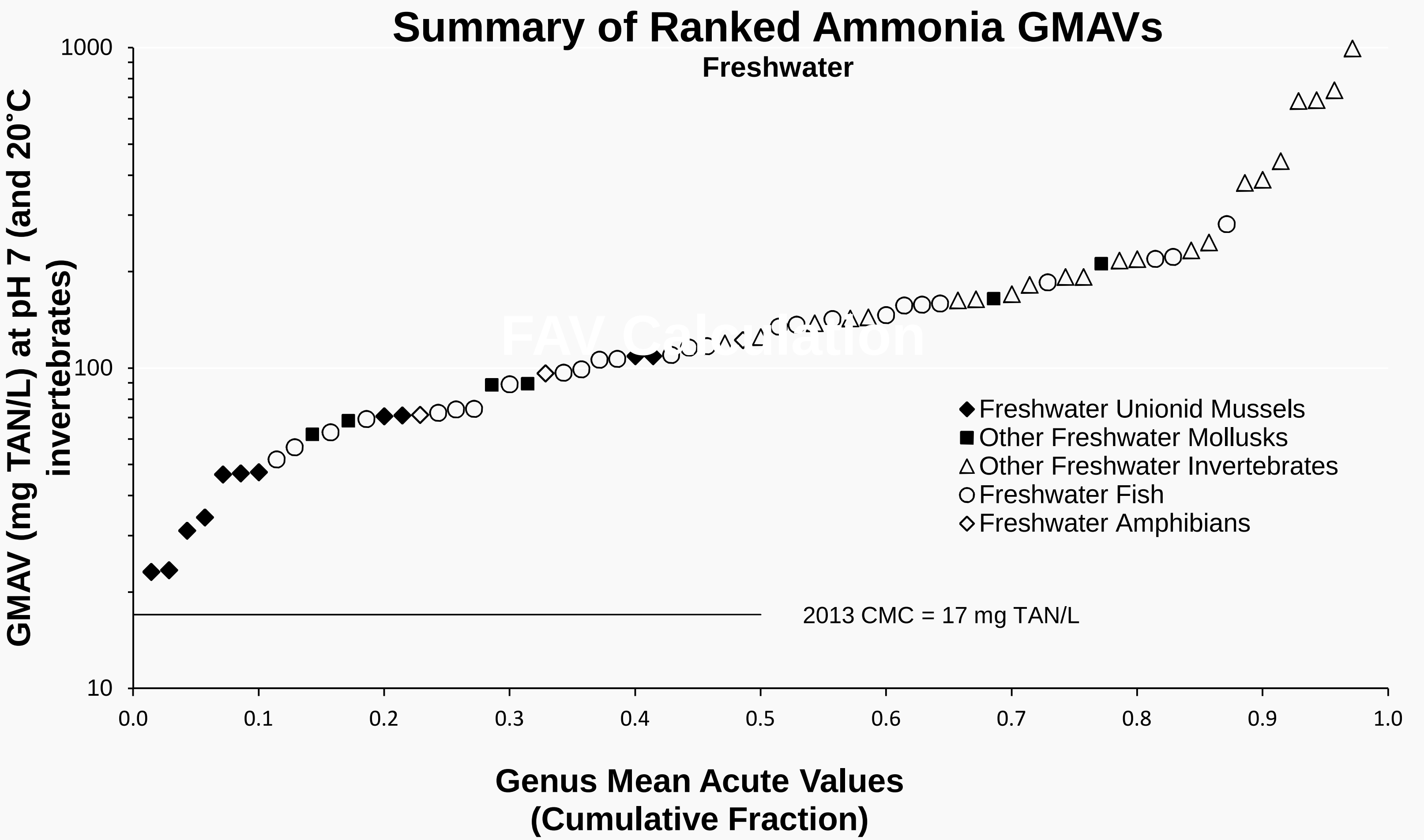
FAV Calculation

GMAV and Calculate the Percentile of each rank (100 R/(N+1))



Using the 4 Most Sensitive Genera, Perform a Least Squares Regression of the GMAV (log values) on the Percentile Ranks (square roots) to generate an HC_5 = FAV

Ranked GMAVs for Ammonia



Acute to Chronic Ratio – Chronic Criterion

Calculating and Applying the ACR

1. Acute & chronic tests using same species in same dilution water *(guidance on test matching and requirements in 1985 Guidelines)*

2. Use results of tests to calculate Acute-Chronic Ratios (ACR):

$$\text{ACR} = \frac{\text{Acute Value}}{\text{Chronic Value}}$$

3. Develop a Final Acute-Chronic Ratio (FACR) by taking a geometric mean of the appropriate ACRs *(3 minimum)*

4. Calculate the Final Chronic Value (FCV) using the FACR:

$$\text{FCV} = \frac{\text{Final Acute Value}}{\text{FACR}}$$

Ongoing work and future focus

Mike Elias
Health and Ecological Criteria Division

Recent Evaluations by EPA

- MOA/AOP based MDR reduction
- FAV divided by 2 (FAVF) re-evaluation, *Host et al*
- MATC / ECx / NOEC evaluations
- ACR derivation considerations
- SSD utilization

Functional Considerations

- Scientific validity and latest scientific knowledge

- Applicability to national context with ability to derive site specific values as appropriate

- Incorporation of uncertainty, both qualitative and quantitative

- Ease of understanding and use

Criterion Process Advancement

- HECD is actively utilizing complete problem formulation in criteria derivation to better relate the assessment process to the protective outcomes.
  - including pollutant sources and uncertainties
  - recent examples include ammonia, carbaryl, & selenium (draft)

Associated Projects

- Contaminants of Emerging Concern, 2008
- Common Effects, 2010
- EPA Plant Methodology, 2015-2016

Next Steps

- EPA will share EPA presentation, and other presentations for authors that agree, on the EPA website for this meeting

- EPA will create an analysis plan to assess the utility of the presented methods for inclusion in revision of the Guidelines.

- OST's Ecological Risk Assessment Branch will lead a small Guidelines workgroup in this effort; the workgroup will include other OW offices, ORD, Regions, and interested EPA Program Offices.

Next Steps

- The EPA Guidelines workgroup will move forward with developing a draft updated Guidelines document
- Updated Guidelines approach will be submitted for rigorous, independent external peer review and public comment
- Guidelines will be revised considering peer review and public comment and subsequently published as final.
- EPA expects this to be a several year effort.

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