REDMOND PAIRED WATERSHED STUDY IMPLEMENTATION: WATER YEARS 2022 (Q2-Q4) TO 2024 (Q1–Q4)

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 will be implemented over an anticipated ten-year timeframe with funding from Ecology's Stormwater Action Monitoring (SAM) program.

To guide its implementation, Herrera Environmental Consultants (Herrera) developed a quality assurance project plan (QAPP) for the RPWS through a previous contract with the City. This QAPP provides detailed descriptions of the procedures that will be used for the following components of the study's experimental design:

- Hydrologic monitoring
- Water quality monitoring
- Sediment quality monitoring
- Physical habitat monitoring
- Biological monitoring

To date, the City has authorized Herrera to implement the monitoring identified in the QAPP over a period that extends from water year 2016 through the first quarter of water year 2022 (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). This scope of work amends this previous contract to extend the monitoring implementation through the following periods:

- Last three quarters of water year 2022 (January 1, 2022 through September 30, 2022)

- All of water year 2023 (October 1, 2022 through September 30, 2023)
- All of water year 2024 (October 1, 2023 through December 31, 2024)

Pursuant to this scope of work, Herrera will take the lead role for implementing all the components of the study's experimental design identified above except hydrologic monitoring; King County will lead this component of the study under a separate contract with the City.

The QAPP for the RPWS indicates trend analyses reports should also be prepared following 4, 6, 8, and 10 years of study implementation. These reports summarize the results of statistical analyses that are described in the QAPP to identify relationships between rehabilitation efforts and improving receiving water conditions. This scope of work includes a task for preparing the trend analysis report following 8 years of study implementation. The trend analyses report following 4 years of study implementation was prepared under Task 10.0 from Supplemental Agreement #2 to the contract for the RPWS. This amendment removes work and budget ($54,280) identified under Task 11.0 from Supplemental Agreement #2 to prepare the trend analysis report following 6 years of study implementation. This change was made with Ecology's concurrence to reduce the overall budget for the study while allowing for a longer period of data collection before conducting analyses to identify relationships between rehabilitation efforts and improving receiving water conditions.

The QAPP also established an Effectiveness Monitoring component for the RPWS to verify specific structural stormwater controls are constructed properly and performing as designed. The City has retrofitted two existing stormwater detention ponds in the Monticello Watershed with a continuous monitoring and adaptive control (CMAC) system to improve their performance for managing peak flows during storm events. This scope of work also amends the previous contract to include a task for monitoring the effectiveness of the pond retrofits pursuant to procedures that are identified in the RPWS Pond Retrofit Effectiveness Monitoring Proposal dated February 1, 2021.

Finally, the Evans Creek watershed is identified as an Application Watershed in the QAPP for the RPWS because it was prioritized by King County (County) for rehabilitation efforts at the onset of the study; specifically, the County constructed two stormwater detention ponds within the watershed in water year 2017. Monitoring has subsequently occurred at individual stations within this watershed over the period extending from water year 2016 through water year 2021. The performance of these ponds for improving receiving water conditions was analyzed in the trend analysis report that was prepared after 4 years of study implementation. Results from this analysis indicated the ponds are generally providing no measurable benefit to the creek. Because the County is not planning to implement any additional rehabilitation efforts within the Evans Creek watershed in the short-term, monitoring at all stations within this watershed is being suspended through this amendment. This change was made with Ecology's concurrence to reduce the overall budget for the study.

This scope of work includes a discussion of the activities, assumptions, deliverables associated with the following tasks:

- Task 12.0 - Water Year 2022 (Q2-Q4) Study Implementation
- Task 13.0 - Water Year 2023 (Q1-Q4) Study Implementation
- Task 14.0 – Water Year 2024 (Q1-Q4) Study Implementation
- Task 15.0 - Trend Analysis Report: Water Years 2016 - 2023
- Task 16.0 - Pond Retrofit Effectiveness Monitoring

The cost by deliverable, and schedule by deliverable for work to be performed by Herrera are included in a separate payment schedule (Exhibit B).

TASK 12.0 – WATER YEAR 2022 (Q2-Q4) STUDY IMPLEMENTATION

Under this task, Herrera will implement required monitoring activities identified in the QAPP for the RPWS over the final three quarters of water year 2022 (January 1, 2022 through September 30, 2022). This would include field measurement collection, data management and quality assurance review, and reporting. These activities are described in more detail under the following subtasks:

Subtask 12.1 - Hydrologic Monitoring

The hydrologic monitoring component of the RPWS involves continuous flow monitoring at 12 stations. Data from the continuous flow monitoring is processed to calculate a suite of indicators for evaluating hydrologic impacts from urban development. King County is leading the implementation of the hydrologic monitoring component of the study under a separate contract with the City. Herrera's involvement will entail the post processing of data compiled by King County to generate summary statistics (e.g., antecedent dry period, flow at time of sample collection) from the flow record for storm and base flow events that were sampled for water quality under Subtask 12.2. Herrera will also coordinate with King County to summarize the continuous flow monitoring data for each station for presentation in the data report described in Subtask 12.4.

Assumptions

- King County will make available continuous flow monitoring data in an electronic format for post processing by Herrera. King County will perform a quality assurance review on these data that will clearly identify any limitations to their use and interpretation.

Deliverables

- Table with flow summary statistics for sampled storm and base flow events from 12 stations.

Subtask 12.2- Water Quality Monitoring

The water quality monitoring component of the RPWS involves the collection of up to twelve grab samples over the water year during storm events (three each quarter) at 12 stations. In addition, up to four grab samples will be collected over the water year during base flow (one each quarter) at these stations. Each sample will be analyzed for the following indicators for evaluating water quality impacts from urban development:

- Total suspended solids
- Turbidity
- Hardness
- Dissolved organic carbon
- Fecal coliform bacteria
- Total phosphorus
- Total nitrogen
- Copper, total and dissolved
- Zinc, total and dissolved

In addition, probes will be used for continuous in-situ monitoring of temperature at all 12 stations.

Under this subtask, Herrera will oversee the collection of grab samples during both storm and base flow events. This will include the following activities that will be performed in accordance with the QAPP for the study:

- Weather tracking and go/no go decision coordination
- Mobilization of field crews for sampling during the event
- Delivery of samples to the laboratory after the event
- Auditing of laboratory analytical results within seven days of their receipt

- Entry of the analytical results into the study's data management system
- Preparation of a data validation memorandum that will establish the usability of all the data
- Preparation of graphical and tabular summaries for the data report described in Subtask 12.4

King County will oversee the continuous in-situ monitoring at each station under a separate contract with the City. Herrera will coordinate with King County to summarize these data in the data report described in Subtask 12.4.

Assumptions

- Storm event sampling will be performed by two teams of two Herrera staff. Sampling for each event will be performed over an 8- hour period including travel but not including storm tracking and go/no go decision coordination. A 15 percent contingency is included to account for sampling event false starts and to allow for make-up sampling.
- Nominally, all 12 stations will be sampled during each storm event. If specific stations are not sampled because a sampling event was terminated, they will be prioritized for sampling in subsequent events to ensure the annual sampling goals established for the study are met for every station.
- Base flow event sampling will be performed by one team of two Herrera staff. Sampling for each event will be performed over a 10- hour period including travel.
- King County will provide continuous water quality monitoring data in an electronic format for review by Herrera. King County will perform a quality assurance review on these data that will clearly identify any limitations to their use and interpretation.
- 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 twelve grab samples from each station over the water year.

Deliverables

- Laboratory analytical results and documentation of Herrera audits from water quality sampling at 12 stations during 3 storm events and 1 base flow event per quarter; these data will be uploaded to the Environmental Information Management (EIM) database.
- Data validation memorandum.

Subtask 12.3 - Biological Monitoring

Under this subtask, Herrera will conduct biological monitoring for the RPWS once during the water year at 17 stations. Pursuant to the QAPP for the study, this entails the collection of a composite sample of benthic macro invertebrates from specific locations along the cross-sections for physical habitat monitoring. These samples will be submitted to an analytical laboratory where they will be processed to compute the following indicators for use in evaluating stream health:

- Benthic Index of Biotic Integrity
- Taxa Richness
- Ephemeroptera Richness
- Plecoptera Richness
- Trichoptera Richness Clinger Percent
- Long-Lived Richness
- Intolerant Richness
- Percent Dominant
- Predator Percent
- Tolerant Percent

Assumptions

- Benthic macro invertebrate sample collection will be performed by one team having two Herrera staff. Collection of these samples from 3 stations will require approximately 8-hours of field time including travel.
- A delay of approximately 6 months can be expected for obtaining processed indicators for evaluating stream health from the analytical laboratory.

Deliverables

- Laboratory results from macroinvertebrate sample analysis for 17 stations entered into the Puget Sound Stream Benthos database.

Subtask 12.4- Water Year Data Summary Report

Herrera will prepare a data summary report with tabular and/or graphical summaries of all data that were collected over the water year in connection with the following monitoring components of the RPWS: hydrologic, water quality, sediment quality, physical habitat, and biological. This report will provide a detailed description of any quality assurance issues associated with these data based on results from audits and data validation memoranda. Any corrective actions that were undertaken to address quality assurance issues will also be described. Finally, this report will document all rehabilitation efforts that have occurred in the Application watersheds over the previous year. Included will be detailed information on the design and operational status of structural stormwater controls and the frequency and geographic extent of nonstructural stormwater control implementation.

Herrera will collaborate with King County to prepare a preliminary draft of the data summary report for review by the City. Based on comments received from the City, Herrera will then prepare a revised draft for review by Ecology and the technical advisory committee (TAC) that has been established for the study (see Subtask 12.5). Herrera will then prepare a finalized version of the report based on comments received.

Deliverables

- Preliminary draft data summary report.
- Draft data summary report.
- Final data summary report.

Subtask 12.5 -Technical Advisory Committee Coordination

The TAC for this study includes representation from the following agencies: Ecology, King County, City of Seattle, and the U.S. Geological Survey (USGS). Under this subtask, Herrera will coordinate and participate in up to two meetings to obtain input from the committee on technical issues related to the study over water year 2022. It is anticipated that one of these meetings may occur after the release of the data report from Subtask 12.4 to review and discuss the monitoring results from the water year. Contingency budget is also provided for a second, optional meeting to address unforeseen issues that may arise during implementation of the RPWS over the water year.

Assumptions

- Technical advisory committee meetings will last 2-hours and be attended by up to 3 Herrera staff.

Deliverables

- Meeting notes documenting discussion items and consensus decisions from the technical advisory committee.

Subtask 12.6 - Project Management

Herrera will be responsible for ongoing contract administration of this project, including preparing invoices and progress reports, as well as coordination of all work efforts with the designated City point of contact and the Project Team. The Herrera project manager (John Lenth) will have phone and e-mail contact with the City on an as-needed basis.

Deliverables

- Monthly invoices and progress reports.

TASK 13.0 – WATER YEAR 2023 (Q1 – Q4) STUDY IMPLEMENTATION

Under this task, Herrera will implement required monitoring activities identified in the QAPP for the RPWS over water year 2023 (October 1, 2022 through September 30, 2023). This would include field measurement collection, data management and quality assurance review, and reporting. These activities are described in more detail under the following subtasks:

Subtask 13.1 - Hydrologic Monitoring

The hydrologic monitoring component of the RPWS involves continuous flow monitoring at 12 stations. Data from the continuous flow monitoring is processed to calculate a suite of indicators for evaluating hydrologic impacts from urban development. King County is leading the implementation of the hydrologic monitoring component of the study under a separate contract with the City. Herrera's involvement will entail the post processing of data compiled by King County to generate summary statistics (e.g., antecedent dry period, flow at time of sample collection) from the flow record for storm and base flow events that were sampled for water quality under Subtask 13.2. Herrera will also coordinate with King County to summarize the continuous flow monitoring data for each station for presentation in the data report described in Subtask 13.6.

Assumptions

- King County will make available continuous flow monitoring data in an electronic format for post processing by Herrera. King County will perform a quality assurance review on these data that will clearly identify any limitations to their use and interpretation.

Deliverables

- Table with flow summary statistics for sampled storm and base flow events from 12 stations.

Subtask 13.2- Water Quality Monitoring

The water quality monitoring component of the RPWS involves the collection of up to twelve grab samples over the water year during storm events (three each quarter) at 12 stations. In addition, up to four grab samples will be collected over the water year during base flow (one each quarter) at these stations. Each sample will be analyzed for the following indicators for evaluating water quality impacts from urban development:

- Total suspended solids
- Turbidity
- Hardness
- Dissolved organic carbon
- Fecal coliform bacteria
- Total phosphorus
- Total nitrogen
- Copper, total and dissolved
- Zinc, total and dissolved

In addition, probes will be used for continuous in-situ monitoring of temperature at all 12 stations.

Under this subtask, Herrera will oversee the collection of grab samples during both storm and base flow events. This will include the following activities that will be performed in accordance with the QAPP for the study:

- Weather tracking and go/no go decision coordination
- Mobilization of field crews for sampling during the event
- Delivery of samples to the laboratory after the event
- Auditing of laboratory analytical results within seven days of their receipt

- Entry of the analytical results into the study's data management system
- Preparation of a data validation memorandum that will establish the usability of all the data
- Preparation of graphical and tabular summaries for the data report described in Subtask 13.6.

King County will oversee the continuous in-situ monitoring at each station under a separate contract with the City. Herrera will coordinate with King County to summarize these data in the data report described in Subtask 13.6.

Assumptions

- Storm event sampling will be performed by two teams of two Herrera staff. Sampling for each event will be performed over an 8- hour period including travel but not including storm tracking and go/no go decision coordination. A 15 percent contingency is included to account for sampling event false starts and to allow for make-up sampling.
- Nominally, all 12 stations will be sampled during each storm event. If specific stations are not sampled because a sampling event was terminated, they will be prioritized for sampling in subsequent events to ensure the annual sampling goals established for the study are met for every station.
- Base flow event sampling will be performed by one team of two Herrera staff. Sampling for each event will be performed over a 10- hour period including travel.
- King County will provide continuous water quality monitoring data in an electronic format for review by Herrera. King County will perform a quality assurance review on these data that will clearly identify any limitations to their use and interpretation.
- 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 twelve grab samples from each station over the water year.

Deliverables

- Laboratory analytical results and documentation of Herrera audits from water quality sampling at 12 stations during 3 storm events and 1 base flow event per quarter; these data will be uploaded to the Environmental Information Management (EIM) database.
- Data validation memorandum.

Subtask 13.3 - Sediment Quality Monitoring

The sediment quality monitoring component of the RPWS involves the collection of sediment samples once during the water year at 17 monitoring stations. Each sample will be analyzed for the following indicators for evaluating sediment quality impacts from urban development:

- Total organic carbon
- Copper
- Zinc
- Polycyclic aromatic hydrocarbons
- Phthalates

Under this subtask, Herrera will oversee the collection of these sediment samples. This includes the following activities that will be performed in accordance with the QAPP for the study:

- Mobilization of field crews for sampling
- Delivery of samples to the laboratory after the event
- Auditing of laboratory analytical results within seven days of their receipt
- Entry of the analytical results into the study's data management system
- Preparation of a data validation memorandum that will establish the usability of all the data
- Preparation of tabular summaries for the data report described in Subtask 13.6

Assumptions

- Sediment samples and the benthic macro invertebrate samples described in Subtask 13.5 will be collected during the same field visit to each station. This sample collection will be performed by one team having two Herrera staff. Collection of these samples from 3 stations will require approximately 8-hours of field time including travel.

Deliverables

- Laboratory analytical results and documentation of Herrera audits from sediment sampling at 17 stations.
- Data validation memorandum.

Subtask 13.4 - Physical Habitat Monitoring

Under this subtask, Herrera will conduct physical habitat monitoring for the RPWS once during the water year at 17 monitoring stations. Herrera will coordinate with Ecology's Environmental Assessment Program (EAP) for training, data management, and quality control of habitat data. At each station, the characteristic bed-form type will be recorded as a whole, and physical habitat quality indicators will be measured at 11 cross sections and one longitudinal (thalweg) profile. Pursuant to the QAPP for the study, the following indicators will be measured at each cross-section:

- Bank-full width, wetted width, and cumulative bar width
- Bank-full depth, wetted depth, substrate class and embeddedness
- Fish cover
- Riparian shading
- Riparian vegetation structure

The following indicators will be measured along the thalweg profile:

- Thalweg depth and the presence of bars and/or edge pools
- Main channel slope and bearing
- Large woody debris tally, including notation of diameter, length, category, zone, and key-pieces

Upon completion of field work, physical habitat monitoring data will be uploaded to the EIM. Based on post processing of these data within this system, Ecology will provide a suite of indicators for assessing physical habitat quality that are consistent with those being used for the broader SAM program. Herrera will summarize these indicators for presentation in the data report described in Subtask 13.6.

Assumptions

- One Herrera staff will participate in an Ecology sponsored 2-day training session on the physical habitat monitoring protocols developed for the SAM program. This staff will coordinate an additional 1-day training session for three additional Herrera staff that will be involved in the monitoring.
- Physical habitat monitoring will be performed by two teams having two Herrera staff. Physical habitat monitoring at each station will require approximately 8-hours of field time including travel.

- Data from the physical habitat monitoring will be recorded on custom forms while in the field. The custom forms will be reviewed in the field upon completion of the monitoring at each station to ensure all required data have been collected. In an office setting, data from the custom forms will then be transferred to the electronic field data collection software that has been developed by Ecology to ensure completeness in field data collection and facilitate upload of these data to Ecology's Watershed Health database in the EIM. Ecology's Environmental Assessment Program (EAP) will perform quality assurance review of the compiled physical habitat monitoring data and calculate metrics for assessing physical habitat conditions using scripts that have been developed to work with the Watershed Health database in the EIM. Costs for EAP's support for these activities are not included in the cost proposal for this scope of work.

- A delay of approximately 6 months can be expected for obtaining processed indicators for assessing physical habitat conditions from EAP via the Watershed Health database in the EIM system.

Deliverables

- Results from physical habitat monitoring at 17 stations that are uploaded to Watershed Health database in the EIM.

Subtask 13.5 - Biological Monitoring

Under this subtask, Herrera will conduct biological monitoring for the RPWS once during the water year at 17 stations. Pursuant to the QAPP for the study, this entails the collection of a composite sample of benthic macro invertebrates from specific locations along the cross-sections for physical habitat monitoring. These samples will be submitted to an analytical laboratory where they will be processed to compute the following indicators for use in evaluating stream health:

- Benthic Index of Biotic Integrity
- Taxa Richness
- Ephemeroptera Richness
- Plecoptera Richness
- Trichoptera Richness Clinger Percent
- Long-Lived Richness
- Intolerant Richness

- Percent Dominant
- Predator Percent
- Tolerant Percent

Assumptions

- Benthic macro invertebrate samples and the sediment samples described in Subtask 13.3 will be collected during the same field visit to each station. This sample collection will be performed by one team having two Herrera staff. Collection of these samples from 3 stations will require approximately 8-hours of field time including travel.
- A delay of approximately 6 months can be expected for obtaining processed indicators for evaluating stream health from the analytical laboratory.

Deliverables

- Laboratory results from macroinvertebrate sample analysis for 17 stations entered into the Puget Sound Stream Benthos database.

Subtask 13.6- Water Year Data Summary Report

Herrera will prepare a data summary report with tabular and/or graphical summaries of all data that were collected over the water year in connection with the following monitoring components of the RPWS: hydrologic, water quality, sediment quality, physical habitat, and biological. This report will provide a detailed description of any quality assurance issues associated with these data based on results from audits and data validation memoranda. Any corrective actions that were undertaken to address quality assurance issues will also be described. Finally, this report will document all rehabilitation efforts that have occurred in the Application watersheds over the previous year. Included will be detailed information on the design and operational status of structural stormwater controls and the frequency and geographic extent of nonstructural stormwater control implementation.

Herrera will collaborate with King County to prepare a preliminary draft of the data summary report for review by the City. Based on comments received from the City, Herrera will then prepare a revised draft for review by Ecology and the TAC that has been established for the study (see Subtask 13.7). Herrera will then prepare a finalized version of the report based on comments received.

Deliverables

- Preliminary draft data summary report.

- Draft data summary report.
- Final data summary report.

Subtask 13.7 -Technical Advisory Committee Coordination

The TAC for this study includes representation from the following agencies: Ecology, King County, City of Seattle, and the USGS. Under this subtask, Herrera will coordinate and participate in up to two meetings to obtain input from the committee on technical issues related to the study over water year 2023. It is anticipated that one of these meetings may occur after the release of the data report from Subtask 13.6 to review and discuss the monitoring results from the water year. Contingency budget is also provided for a second, optional meeting to address unforeseen issues that may arise during implementation of the RPWS over the water year.

Assumptions

- Technical advisory committee meetings will last 2-hours and be attended by up to 3 Herrera staff.

Deliverables

- Meeting notes documenting discussion items and consensus decisions from the technical advisory committee.

Subtask 13.8 - Project Management

Herrera will be responsible for ongoing contract administration of this project, including preparing invoices and progress reports, as well as coordination of all work efforts with the designated City point of contact and the Project Team. The Herrera project manager (John Lenth) will have phone and e-mail contact with the City on an as-needed basis.

Deliverables

- Monthly invoices and progress reports.

TASK 14.0 – WATER YEAR 2024 (Q1-Q4) STUDY IMPLEMENTATION

Under this task, Herrera will implement required monitoring activities identified in the QAPP for the RPWS over the first quarter of water year 2024 (October 1, 2023 through September 30, 2024). This would include field measurement collection, data management and quality assurance review, and reporting. These activities are described in more detail under the following subtasks:

Subtask 14.1 - Hydrologic Monitoring

The hydrologic monitoring component of the RPWS involves continuous flow monitoring at 12 stations. Data from the continuous flow monitoring is processed to calculate a suite of indicators for evaluating hydrologic impacts from urban development. King County is leading the implementation of the hydrologic monitoring component of the study under a separate contract with the City. Herrera's involvement will entail the post processing of data compiled by King County to generate summary statistics (e.g., antecedent dry period, flow at time of sample collection) from the flow record for storm and base flow events that were sampled for water quality under Subtask 14.2. Herrera will also coordinate with King County to summarize the continuous flow monitoring data for each station for presentation in the data report described in Subtask 14.4.

Assumptions

- King County will make available continuous flow monitoring data in an electronic format for post processing by Herrera. King County will perform a quality assurance review on these data that will clearly identify any limitations to their use and interpretation.

Deliverables

- Table with flow summary statistics for sampled storm and base flow events from 12 stations.

Subtask 14.2- Water Quality Monitoring

The water quality monitoring component of the RPWS involves the collection of up to twelve grab samples over the water year during storm events (three each quarter) at 12 stations. In addition, up to four grab samples will be collected over the water year during base flow (one each quarter) at these stations. Each sample will be analyzed for the following indicators for evaluating water quality impacts from urban development:

- Total suspended solids
- Turbidity
- Hardness
- Dissolved organic carbon
- Fecal coliform bacteria
- Total phosphorus
- Total nitrogen

- Copper, total and dissolved
- Zinc, total and dissolved

In addition, probes will be used for continuous in-situ monitoring of temperature at all 12 stations.

Under this subtask, Herrera will oversee the collection of grab samples during both storm and base flow events. This will include the following activities that will be performed in accordance with the QAPP for the study:

- Weather tracking and go/no go decision coordination
- Mobilization of field crews for sampling during the event
- Delivery of samples to the laboratory after the event
- Auditing of laboratory analytical results within seven days of their receipt
- Entry of the analytical results into the study's data management system
- Preparation of a data validation memorandum that will establish the usability of all the data
- Preparation of graphical and tabular summaries for the data report described in Subtask 14.4

King County will oversee the continuous in-situ monitoring at each station under a separate contract with the City. Herrera will coordinate with King County to summarize these data in the data report described in Subtask 14.4.

Assumptions

- Storm event sampling will be performed by two teams of two Herrera staff. Sampling for each event will be performed over an 8- hour period including travel but not including storm tracking and go/no go decision coordination. A 15 percent contingency is included to account for sampling event false starts and to allow for make-up sampling.
- Nominally, all 12 stations will be sampled during each storm event. If specific stations are not sampled because a sampling event was terminated, they will be prioritized for sampling in subsequent events to ensure the annual sampling goals established for the study are met for every station.
- Base flow event sampling will be performed by one team of two Herrera staff. Sampling for each event will be performed over a 10- hour period including travel.

- King County will provide continuous water quality monitoring data in an electronic format for review by Herrera. King County will perform a quality assurance review on these data that will clearly identify any limitations to their use and interpretation.

- 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 twelve grab samples from each station over the water year.

Deliverables

- Laboratory analytical results and documentation of Herrera audits from water quality sampling at 12 stations during 3 storm events and 1 base flow event per quarter; these data will be uploaded to the Environmental Information Management (EIM) database.

- Data validation memorandum.

Subtask 14.3 - Biological Monitoring

Under this subtask, Herrera will conduct biological monitoring for the RPWS once during the water year at 17 stations. Pursuant to the QAPP for the study, this entails the collection of a composite sample of benthic macro invertebrates from specific locations along the cross-sections for physical habitat monitoring. These samples will be submitted to an analytical laboratory where they will be processed to compute the following indicators for use in evaluating stream health:

- Benthic Index of Biotic Integrity
- Taxa Richness
- Ephemeroptera Richness
- Plecoptera Richness
- Trichoptera Richness Clinger Percent
- Long-Lived Richness
- Intolerant Richness
- Percent Dominant
- Predator Percent
- Tolerant Percent

Assumptions

- Benthic macro invertebrate sample collection will be performed by one team having two Herrera staff. Collection of these samples from 3 stations will require approximately 8-hours of field time including travel.
- A delay of approximately 6 months can be expected for obtaining processed indicators for evaluating stream health from the analytical laboratory.

Deliverables

- Laboratory results from macroinvertebrate sample analysis for 17 stations entered into the Puget Sound Stream Benthos database.

Subtask 14.4- Water Year Data Summary Report

Herrera will prepare a data summary report with tabular and/or graphical summaries of all data that were collected over the water year in connection with the following monitoring components of the RPWS: hydrologic, water quality, sediment quality, physical habitat, and biological. This report will provide a detailed description of any quality assurance issues associated with these data based on results from audits and data validation memoranda. Any corrective actions that were undertaken to address quality assurance issues will also be described. Finally, this report will document all rehabilitation efforts that have occurred in the Application watersheds over the previous year. Included will be detailed information on the design and operational status of structural stormwater controls and the frequency and geographic extent of nonstructural stormwater control implementation.

Herrera will collaborate with King County to prepare a preliminary draft of the data summary report for review by the City. Based on comments received from the City, Herrera will then prepare a revised draft for review by Ecology and the TAC that has been established for the study (see Subtask 14.5). Herrera will then prepare a finalized version of the report based on comments received.

Deliverables

- Preliminary draft data summary report.
- Draft data summary report.
- Final data summary report.

Subtask 14.5 -Technical Advisory Committee Coordination

The TAC for this study includes representation from the following agencies: Ecology, King County, City of Seattle, and the USGS. Under this subtask, Herrera will coordinate and participate in up to two meetings to obtain input from the committee on technical issues related to the study over water year 2022. It is anticipated that one of these meetings may occur after the release of the data report from Subtask 14.4 to review and discuss the monitoring results from the water year. Contingency budget is also provided for a second, optional meeting to address unforeseen issues that may arise during implementation of the RPWS over the water year.

Assumptions

- Technical advisory committee meetings will last 2-hours and be attended by up to 3 Herrera staff.

Deliverables

- Meeting notes documenting discussion items and consensus decisions from the technical advisory committee.

Subtask 14.6 - Project Management

Herrera will be responsible for ongoing contract administration of this project, including preparing invoices and progress reports, as well as coordination of all work efforts with the designated City point of contact and the Project Team. The Herrera project manager (John Lenth) will have phone and e-mail contact with the City on an as-needed basis.

Deliverables

- Monthly invoices and progress reports.

TASK 15.0 –TREND ANALYSIS REPORT: WATER YEARS 2016 - 2023

Following completion of required monitoring for water year 2023 and preparation of the associated data summary report, Herrera will prepare a trend analysis report covering data collected over the first 8 years of study implementation (water years 2016 – 2023). This report will summarize results from statistical analyses performed to detect improving or degrading trends in receiving water conditions in the seven watersheds that are the focus of monitoring efforts for the RPWS. A detailed discussion of these trends will be provided with a specific emphasis on relationships between trends and rehabilitation efforts in the Application watersheds relative to trends in the Reference and Control watersheds. A summary of major conclusions from these analyses will also be provided.

Statistical analyses will follow procedures that are described in the QAPP and documented in minutes from the technical advisory committee meeting that occurred on July 29, 2019. The following specific procedures will be performed in connection with these analyses:

- Correlation analyses to detect trends over time in water and sediment pollutant concentration data and computed indicators from hydrologic and biological monitoring.
- Computation of annual mass load estimates from data for a subset of parameters from water quality monitoring; correlation analyses would then be performed on these estimates to detect trends over time.
- Comparison of data from physical habitat monitoring to reference conditions from Puget Sound lowland ecoregion streams.

Herrera will collaborate with King County to 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 and the TAC that has been established for the study. Herrera will then prepare a finalized version of the report based on comments received.

Herrera will communicate the trend findings report by creating and conducting two (2) presentations of the design results, and interim-study conclusions to permittees and stakeholders. One of these presentations will be made to the Stormwater Work Group. The other can be made at a conference with a stormwater and regional focus (e.g. MuniCon), upon agreement with the City and Ecology (SAM Coordinator). Herrera will also create a SAM factsheet for distribution on the SAM website.

Assumptions

- Comments on the draft and revised draft trend analysis reports will be provided using a standardized template to be provided by Herrera.

Deliverables

- Preliminary draft trend analysis report.
- Draft trend analysis report.
- Final trend analysis report.
- Two presentations on study design and findings to date.
- SAM factsheet on project findings to date.

TASK 16.0 – POND RETROFIT EFFECTIVENESS MONITORING

Herrera will implement monitoring to evaluate the effectiveness two existing stormwater detention ponds in the Monticello Watershed that were retrofitted with a CMAC system to improve their performance for managing peak flows during storm events. As described in the RPWS Pond Retrofit Effectiveness Monitoring Proposal dated February 1, 2021, this monitoring will involve the following steps:

1. Develop relationships for predicting the available storage in each pond as a function of stage.
2. Develop spreadsheet models to predict inlet discharge to the ponds in 15-minute intervals based on the relationship from Step 1 and using measured data from the CMAC system for outlet discharge and stage.
3. Estimate the inlet discharge for each pond over an entire water year using the models from Step 2 and the continuous measurements (15-minute logging interval) of outlet discharge and stage from the CMAC system over the same period.
4. Use the continuous estimates of inlet discharge from Step 3 as input for a Western Washington Hydrology Model (WWHM) that will be developed for each pond to predict outlet discharge in their current configuration.
5. Conduct statistical analyses to detect a significant decrease in peak outlet discharge from the ponds relative to the expected peak outlet discharge of the ponds in their current configuration.

In addition to the comparison in Step 5, data from the hydrologic monitoring described above will be analyzed to detect improving trends in receiving water conditions that may stem from the pond retrofits. Similarly, data from the physical habitat monitoring stations described above will be analyzed for the same purpose.

The effectiveness monitoring will initiate once the CMAC system becomes operational in each pond (spring of 2021) and extend over a period capturing water years 2022 and 2023. This will produce a continuous time series of outlet discharge data that will be collected over a sufficient duration to detect pond performance improvements across a range of storm sizes.

Results from the analyses described above will be summarized in a stand-alone effectiveness monitoring report that will be produced following the conclusion of monitoring at the end of water year 2023. A preliminary draft version of this report will be produced for review by the City. Based on comments received from the City, Herrera will then prepare a revised draft for review by Ecology and the TAC that has been established for the study. Herrera will then prepare

a finalized version of the report based on comments received. Herrera will also create a SAM factsheet for distribution on the SAM website.

Deliverables

- Spreadsheet and WWHM models to predict pond outlet discharge.
- Inlet discharge estimates for ponds through the end of WY2022.
- Inlet discharge estimates for ponds through the end of WY2023.
- Preliminary draft effectiveness monitoring report.
- Draft effectiveness monitoring report.
- Final effectiveness monitoring report.
- SAM Factsheet.

EXHIBIT B: PAYMENT SCHEDULE

Redmond Paired Basin Retrofit Effectiveness monitoring Implementation - Water Years 2022 (Q2-Q4) - 2024 (Q1-Q4)

Task/Deliverable	Target Completion Date	Quantity	Unit Cost	Total by Deliverable
Task 11.0 – Trend Analysis Report: Water Years 2016 - 2021				
Draft data analyis report	Jun 2022	0	$ 39,900	$ (39,900)
Final data analysis report	Aug 2022	0	$ 9,980	$ (9,980)
Stormwater Work Group and Conference Presentations	Sep - Dec 2022	0	$ 1,650	$ (3,300)
Fact Sheet	Sep 2022	0	$ 1,100	$ (1,100)
Task Total				$ (54,280)
Task 12.0 – Water Year 2022 (Q2 - Q4) Study Implementation				
Subtask 12.1 – Hydrologic Monitoring				
Table with flow summary statistics for sampled storm and base flow events from 12 stations	Mar 2023	1	$ 7,850	$ 7,850
Subtask Total				$ 7,850
Subtask 12.2 – Water Quality Monitoring				
Laboratory analytical results and documentation of Herrera audits for 12 stations x 12 sampling events	Dec 2022	12	$ 7,770	$ 93,240
Data validation memorandum	Mar 2023	1	$ 13,800	$ 13,800
Subtask Total				$ 107,040
Subtask 12.3 – Biological Monitoring				
Laboratory results from macroinvertebrate sample analysis for 17 stations	Mar 2023	1	$ 14,810	$ 14,810
				$ 14,810
Subtask 12.4 – Water Year Data Summary Report				
Draft data summary report	Jun 2023	1	$ 21,500	$ 21,500
Final data summary report	Sep 2023	1	$ 5,390	$ 5,390
Subtask Total				$ 26,890
Subtask 12.5 – Technical Advisory Committee Coordination				
Meeting notes documenting discussion items and consensus decisions	Jun 2023	2	$ 1,850	$ 3,700
Subtask Total				$ 3,700
Subtask 12.6 – Project Management				
Monthly invoices and progress reports	Sep 2022	9	$ 1,860	$ 16,740
Subtask Total				$ 16,740
Task Total				$ 177,030

EXHIBIT B: PAYMENT SCHEDULE

Redmond Paired Basin Retrofit Effectiveness monitoring Implementation - Water Years 2022 (Q2-Q4) - 2024 (Q1-Q4)

Task/Deliverable	Target Completion Date	Quantity	Unit Cost	Total by Deliverable
Task 13.0 – Water Year 2023 (Q1 - Q4) Study Implementation				
Subtask 13.1 – Hydrologic Monitoring				
Table with flow summary statistics for sampled storm and base flow events from 12 stations	Mar 2024	1	$ 8,080	$ 8,080
Subtask Total				$ 8,080
Subtask 13.2 – Water Quality Monitoring				
Laboratory analytical results and documentation of Herrera audits for 12 stations x 16 sampling events	Dec 2023	16	$ 7,910	$ 126,560
Data validation memorandum	Mar 2024	1	$ 14,100	$ 14,100
Subtask Total				$ 140,660
Subtask 13.3 – Sediment Quality Monitoring				
Laboratory analytical results and documentation of Herrera audits for 17 stations	Dec 2023	1	$ 17,500	$ 17,500
Data validation memorandum	Mar 2024	1	$ 4,380	$ 4,380
Subtask Total				$ 21,880
Subtask 13.4 – Physical Habitat Monitoring				
Results from physical habitat monitoring at 17 stations	Mar 2024	1	$ 65,750	$ 65,750
Subtask 13.5 – Biological Monitoring				
Laboratory results from macroinvertebrate sample analysis for 17 stations	Mar 2024	1	$ 15,050	$ 15,050
				$ 15,050
Subtask 13.6 – Water Year Data Summary Report				
Draft data summary report	Jun 2024	1	$ 22,200	$ 22,200
Final data summary report	Sep 2024	1	$ 5,540	$ 5,540
Subtask Total				$ 27,740
Subtask 13.7 – Technical Advisory Committee Coordination				
Meeting notes documenting discussion items and consensus decisions	Jun 2024	2	$ 1,900	$ 3,800
Subtask Total				$ 3,800
Subtask 13.8 – Project Management				
Monthly invoices and progress reports	Sep 2023	12	$ 1,920	$ 23,040
Subtask Total				$ 23,040
Task Total				$ 306,000

EXHIBIT B: PAYMENT SCHEDULE

Redmond Paired Basin Retrofit Effectiveness monitoring Implementation - Water Years 2022 (Q2-Q4) - 2024 (Q1-Q4)

Task/Deliverable	Target Completion Date	Quantity	Unit Cost	Total by Deliverable
Task 14.0 – Water Year 2024 (Q1 - Q4) Study Implementation				
Subtask 14.1 – Hydrologic Monitoring				
Table with flow summary statistics for sampled storm and base flow events from 12 stations	Mar 2025	1	$ 8,310	$ 8,310
Subtask Total				$ 8,310
Subtask 14.2 – Water Quality Monitoring				
Laboratory analytical results and documentation of Herrera audits for 12 stations x 16 sampling events	Dec 2024	16	$ 8,050	$ 128,800
Data validation memorandum	Mar 2025	1	$ 14,300	$ 14,300
Subtask Total				$ 143,100
Subtask 13.5 – Biological Monitoring				
Laboratory results from macroinvertebrate sample analysis for 17 stations	Mar 2025	1	$ 15,050	$ 15,050
				$ 15,050
Subtask 13.6 – Water Year Data Summary Report				
Draft data summary report	Jun 2025	1	$ 22,800	$ 22,800
Final data summary report	Sep 2025	1	$ 5,700	$ 5,700
Subtask Total				$ 28,500
Subtask 13.7 – Technical Advisory Committee Coordination				
Meeting notes documenting discussion items and consensus decisions	Jun 2025	2	$ 1,900	$ 3,800
Subtask Total				$ 3,800
Subtask 14.2 – Project Management				
Monthly invoices and progress reports	Sep 2024	12	$ 1,970	$ 23,640
Subtask Total				$ 23,640
Task Total				$ 222,400

EXHIBIT B: PAYMENT SCHEDULE

Redmond Paired Basin Retrofit Effectiveness monitoring Implementation - Water Years 2022 (Q2-Q4) - 2024 (Q1-Q4)

Task/Deliverable	Target Completion Date	Quantity	Unit Cost	Total by Deliverable
Task 15.0 – Trend Analysis Report: Water Years 2016 - 2023				
Draft trend analyis report	Dec 2024	1	$ 35,000	$ 35,000
Final trend analysis report	Mar 2024	1	$ 7,000	$ 7,000
Stormwater Work Group and Conference Presentations	Mar 2024	2	$ 1,700	$ 3,400
Fact Sheet	Mar 2024	1	$ 1,160	$ 1,160
Task Total				$ 46,560
Task 16.0 – Pond Retrofit Effectiveness Monitoring				
Spreadsheet Models and WWHM models to predict pond outlet discharge	Jun 2022	1	$ 8,000	$ 8,000
Inlet discharge estimates for ponds through the end of WY2022	Dec 2022	1	$ 8,500	$ 8,500
Inlet discharge estimates for ponds through the end of WY2023	Dec 2023	1	$ 8,500	$ 8,500
Draft Effectiveness Monitoring Report	Jan 2024	1	$ 13,840	$ 13,840
Final Effective Monitoring Report	Feb 2024	1	$ 4,000	$ 4,000
Fact sheet	Mar 2024	1	$ 1,160	$ 1,160
Task Total				$ 44,000
Project Total				741,710