

REDMOND PAIRED WATERSHED STUDY IMPLEMENTATION: TOSH CREEK WATERSHED STREETSWEEPING EFFECTIVENESS MONITORING

In February 2014, the Washington State Department of Ecology (Ecology) approved a Citywide Watershed Management Plan (WMP) for the City of Redmond (City) that allows use of a watershed approach for implementing required stormwater best management practices (BMPs) pursuant to the Phase II municipal stormwater permit. Through the implementation of this WMP, the City will focus stormwater BMPs in a subset of priority watersheds that are moderately impacted by urbanization and therefore expected to respond more quickly to rehabilitation efforts. This provides a unique opportunity to study the effectiveness of stormwater BMPs for improving receiving water conditions on an accelerated timeframe. Recognizing this opportunity, the City is implementing the Redmond Paired Watershed Study (RPWS) to quantify improvements in receiving water conditions based on routine and continuous measurements of various hydrologic, chemical, physical, and biological indicators of stream health.

This study is be implemented over an anticipated ten-year timeframe with funding from Ecology's Stormwater Action Monitoring (SAM) program. To date, the City has authorized Herrera to implement the monitoring identified in the QAPP over a period that extends from water years (WY) 2016 through 2024 (a water year is defined as the 12-month period that extends from October 1 in any given year through September 30 of the following year). The monitoring is planned to be a 10-year effort and will extend through WY 2025.

A trend analysis report that was prepared by Herrera after four years of study implementation (Herrera 2021) documented a significant decrease in total suspended solids (TSS) and total copper concentrations in Monticello Creek that appeared related to a City project that progressively increased street sweeping frequency in the associated watershed. These results were consistent with another study that was implemented by Seattle (SPU 2018).

To further evaluate the effectiveness of street sweeping for improving water quality, the City obtained grant funding from King County Wastewater Treatment Division (WTD) to progressively increase street sweeping in the Tosh Creek watershed. Using this funding, City staff are sweeping all public roads (3.54 miles) in the Tosh Creek watershed within Redmond city limits one time per month from October 2022 through September 2023, and two times per month from October 2023 through September 2024. This is in addition to the regularly scheduled quarterly street sweeping.

At the same time, Herrera has performed supplemental sampling and analysis for the RPWS to evaluate whether the increased frequency of street sweeping is effective at removing other pollutants of concern

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that are associated with roadway runoff. Specifically, using Ecology proviso funds, the City is collecting samples for evaluating concentrations of 6PPD-quinone (6PPD-q) and polycyclic aromatic hydrocarbons (PAHs) during the routine water quality monitoring that is conducted for the RPWS.

This monitoring was conducted over the first three quarters of WY 2023 (October 1, 2022 through June 30, 2023) pursuant to amendment #4 to Herrera's existing contract for the RPWS. This scope of work further amends this contract to extend the supplemental sampling and analysis through the end of WY 2024. It also includes the following additional activities related to this monitoring:

- Preparation of a data validation memorandum, trend analysis report, and factsheet
- Presentation of study results at a local or regional conference
- Budget adjustment for previous laboratory analytical services

The cost by deliverable, and schedule by deliverable for this work are included in the attached payment schedule (Exhibit B). All costs associated with Task 18.0 will be funded by Ecology funds designated for 6PPD-Q research, except for the trend analysis report, which will be funded by the King County WTD grant.

Task 18 – Tosh Creek Street Sweeping Effectiveness Study

Subtask 18.1 – Sample Collection and Analysis

Under this task, Herrera will extend the supplemental sampling and analysis for 6PPD-Q and PAHs from the fourth quarter of WY 2023 through the end of WY 2024 (July 1, 2023, through September 31, 2024) in the Tosh Creek watershed (an Application watershed) and the Country Creek watershed (a Control watershed). In these watersheds, the additional sampling and analysis will specifically occur at the following stations located at the creek mouth and mid-watershed:

- Tosh-Mouth (TOSMO)
- Tosh-Mid (TOSMI)
- Country-Mouth (COUMO)
- Country-Mid (COUMI)

The locations of these stations are shown in Figures 4 and 7 of the quality assurance project plan (QAPP) that was prepared for the RPWS (Herrera 2015).

Up to three grab samples will be collected during storm events at each station per quarter. In addition, one grab sample will be collected during a base flow event at each station per quarter. Given the specified monitoring period identified above spans 5 quarters, this will nominally result in sample collection from each station up to 20 events (4 events per quarter x 5 quarters). One additional sample will be collected during either a storm or base flow event each quarter to serve as a field duplicate. The anticipated total number of samples to be collected under this subtask is summarized below:

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Number of Stations	Number of Storm Event Samples Per Quarter	Number of Base Flow Event Samples Per Quarter	Total Number of Regular Samples per Quarter	Number of Field Duplicates Samples per Quarter	Total Number of Samples per Quarter	Number of Quarters	Total Number of Samples
4	3	1	16	1	17	5	85

In connection with this supplemental sampling and analysis, the following activities will be performed:

- Weather tracking and go/no go decision coordination
- Mobilization of field crews for sampling during the event
- Delivery and shipment of samples to the laboratory after the event
- Auditing of laboratory analytical results for quality assurance / quality control (QA/QC) purposes within seven days of their receipt

Assumptions

- The supplemental sampling for 6PPD-q and PAHs will be performed in connection with routine sampling for the RPWS.
- Obtaining storm event samples may not be possible during particularly dry quarters. If this should occur, efforts will be made to conduct makeup sampling in subsequent quarters to obtain 20 grab samples from each station over the water year.

Deliverables

- Laboratory analytical results from up to 20 sampling events with documentation from the associated QA/QC audits.

Subtask 18.2 – Study Reporting

Following completion of the supplemental sampling and analysis at the end of WY 2024, Herrera's Data Quality Assurance Officer will provide an independent review of the laboratory quality control (QC) data from each sampling event based on the method quality objectives (MQOs) that have been identified for the study (Herrera 2022). The results will be presented in a data validation memorandum that will be included as an appendix to the trend analysis report for the study (see description below). The data validation memorandum will summarize quality control results, identify when data quality objectives were not met, and discuss the resulting limitations (if any) on the use or interpretation of the data.

Following preparation of the data validation report, Herrera will prepare a trend analysis report for the study. This report will summarize the compiled data for 6PPD-q and PAHs (WY 2023 – 2024) and summarize results from statistical trend analyses that will be performed on these data to assess potential benefits from the increase in street sweeping frequency. The statistical trend analyses will follow

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procedures that are identified in the QAPP for the RPWS. This report will be written to satisfy both the City's reporting obligations related to the King County WTD grant funding and Ecology's 6PPD-Q research funding described above. The King County WTD grant funding will be used for the cost of the trend analysis report.

Herrera will prepare a preliminary draft of the trend analysis report for review by the City. Based on comments received from the City, Herrera will then prepare a revised draft for review by Ecology, King County, and the technical advisory committee for the RPWS. Herrera will then prepare a final version of the report based on comments received.

Following preparation of the data validation report and concurrent with the preparation of the trend analysis report, Herrera will upload all the compiled data for 6PPD-q and PAHs to Ecology's Environmental Information Management (EIM) database. The uploaded data will include any necessary quality assurance flags that were identified through the independent review of the laboratory QC data as documented in the data validation memorandum.

Finally, Herrera will coordinate with the City to co-present findings from the study at a local or regional conference (e.g., Washington Stormwater Center's Municon, Pacific Northwest Clean Water Association Annual Conference, or American Public Works Association's Spring or Fall Conference). In connection with this effort, Herrera will prepare a PowerPoint presentation for the conference that provides a summary of the study's experimental design, compiled 6PPD-q and PAHs data, and results from the statistical trend analyses. Herrera will prepare a draft version of this presentation for review by the City. Based on comments received, Herrera will then prepare a final version of the presentation.

Assumptions

- The data summary report identified above will 10 to 20 pages in length include tables, figures, and appendices (excluding the appendix for the data validation memorandum).
- The factsheet identified above will be 2 to 4 pages in length including figures and tables.

Deliverables

- Data validation memorandum
- Preliminary draft, revised draft, and final trend analysis report
- Upload of compiled 6PPD-q and PAHs data to the EIM. The EIM upload file will be emailed to the SAM Coordinator and the City Project Manager.
- Preliminary draft, revised draft, and final factsheet
- Draft and final conference presentation

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Subtask 18.3 - Budget adjustment for previous laboratory analytical services

Due to a miscommunication between Herrera and the two laboratories providing analytical services for the study (Onsite for PAHs; SGS AXYS Analytical Services for 6PPD-q); the cost for analyzing 6PPD-q was incorrectly represented in the budget for previous sampling that was conducted over the first three quarters of WY 2023. The cost included in the budget for this parameter was \$305 per sample whereas the actual cost is \$435 per sample. This subtask provides additional budget to make up the difference (\$130) between these two costs for laboratory services. The full cost for this adjustment is estimated to be \$6,500 based on the 50 samples for 6PPD-q that have been analyzed. The table below summarizes the following information for these samples: laboratory reference number, sample collection date, event type (e.g., storm versus base), the number of samples collected per event (regular and field duplicate), and cost difference for analytical services.

Laboratory Reference No.	Sample Collection Date	Event Type	No. Regular Samples Collected	No. Field Duplicates Collected	Total No. Samples Collected	6PPD-Q at \$305	6PPD-Q at \$435	Difference
2210-222	10/21/2022	Storm	4		4	\$1,220	\$1,740	\$520
2210-298	10/26/2022	Base	4		4	\$1,220	\$1,740	\$520
2211-296	11/22/2022	Storm	4		4	\$1,220	\$1,740	\$520
2211-351	11/29/2022	Storm	4		4	\$1,220	\$1,740	\$520
2301-049	1/8/2023	Storm	4		4	\$1,220	\$1,740	\$520
2301-084	1/12/2023	Storm	4		4	\$1,220	\$1,740	\$520
2301-173	1/20/2023	Base	4	1	5	\$1,525	\$2,175	\$650
2302-068	2/7/2023	Storm	4		4	\$1,220	\$1,740	\$520
2304-066	4/6/2023	Storm	4		4	\$1,525	\$2,175	\$650
2304-245	4/20/2023	Storm	4	1	5	\$1,220	\$1,740	\$520
2304-315	4/27/2023	Base	4		4	\$1,525	\$2,175	\$650
2305-051	5/5/2023	Storm	4		4	\$1,220	\$1,740	\$520
Total:			48	2	50	\$15,250	\$21,750	\$6,500

Deliverables

- Documentation of budget shortfall for previous laboratory analytical services

EXHIBIT B: COST ESTIMATE AND SCHEDULE

Task	Deliverable	Quantity	Unit Cost	Total Costs	Schedule
18.1	Laboratory analytical results from up to 20 sampling events with documentation from the associated QA/QC audits	20	\$2,980	\$59,600	7/1/2023 to 9/31/2024
18.2a	Data validation memorandum	1	\$2,070	\$2,070	10/1/2024 to 11/30/24
18.2b	Preliminary draft, revised draft, and final trend analysis report	1	\$14,000	\$14,000	12/1/2024 to 12/31/2024
18.2c	Upload of compiled 6PPD-q and PAHs data to the EIM	1	\$1,280	\$1,280	12/1/2024 to 12/31/2024
18.2d	Draft and final conference presentation	1	\$600	\$600	1/1/2025 to 6/30/2025
18.3	Documentation of budget shortfall for previous laboratory analytical services	1	\$6,500	\$6,500	8/1/2023 to 8/31/2023
Task Total				\$84,050	