Comment number	Comment	QAPP location referenced in	Comment response
SPU #1	The QAPP includes sections for PLA project goals, watershed modeling goals, PLA project objectives and Watershed modeling objectives. The section entitled Watershed modeling objectives (Section 4.2.2) itself has a subsection (Section 4.2.2.2) also called Watershed modeling objectives. Overall, the goals and objectives sections are difficult to follow. We recommend the document clearly state the difference between "goals" and "objectives" for this context and ensure that these sections do not overlap in content.	Sections 4.2.2 and 4.2.2.2	Thank you for the comment. We added a paragraph to explain the difference between goals and objectives for the purposes of the QAPP. In the document, a project goal refers to intended purposes for the tools that we are developing to accomplish these goals. A project objective refers to the tools developed to achieve the project goals. The objective is more quantitative and measurable.
SPU #2	The watershed modeling questions (Section 4.2.2.1) are specific and well defined. We recommend a greater focus on these specific questions that the model will be designed to answer, such as "What is the contribution of contaminant loadings coming from Howard Hanson Dam versus downstream sources?" The QAPP should be focused on how it will be ensured that the model will be an appropriate tool to answer these questions.	Section 4.2.2.1	We will provide detailed write-up how we will address those questions in separate document. We will discuss the detailed modeling set-up for those management scenarios.
SPU #3	The watershed modeling objectives subsection (Section 4.2.2.2) includes the objective "Characterize the watershed to estimate loadings from pollutant-generating sources and the pathways pollutants can take." The first part of this objective ("characterize the watershed to estimate loadings from pollutant-generating sources") is appropriate and well stated. However, the second part "and the pathways pollutants can take" seems to mix qualitative and quantitative evaluations. Which specific pathways will be evaluated and quantified?	Section 4.2.2.2, page 18	The pathways were described in detail in the later model devleopment sections, such as stormwater, CSO, groundwater, air deposition and etc.. This objective is meant to estimate how much loadings are from different sources, such as how much loadings were generated from stormwater, then to understand the pathways the pollutant take to get to the receiving water. To better clarify this objective, we edited the sentence to: "Characterize the watershed to estimate loadings from pollutant-generating sources and to identify and quantify the pathways pollutants take."

SPU #4	Section 4.2.2.2 also includes the objective "Evaluate the effectiveness of proposed mitigation strategies." We recommend specifically naming the mitigation strategies that will be considered.	Section 4.2.2.2, page 18	Thanks for the comment, however, at this stage, it is a little early for us to specify the mitigation strategies. This is a long-term project and we will continue to explore different mitigation options using modeling and scenarios based on management questions. To provide some examples, we edited the sentences as: "(3) Evaluate the effectiveness of proposed mitigation strategies, such as permitting, CSO control, building materials removal, variety of BMPs and etc.. "
SPU #5	Section 4.2.2.2.9 is entitled "Summary of objectives," but instead includes specific statements regarding how boundary conditions will be specified. For example, "Rates of atmospheric loadings of pollutants onto land will likely be applied as two distinct time series: higher loading rates for land within the LDW basin and lower rates for land in the Green River basin. The relative importance of background atmospheric loading rates can be compared to what is generated from stormwater and subsurface contributions." Such statements would be more appropriate in a different section.	Section 4.2.2.2.9, page 21	Good catch! Text is revised to: "Atmospheric loadings will be discretely evaluated to identify the relative contribution of pollutant loading to the LDW."
SPU #6	Section 14.0, Data Quality (Usability) Assessment states that "the primary model development goals are (1) to minimize the difference between simulated and observed hydrology, water/sediment quality and fish tissue concentration, and (2) to capture the spatial and temporal patterns in the observed environmental conditions." We recommend restating this—model development goals should be based on key questions to be answered. While minimizing difference between observed data and model predictions as well as matching spatial and temporal patterns is important, we recommend referring to these as criteria for assessing how effective the model is at reproducing reality.	Section 14.1, page 98	We edited the sentence as follows: " The processes to ensure the model is effective at reproducing reality are:...."

SPU #7	We agree that model-data error statistics and plots are not the only way in which model quality is evaluated. It is acceptable that the QAPP does not suggest numerical targets that must be met. However, we still recommend comparing model statistics to reasonable targets (e.g. those described in Donigian, 2001) and, for cases where the model fails to meet these targets, clearly describe the reasons why the model error exceeds the target and why the key modeling questions can still be answered.	Section 14.1, page 98	Agreed
SPU #8	The QAPP mentions that assessing the overall quality of a model goes beyond error statistics and graphical plots and includes "several parallel tasks to achieve overall model quality" alongside efforts to reduce model error. We agree with this in general but have concerns regarding the descriptions of the parallel efforts. The specific efforts mentioned are listed below, with our annotations:	Section 14.1, page 98	Thanks for the comment.
SPU #9	*1. Incorporation of all available observations of the system (e.g., geometry, flow, boundary inputs/withdrawals, and meteorology) for the time period simulated.* We disagree with this as a measure of model quality. While it is important to include appropriate inputs to the model, that does not mean including "all" available data—some data may be poor in quality, old or superseded, or otherwise not appropriate for inclusion.	Section 14.1, page 98	We include the data for our use based on our modeling needs and timelines. Systematic data would be our highest priority. Scattered or supersed data providing useful or additional info could be used in the model. In this case it's likely that all available data, means all data that has met QAQC standards and has therefore been deemed of sufficient quality to be used.
SPU #10	*2. Reasonable estimation methods and assumptions to fill gaps in the observations.* We agree that this is important.	Section 14.1, page 98	Thanks for the comment.

SPU #11	*3. Calibration of model parameters and unmeasured boundary conditions within reasonable bounds to improve agreement between simulated and observed water quality.* We agree that calibration is an important part of the modeling process. However, it is not clear how this step is in parallel with an effort to reduce model error—rather, calibration is the process of reducing model error through appropriate changes to model parameters and unmeasured boundary conditions.	Section 14.1, page 98	We changed it to "Identify model parameters within reasonable bounds and specify a more reliable boundary condition".We try to use measured boundary as much as possible. But if there is issue caused by computational cost or spatial/temporal data gap, we will generate the boundary condition using regressions and trials & erros to simulate boundary condition based on existing field data.
SPU #12	*4. Identification of key parameters/processes through model calibration and sensitivity analysis.* We agree that this is an important analysis, but it is not clear how identifying key parameters and processes is a measure of model quality.	Section 14.1, page 98	We changed it to "Identify key or important parameters/processes and then improve the methods to generate a more accurate model inputs for those parameters/processes". it's similar to SPU #11, use filed data if exist. Set more accurate values based on data or literature review and consider spatial/temporal variations.
SPU #13	*5. Clear communication of key assumptions during model development with the project team.* As with #4, we agree that this is important, but it is not clear how this relates to a measure of model quality.	Section 14.1, page 98	"Consult project team, groups and people with variety of backgrounds and experiences to fill the insitu and knowledge gaps that might need to be considered in the model development".

SPU #14	*6. Clearly written documentation of all important elements in the model, including model setup, boundary conditions, assumptions, and known areas of uncertainty.* We agree that written documentation is critical; we recommend a full separate section of the QAPP describing and outlining the report and outlining the report that will be developed. We expand on this recommendation in the next section of this memorandum.	Section 14.1, page 98	Thanks for the comment, however, right now, it is a little too early for us to know exactly how the model report will be look like at this stage. We added the sentences in the section: "We will develop a separate model report that will include following sections and that report will be public available after the completion of the model development. 1. Executive Summary 2. Background 3. Model Development 4. Model Calibration 5. Model Validation 6. Sensitivity Analysis 7. Summary "

SPU #15	*7. Development of management scenarios to meet the project objectives.* We agree that management scenarios are an important part of a modeling project— however, this is not related to model quality. Rather, a model that is accurate enough to evaluate which mitigation strategies are effective is a prerequisite before evaluating management scenarios.	Section 14.1, page 98	We do think clear development of management scenarios that can best reflect the project goals will be important for the modelers to develop the model to better address the concerns and meet the project objectives. Evaluation of mitigation strategies will be part of management scenarios. The number 2 and 3: #2. Reasonable estimation methods and assumptions to fill gaps in the observations.#3. Calibration of model parameters and unmeasured boundary conditions within reasonable bounds to improve agreement between simulated and observed water quality. Those two will ensure the model that will be accurate enough for us to run different scenarios. Model development will follow the modeling goal directly, modeling goal will follow the project objective and original management questions. If the scope of management scenarios is following the modeling goal and project objective, a well calibrated or validated model can do any management scenarios with given computational resources.

SPU #16	*8. Peer review.* Conducting an independent peer review is a valuable way of ensuring model quality. However, this should be done after the model has been developed and calibrated. As written, this section implies peer review will be done in parallel with model development and calibration.	Section 14.1, page 98	We do plan have peer review in the meantime as we develop and calibrate the model. For example, we already have a contract with an outside firm, RESPEC, to review our HSPF model development and management scenario setup. We got the brief review comments of the HSPF model from RESPEC. The main goal of the review was to gain enough background information to efficiently provide MATLAB scripts/tools and support the review of HSPF management scenarios. To maximize effieciencies, we don't want to wait till the model has been developed and calibrated to have peer review. In addition, TAC members have also helped us review the model development and calibration periodically during our meetings. To clarifiy this point, we modified the text to be "Multiple rounds of peer review during model development. "

SPU #17	The QAPP includes the phrase "model development report" three times and also refers to documentation in several other places (including item #6, above, from the Data Quality (Usability) Assessment section). However, we recommend a separate section of the QAPP describing what will be included in the model development report, who will have the opportunity to review the report, and the process for revising the report. We recommend that the QAPP state clearly that the model development report will include the following sections: • Executive Summary—it is important that the most important points of the modeling (purpose of the model, how it was developed, how well it matched measured data and the results of the management scenarios) be conveyed in a format that can be understood and utilized by non-modelers, including policy makers as well as the general public. • Background—The background section of the approach should include an overview of the project site and a description of the key questions the model will answer. The report should also describe the goals and objectives from the finalized QAPP, either in the background section or in a separate section. • Model Development—this should include a description of the model geometry, boundary conditions, initial conditions and parameters and how they were specified (e.g. datasets used and assumptions made).		Thanks for the valuable suggestions! We will definitely will refer back to them when we develop the model development report. We will definitely will refer back to this comment when we develop the model development report. We included this list in the section 14.1 as example. The outline of the model report will probably change based on what we find as the model development progresses.

	• Model Calibration—this should be a description of which parameters were varied, the justification (e.g. literature, site-specific data) for the final values used, and plots and statistics showing how well the final model agrees with data. • Model Validation—ideally, the model should be compared to at least one additional dataset not used during model calibration (without further model adjustment). This demonstrates that the model can accurately simulate reality for an appropriate range of conditions. The validation process should be described in the model development report. • Sensitivity Analysis—As alluded to in item 4 of the previous section, the purpose of the sensitivity analysis should be to identify the parameters that most impact the model results. This section of the model documentation should include which parameters were adjusted, how sensitive the model is to these parameters, and the implications for overall uncertainty as well as the confidence stakeholders can have in the answers to the key modeling questions and ability of the model to be used to evaluate mitigation strategies. • Summary—the report should summarize clearly the purpose of the model and the key questions it is intended to be used to answer. This should help ensure the model is used for appropriate purposes and not to attempt to answer questions it was not built to answer.		

SPU #18	The QAPP document includes some well stated goals and objectives. Sections 4.1.1 and 4.2.2.1 are well written. The document could be improved by clearly stating the difference between goals and objectives in this context and then ensuring the appropriate sections clearly define the goals and objectives without overlap. We recommend significant revisions to the Data Quality (Usability) Assessment (Section 14) as well as expanding the descriptions of model documentation into a separate section and with additional detail.	Summary of recommendations already included elsewhere in the letter.	See the response above
KC #1	While the County understands Ecology's need to have laid out a robust methodology to guide implementation of this complex project, for several reasons, we are not sure documenting the modeling scope under a QAPP is the correct fit. A QAPP is typically a way to ensure that an investigation is addressing the study questions and the methodology employed will result in the necessary information being acquired to address those questions at the robustness targeted. This product is more of a scope of work needed to implement a project. As such it suffers from trying to present the scope in the rigid format of a QAPP. KC's Suggestion: A separate document focusing on addressing those specific study questions would be a more targeted product that could provide a focused benefit to this project. Still, an overall detailed scope of work is needed not only for Ecology to manage the project but for stakeholders to understand and provide informed input to the project. We hope that Ecology considers separating this document into two more appropriate documents to facilitate getting more valuable input from the TAC.		Thanks for the comment. We agree with King County that having a separate document focusing on the discussion of those specific study questions for watershed model will be a great idea. The project objectives for watershed model was actually going be a seperate document that was prepared for the discussion of management questions in the TAC meeting and then we decided to incooperate it into our QAPP for better documentation. While we are in the process of the watershed model development, we will prepare a document that will discuss the management scenarios for watershed model. Hopefully we will provide that document for TAC review before the next TAC meeting. In the meantime, we will just keep the section in the QAPP since QAPP itself will be living document, it is best to keep the section in for documentation.

KC #2	Two objectives of the PLA in Section 4.2.1 (i.e., to improve the effectiveness of the sediment remedial action; and address CWA water, sediment, and tissue quality impairments in the Green/Duwamish River watershed, including the LDW) are not actually being addressed by this QAPP. We recommend these be removed or clarified.	Section 4.2.1	We still believe the receiving water model will help addressing these two statements. The receiving water model will help evaluate the sediment quality post clean-up and evaluate the different management scenarios to address those impairments in the LDW. Even though we didn't include detailed objectives for receiving water, we still think it is important to keep these general objectives in the QAPP as a guidance. We edited the sentence to emphasize that: "to **evaluate** and improve the effectiveness of …." and "and address and **predict** CWA…..".
KC #3	In Section 4.2, the modeling objectives only focus on the watershed model; no objectives are presented for the receiving waterbody model. Objectives for both models are needed to address the overall PLA objectives. Without seeing both models' objectives, it is difficult to determine if the project would adequately address the PLA objectives. We request another subsection in section 4 (4.2.3) be added to address receiving waterbody objectives. Once developed, please send these objectives to the TAC for review. Conversely, if that was the intent, please clarify in the document that currently only the watershed model portion is developed at this time and state that the other modeling sections will be revised at the appropriate times. Furthermore, we found the objectives are scattered throughout the document, making it difficult to determine what the principle objectives are that the project is focusing development on and which are secondary and used to help make project decisions moving forward.	Section 4.2	In this QAPP, we did just focus on the project objectives for watershed model. There are still a lot of uncertainty for receiving water model and food web model. It is a little too early for us to present the project objectives in the version of QAPP. We did include a paragraph to explain that this version will only include the project goals and objectives for watershed model, the rest of two will be included in the future QAPP revision. There are some brief Receiving Water modeling objectives in QAPP Section 7.3.2.2.1.

KC #4	A QAPP explicitly describes how specific goals are proposed to be met. However, in sections 6.4 and 14, that is not apparent. There are no performance criteria or targets listed, but rather a more general listing of comparison to measurements and spatial resolution of patterns seen. While these are useful in determining how the model is best applied, it is hard to determine if the model will achieve its objectives. This also suggests the QAPP format to determine how well one addresses specific questions is not the appropriate format for this document. Is there a format more related to model development where exploring applications of the model is expressed?	Section 6.4 and 14	Thanks for the comment, in the Section 14, we did include a write-up to explain that why the project team is not establishing quantitative model acceptance criteria in this QAPP based on the considerations listed in that section. Once we develop the model, we will present the calibration results including the statistic analysis between the model output and field data. It will be subjective for the reviewers to evaluate the performance of the model. Again, we agree that developing a separate document including the management questions/scenarios and how to address those will be valuable, and we will work on that document.
KC #5	Based on Section 3.2.3, total PCBs are being modeled; we agree with this approach because data would be limited if PLA only modeled select PCB congeners. The QAPP indicates the use the physico-chemical properties from a selected group of homologs for the models. It is unclear how the partition coefficient representing a particular homolog group will be selected. Will a partition coefficient for a specific congener in each homolog group be used or a weighted partition coefficient for each homolog group be used? We recommend a weighted approach is used, and it be weighted similar to the weighted total PCB method used in the LDW FWM. It is not clear how Ecology is proposing to do this key factor to bioaccumulation. There is also concern that including only the higher chlorinated homologs will miss significant areal differences seen to date in body burdens due primarily to lower chlorinated congeners. (Also related to KC's comment in QAPP Table 1)	Section 3.2.3	A constant partitioning coefficient of (Kd = 5.0x 10-2 L/mg) is used for PCB watershed model now. Based on PCB data, a spatially variation of partitioning coefficient in the watershed will be developed based on a weighted method. For the receiving water model, we will start with the partitioning coefficient from LDW FWM (Kd = 1.4 x 10-2 L/mg for the sediment bed and Kd = 5.5 x 10-3 L/mg for the water column). With more OC data from King County and the Leidos Database (and SSM results), we will add more complexities into the partitioning. Black carbon's effect will be implicitly considered as addressed in the QAPP.

KC #6	Using low flow instream water concentrations as the default groundwater input concentrations will overestimate actual groundwater concentrations and create significant issues meeting stated objectives. Because the bed sediments have contaminate concentrations (albeit low), they contribute to the water concentrations through partitioning and could drive baseflow concentrations. We recommend this data gap be verified by collecting some congener data from groundwater wells in rural areas to help address this and to collect congener data in upstream reach bedded sediments to get accurate concentrations for input to the water from sediment.	TBD	It looks like that looking into the upstream reach sediment bed pollutant concentration may be a good start to estimate groundwater concentration. We will also see if there is any PCBs Congeners data from Groundwater wells. There are some water column data approximately 20 miles upstream of the HHD reservoir at Stations UG319 and SC319. The goal is to set a spatial variation of groundwater concentration.
KC #7	It is not clear how Ecology is proposing to separate atmospheric contributions from the other non-point sources. It appears that the model will be adjusted to atmospheric deposition changes by adjusting the washoff. However, this also affects all other nonpoint inputs also driven by washoff which we do not believe should be adjusted by such a spatial factor.	TBD	Atmospheric loadings will be tracked separately in the build-up process. As part of the build-up, there will be build-up differentiated by land use, and contribution of build-up by atmospheric deposition that is not differentiated by land use. The wash-off function in the model will then be applied to the total build-up from atmospheric as well as the from land use and will get washed off combined. This adjustment factor is defined as the pollutant removed from the land surface is in proportion to the sediment removal. We don't change the runoff and sediment washoffs themselves, but specify the amount of pollutant associated with unit detached sediment in US ton. We need to know what and where those non-point sources or lands are so that we make sure they are not affected by this adjustment factor.

KC #8	As we have stated before, we still think the questions Ecology is asking the modeling to do as part of this methodology needs further refinement. Only by clarifying exactly what questions the modeling is being developed to answer, and keeping that focus as narrow as possible, can a model be developed that can be expected to produce results within acceptable quality and accuracy. In our experience, a complex model is best focused on a few objectives if it is expected to produce acceptable output for the stated objectives. With an increase in modeling objectives, and thus complexity and the assumptions needed, we inevitably lose accuracy in with the modeling outputs. The result tends to be a model that does everything relatively poorly.		Thanks for the comment. We understand the importance of defining the modeling questions with right expectations. For the watershed model, the modeler provided more detailed questions. We will continue developing the questions and management scenarios for the watershed model. We will provide more updates in our next TAC meeting. We also have a contract in place for RESPEC to review our management scenarios and setup. For the receiving water model, we will need some more time to further refine the management quesitons. We appreciate the suggestion on focusing on fewer objectives. We will keep that in mind when we identify these quesitons.
KC #9	Minor comment: With reference to text "The assessment tool can also help identify load reductions from various sources in the watershed and the receiving waters ; and can be used to estimate loadings during and after sediment cleanup." KC asked question "Do you mean identify needed reductions to remove impairments?"	Section 3.1	Yes, we edited the sentence to clarify that. "The assessment tool can also help identify required load reductions from various sources in the watershed and the receiving waters to address impairments."

KC #10	One of the salient requirements for a QAPP is explicitly describing how you will prove the model met your goals. Because you don't want to do that, I suggest you use a different document format. Is there a format more related to model development where one is exploring applications of the model? You have so many goals scattered through out the document that it is difficult to determine what is your real goal(s). Maybe turn some of the goals into an objective. As written this QAPP is for only the watershed model; why do you include so much information about the other models? When are you going to write QAPPs for the receiving water and food web models? The document states that the Green/Duwamish River watershed is a complex system that requires complex models; however, it appears that the selected models are not equal matches on their formulated fate and transport processes, but this unequal match is okay. How have you determined that this complexity disparity is acceptable? How have you determined what formulations must be included? One would assume that those formulations should be present in all models.	Section 3.2.2	For this version of QAPP, we only plan to focus on the management questions for watershed model. We do have a paragraph in the QAPP to explain that. (Section 4.0) We will work on the questions for receiving water model in the future. For the detailed plan of management scenarios, we will work on that as a seperate document and present to TAC in the next TAC meeting. A couple of the watershed model management questions within tidal influenced Duwmish River Estuary might also be applicable to receiving water model. As a supplement to watershed modeling, one of receiving water model's objectives is to evaluate the impact of watershed management scenarios on LDW water, sediment and tissue via receiving water modeling.

KC #11	Several questions and issues related to the PLA project objectives, including: 1) Reference to "specific point or distributed source": "Does this mean outfall/drainage basin? Or landuse type, building type? Please clarify. Please elaborate on what is meant by assessing the pollutant contribution of a "specific point or distributed source". Please define and/or provide examples." 2) Reference to recontamination of post-cleanup sediments: "Sediment recontamination is more complex that just source loads, e.g., sediment movement within the site, dredge residuals, etc., will all affect sediment recomtamination. Recommend clarify the intent of this statement." 3) Reference to "improve the effectiveness of the sediment remedial action": "How will model do this? Does this mean as it relates to SC actions? On a basin specific scale, I think the local SC actions are best to do this versus a model that makes general assumptions being applied to multiple basins based on land use and age of buildings (for PCBs). Please clarify the intent of this statement as it relates to the PLA."	Section 4.2.1	1). Specific point sources including stormwater outfalls, CSO outfalls and any other point sources. Dsitributed sources including groundwater, air deposition and any other non-point sources. We will edit the text slightly to relate the term distributed to non-point, which is the more familiar term. 2).The intent of this statement is to evaluate the sediment quality after the cleanup and then analyze the contribution of different sources and pathways (including sources like stormwater, sediment movement, dredging activities and etc.) to the contamination of sediment. (7.3.2.2.4 Model representation of sources and processes) 3) By evaluating different source control actions, we can examine how to minimize the recontamination to the sediment and thus, improve the effectiveness of the cleanup. In the near term, we will focus on the big picture questions and will hold off on doing the anlaysis at a smaller scale until a later date. We agree this model might not be the best to evaluate the local conditions, but it can be a tool in the future and we can refine the model scale to better address specific question.

KC #12	Series of questions related to if/how the model will address the questions, including: 1) "It seems more empirical data needed to answer many of these questions. Please clarify how Watershed model helps with these questons vs empirical data?" 2) "It would be helpful to describe, even at a high level, how the model is intending to answer these questions (e.g. the potential data sources and assumptions being used, etc.)… It is not clecar that some of these questions can be addressed by the modeling proposed. Specifically 2, 5 and 6 don't appear to be answered by the model as proposed and questions 8,9,10 and 12 arent answered by the modelalthough the model may provide some information to managers on these issues." 3) With regard to question 12 "(12) What are the different methods of treatment that might be modeled? ": "Do you mean source reduction actions that could include treatment? Please clarify the intent of this question."	Section 4.2.2.1	1) The primary benefit of watershed modeling, is it fills in where information is missing. However, in addition to filling in where information is missing geographically and temporarily, watershed modeling provides a tool to then isolate and evaluate specific conditions and assumptions that would not be possible simply relying empricale observations. Data compilation and analysis are necessary to address many questions. Spatial pattern could be addressed to fill the spatial data gap. The watershed model has the prediction capability and helps us establish cause-and-effect relationships and identify the knowledge limits. 2) per modeling question (2) the watershed models are specifically designed to have the ability to evaluate pollutant loadings from the landscape in a non-point manner (i.e., generated from HRUs) and point sources (user supplied). Per question (5), similarly, groundwater is a pathway rainfall and pollutants are simulated. Groundwater contributions are typically adjusted to match baseflow conditions. Models are initialized with bed sedment concentrations. Then as suspension/deposition processes occur, groundwater concentrations are adjusted. Because the groundwater loading rates are tracked they can be evaluated the same way as the other pathways.

			Per question (6), these models are not designed to evalaute bank erosion with any specificity. This question will be removed.Question (8) is a little dubious and can be stricten. Question (9) can be directly evaluated based on physical processes in the watershed model: this includes deposition in waterbodies with very low velocities, and decay associated with attenuation. Per question (10), if we don't plan on modeling climate change we should take this out. 3) Possible treatments may include source reductions, treatments at a parcel level, and treatment at larger scales (e.g., neighborhoods, regional facilities) and remediation of specifically known point sources.We will continue developing the questions and management scenarios for the watershed model, and will include this in a separate document which we will provide for the next TAC meeting. We also have a contract in place for RESPEC to review our management scenarios and setup.

KC #13	Regarding pollutants to be evaluated: "Previously, this was tiered. PCBs first, then others later. Is this a change? Does Ecology think they can do all?" With regard to "hardness, simulated as a conservative parameter": "Is this an acceptable assumption for affected parameters?"	Section 4.2.2.2.1	We evaluate Total PCBs first and then apply the similar approach to other pollutants. We will separate them into two types: organic chemicals and metals; organical chemicals will follow the Total PCBs approach, and metals will follow both Total PCBs and Arsenic approaches. Simulation of hardness will be variable in concentration, it can be diluted, but will not decay over time. Thus, treated as a conservative parameter. Storm runoff will typically reduce hardness which influences toxicity of certain pollutants among aquatic species. Hardness is simulated to support estimates of chronic and accute conditions for copper and zinc.

KC #14	Regarding 2007 land use data: "Please add text explaining why using 2007 data is ok to use vs more recent data (assuming there is more recent data). Please add a rationale for using 2007 data." Regarding roofs as non-pollutant generating surfaces: "These are sources of pollutants. Ecology did a study on run off from roofs depending on material type there were contaminants released from roof materials. This reads like roofs will not be considered as a source of pollutants. Is that the intent? If so, what is the rationale? Is this a model limitation or data limitation?"	Section 4.2.2.2.3	At the beginning of this watershed modeling project the most recent data available was 2011 and existing watershed models were built/calibrated using 2007 land use. Data used for calibration also spans multilpe years and goes back to early 2000's. Thus it is appropriate to pick an era that is somewhere in the range of data used for model calibfration. Additionaly, a comparison between 2007 and 2011 was made by Ecology for the Soos Creek TMDL. This resulted in minimal impacts to the watershed hydrology. In addition, other various layers used to develop the watershed model includes, roads, impervious surfaces, LiDAR. These layers of information are derived from the most recent available which is variable and can be as recent as 2015 (need to confirm date) when modeling started for this project. While it would be best to use the most recent data avaialble in all aspects, at some point we need to lock into a condition and progress forward in model development. A prudent near-term action may be to update the land use in the watershed model after the calibration is complete. Presumably, if the model is robust, it should update and still simulate with adquate accuracy newer conditions. Roofs will be defined with the same build-up wash-off for each contaminant as is the land use the roof is a part of (e.g., Residential-roof, Commercial-roof, etc.).

KC #15	Regarding pollutant fate: "How do you handle PCBs and PAHs that can be degraded over time. For example, dechlorination and volitization of PCB congeners. It is not clear what assumptions are being applied regarding chemical fate." Regarding decay over time: "probably could clarify and say, decay will be simulated but not degradation into byproducts. "	Section 4.2.2.2.7	General decay and volitilization will be included for organic chemicals modeling. Decay will be included but degradation into byproducts will not be included. The decayed and volatilized pollutant mass will be directly removed from the model system. The degradation or dechlorination into other congeners is not considered since we consider the PCBs and cPAHs as a whole and the total congeners' mass will not be changed.
KC #16	Regarding Boundary Conditions: "Needs clarification on exactly what are the boundary conditions for the watershaed model and how it generates inputs for the receiving body model. In order to do what is suggested, the watershed model would need to be calibrated to the LDW conditions. Since cant really handle tidal conditions which are extremely relevant to groundwater inputs,then a major component cant be estimated in the LDW (groundwater). Below state this input will not be estamted but used to calibrate model. " Regarding upstream: "Probably need to define downstream river bondary as at the Black River confluence. Downstream of that point will be lateral flows only. " Regarding HHD outflows: "Need output defined for use by the receiving water model."	Section 4.2.2.2.8	HSPF watershed model has two inflow boundaries: 1) Howard Hansen Dam, 2) Lake Young (constant flow and concentration), and 3) downstream boundary - USGS12113390 at Golf Course on Duwamish River (~half mile downstream of the confluence with Black River). The watershed model outputs from station 12113390 will be used as receiving water sediment transport and pollutant fate and transport model boundary conditions. Additionally, HSPF will generate the tributary and lateral constituent time series, some of them will be used as inputs for receiving water model. We will rely on receiving water model for Lower Duwamish Waterway analysis since HSPF doesn't handle tidal influenced LDW.

KC #17	Comments/questions regarding summary of objectives: 1) "No receiving waterbody and food web modeling objectives? Not complete without, particularly as next sections go into all components" 2) Regarding loading rates being user specified: "But there are two inputs that have to be user specified. Groundwater and sediment flux. Both are important in fate, but neither can be estimated and are codependant variables." 3) CSO being evaluated separately: "Can this be expanded upon to say how CSOs will be evaluated? CSOs are also dominated by stormwater which are being modeled. How get to vary dependently?"	Section 4.2.2.2.9, page 21	1) See response above on this matter, add a couple of sentences at the end of section 7.3.2.1.2 to describe the models used by King Co or include some references to publications of Receiving water and Food web models. 2) We will try to obtain Groundwater and Sediment Flux info and work on these two items, respectively.3) There is some explanation of the CSO modeling in section 7.3.2.1.2 Existing watershed models. CSOs will be represented using the data from King County and City.
KC #18	Suggestions for report references in Table 3. See pg 25 for details.	Section 4.3.1.1.3	Thanks for the information! We updated the references.
KC #19	Regarding model gaps: "It may be helpful to understand how these data gaps relate to the watershed modeling questions, to determine how signigicant some of these data and knowledge gaps might be."	Section 4.3.2	Assume the question is for pollutant modeling. We acknowledge the mode uncertainty due to data gap. However, we are trying to minimize the uncertainty by concentrating on the major processes and filling the data gap. There is a section in the QAPP that specifically discusses the data gap. (Section 4.3)

KC #20	Various comments disagreeing with Food Web Model statements. See page 35.	Section 4.3.2.3	"...suggests **a certain model limitations or EFDC linkage issues**.", "Some adjustments will need to be made to account for both interim remedial actions and possible **sediment resuspension and** dilution of surface sediment concentrations by continued deposition of cleaner sediment from the Green River.", "Temporal variability in water column concentrations can be addressed to some extent by the development of **an updated EFDC model** that simulates the responses to varying flow and loading conditions over time, **to effectively simplify the processes, a steady-state assumption can be made to approximately represent long period water column conditions, thus, the long-term water column EFDC averages will be used as the steady-state model concentration inputs.**", "Obtaining additional quantitative data on dietary sources of individual species and pollutant concentrations in prey species would likely improve the model performance." -> "As a test case, additional quantitative data on dietary sources of individual species and pollutant concentrations in prey species **can be incoporated into the model to evaluate the performance.**"
KC #21	Minor comment - Suggestion to change to "general tasks".	Section 4.4	Unfortunately we won't be able to change the title of the section as it is required in our Ecology QAPP guidance.

KC #22	Regarding particulate and dissolved organic carbon: "How does this vary on average between storm vs baseflow conditions? Does this need to be factored into the analysis? May need a 2-phase OC model to accurately account for the effects Black Carbon has on transport kenitics."	Section 7.3.2.1.4 (Instream fate and transport)	It is a good question whether the relative concentrations of POC and DOC vary seasonally. We currently don't have high resolution datasets to answer this question and therefore will rely on the average instantaneous measurements of TOC. During the model compilation we will assess whether sufficient instantaneous results of POC and DOC can be compiled in order to define OC fractions within baseflow and stormflow. Hourly suspended sediment concentration is simulated to differentiate storm event from baseflow condition in current HSPF model, sediment transport with spcified OC fractions can be used to specifying a spatial varying partition coefficient based on watershed OC data, so we do not miss both the suspended sediment concentration and OC to capture the storm and baseflow events. We considered using a 2-phase OC model, however the requirements for data and the added workload were considered too much for the information gained. We will assume that black carbon is part of the POC fraction and implicit to the TOC concentrations; we will not be modeling this separately.
KC #23	Regarding USGS study as a basis for GW flows: "There are no PCB congener data upstream of LDW. All GW data are based on PCB Aroclors and are not detected at highler detection level than detects by congenes so how do you model GW for upstream areas? This looks like a data gap. Also will overestimate background concentrations. Sedimetnt concentrations	Section 7.3.2.1.5	Yes, we saw that there is a significant Total PCBs data deficiency for upstream area. Please refer to KC#6.

KC #24	Regarding OC data: "How will empirical OC data be used? To validate? KC has water column TOC/DOC data monthly over many years and there is also LDW sediment TOC data. Recommend an evaluation of empirical data before defaulting to simiulated data by SSM. Please contact Debra Williston for more information on available OC data."	Section 7.3.2.2.3	If we use SSM results, the organic carbon (OC) data will be used for validation. If we don't use the OC simulation results by SSM, we will use OC data to generate time series OC inputs for pollutant partitioning, while SSM results could be used to verify our receiving water hydrodynamic model and its OC results might show us some OC spatial distribution
KC #25	cPAHs: "What partition coeffient will be used? BaP not usually the most abundant of the cPAHs." USACE work: "What about work LDWG doing with measuring freely dissolved PCBs in water column at two locations (all congeners not subset like Gschwend)?	Section 7.3.2.2.4	An initial estimate of constant cPAHs TEQ partitioning coefficient of Kd = 2.0x 10^{-2} L/mg is used for watershed model. BaP accounts for 60-70% of the Total cPAHs TEQ and can represent Total cPAHs TEQ.
KC #26	Regarding PCB and DEHP degradation being ignored: "This depends on the PCB homolog group. The lower chlorinated homologs will degrad faster than the more chlorinated PCB compounds."	Section 7.3.2.2.4	A constant decay rate is used for current model.
KC #27	Regarding the influence of contaminant partitioning on the transfer of particle-bound contamininants across the sediment-water interface and between bed sediment: "Not clear how this will be estimated in the modeling.... Check LDW Sediment Transport Model but not sure had any bed movement from tidal flows. Kevin can probably check on this."	Section 7.3.2.2.4	Thanks. We will discuss with Kevin when we move to sediment transportation and pollutant modeling in receiving water model.
KC #28	Regarding model calibration and dredging operations: "Note for dredged areas within intertidal, there will be back filling to grade so bathy will be maintained."	Section 7.3.2.2.5	Thanks for the info. So we don't need to put several versions of bathymetries into the model. However, we hope that the model is able to reflect this back filling.
KC #29	Suggestion to use LDW data (baseline dataset avaiable at end of 2020) instead of literature data to explore the relationship between PCB congeners/aroclors and total PCBs.	Section 7.3.2.2.5	Agreed. We will use LDW data first. We will only use literature data for reference.
KC #30	Regarding linkages to SSM hourly outputs: Has this been calibrated to all the actual data that exisits in the LDW and EB. May be bad input using model generated over actual.	Section 7.3.2.4	Thanks and that is good to know. We are not sure if SSM has been calibrated to the LDW and EB OC data. will take a look at SSM outputs. If significant efforts are needed to calibrate SSM, we will use the actual data to obtain a simpler OC inputs at the beginning.

KC #31	How is model sensitivity to the general modeling assumptions to be tested? How was it decided that these are reasonable assumptions?	Section 7.4	The assumptions will be based on previous study findings and data explorations. We also need to conduct model sensitivity test during model development.
KC #32	Regarding logistical problems not expected: Concern over the limited data for model calibration for some parameters and/or basins.	Section 7.5	Data limitations for model calibrations will be reflected in the uncertainty and diagnostics of the model. For instance, the sensitivity analysis of the model runs will help idenitify parameters where limited data will have a greater impact to the model uncertainty. It is our hope that the TAC and regional collaboration under the PLA will increase our access to model calibration data and identify possible data gaps that Ecology or regional partners can assist in addressing. We will balance between model complexity, uncertainty, data requirement & model calibration efforts for pollutant modeling. The more important processes and parameters will be specified within acceptable value ranges if it's possible, the parmeter sensitivity will be performed by several model tests. Also, spatial pattern of the parameters will be identified to provide basis for adjustment.

KC #33	Regarding the model development goal of capturing the spatial and temporal patterns: "To what degree? Model can't capture all so must have an accepted bounding on these"	Section 14.1	Model will be able to capture spatial variabliliy of pollutant generation and transport at a catchment scale. Thus substantive shifts in distributions in land use that are differentiated either in stormwater runoff and/or pollutent generation can be evaluated when necessary. The watershed modeling uses time-series of continuous meterological inputs. Thus any changes in hydrology due to rainfall intensities/volumes will be recognized in modeling results. However, simulated landscape conditions are static during the model simulation (e.g., land use is not changing over time in the model). For receiving water model, the resolution should meet the the requirement of Regulatory criteria or Standards. Also the resolution depends on the scale of interest and time/spatial variations for each sub-model. The model will include the system and processes of interest, but no larger. The balance among spatial/temporal resolutions, data requirements, uncertainty and computational cost will be evaluated. Ideally, we will increase the resolution until the model performance are not sensitive to the resolutions. However, the computational requirements increase and we have the computational limitations. So for receiving water model, the spatial resolution of 3D STM model with a hourly output is a good start.