Memorandum

To: BCWMC Commissioners
From: Jen Koehler, PE; Lulu Fang, PE; and Stephanie Johnson, PhD, PE
Subject: Item 5D – Review Results of Hydrologic & Hydraulic Model Conversion and Consider TAC Recommendation to Proceed with Remainder of Project
BCWMC November 18, 2026 Meeting Agenda
Date: November 12, 2026

5D. Review Results of Hydrologic & Hydraulic Model Conversion and Consider TAC Recommendation to Proceed with Remainder of Project

Recommendations:

1. Approve the TAC's recommendation for the Commission Engineer to begin work on the remaining tasks with the approved BCWMC XP-SWMM to PCSWMM Model Conversion and Update Project scope of work.

Background

At their April 2024 meeting, the Bassett Creek Watershed Management Commission (BCWMC) approved the conversion of its watershed hydrologic and hydraulic (H&H) model from the XP-SWMM to PCSWMM software platform. Following approval of an updated scope of work and budget for the project May 2026, the Commission directed the Commission Engineer to begin work on the project, starting with Task 1: Model Conversion. Work on Task 1 of the project has been completed and was presented to the BCWMC Technical Advisory Committee (TAC) at their November 8, 2026 meeting. At that meeting, the TAC approved a recommendation for the Commission to approve the Commission Engineer to move forward with the remaining model conversion and update project tasks.

The BCWMC has maintained watershed-wide H&H models since the 1970s. The BCWMC's original HEC-1/HEC-2 models were transitioned to XP-SWMM in 2012 (Phase 1). In 2017, a more detailed Phase 2 model was developed and calibrated to observed data at five locations throughout the watershed. The model was subsequently updated in coordination with the Minnesota Department of Natural Resources (MnDNR) and FEMA mapping efforts. More recently, it was revised to incorporate development and capital improvement projects completed through 2021. The resulting 2022 model is the current version being used by the BCWMC for floodplain regulation.

Due to upcoming changes in the available technical support and pricing structures for the XP-SWMM software, the BCWMC TAC recommended transitioning the BCWMC's H&H model to a new modeling platform. Barr completed the conversion of the BCWMC's 2022 XP-SWMM model from XP-SWMM Version 2014 SP1 to PCSWMM Version 7.7.3920 (May 2025 release). Below is a high-level overview of the model conversion process and results; complete details of the conversion, including figures summarizing differences in the predicted maximum water surface elevations (MWSEs) between the two modeling platforms can be found in a memo provided to the BCWMC Technical Advisory Committee (TAC).

1 Conversion Process

1.1 Hydrology Input Conversion

Predictions of watershed hydrology (i.e., the amount of stormwater runoff created by a given storm event) were validated as part of the Phase 2 XP-SWMM model creation. Because of this, all hydrologic parameters within the 2022 XP-SWMM model were transferred directly into PCSWMM without modification. This included subwatershed characteristics, infiltration parameters, routing assignments, and impervious area definitions. Maintaining identical hydrologic inputs between the two models allows for any differences in model-predicted outputs to be attributed to software implementation rather than changes in watershed representation.

1.2 Hydraulic Input Conversion

Similar to the hydrologic inputs, the hydraulic network, storage features, conveyance system geometry, inflows, outflows, and boundary conditions within the XP-SWMM model were preserved to the greatest extent possible when converting over to PCSWMM, without significant changes to the model geometry. Several formatting changes were required to accommodate differences between software platforms, including conversion of specialized weirs, pump curves, sealed nodes, and outfall configurations.

Barr performed initial model runs followed by targeted adjustments to improve model performance and maintain complete volume accounting for water throughout the model domain, following standard procedures for the XP-SWMM to PCSWMM model conversion process. Following these procedures, the hydraulic routing error for the 100-year event within the PCSWMM model was approximately 1.2%, which is within acceptable modeling standards (typically within 2%) and comparable to the original 2022 XP-SWMM model before the conversion.

2 Results Comparison

2.1 Hydrology Output Comparison

Hydrologic results were compared for all 1,193 subwatersheds throughout the model domain. Agreement between the two models was excellent:

- Approximately 98% of subwatersheds had total runoff depths within 2%.
- More than 90% had total runoff volumes within 2%.
- Nearly all peak runoff flow rates matched within 2%.
- Overall runoff volume differences across the watershed were less than 2%.

Minor differences were generally limited to small, highly impervious subwatersheds with minimal influence on overall watershed response.

2.2 Hydraulic Output Comparison

The converted PCSWMM model contains 4,268 hydraulic nodes, including 2,886 junctions, 1,367 storage nodes, and 15 outfalls. Comparison of MWSEs for the 100-year, 24-hour event showed strong agreement:

- More than 88% of nodes were within 0.5 feet of the XP-SWMM results.
- More than 84% of storage nodes were within 0.2 feet.
- Differences greater than 5 feet were primarily associated with sealed node (e.g. lift station structures), where the two software platforms handle surcharging differently; however, these

differences are not impacting the predicted water surface elevations on the upstream water bodies and result in similar pumped discharges.

Review of these locations determined that the larger differences reflect software functionality differences rather than deficiencies in the conversion process. Key storage facilities, lakes, and wetlands generally showed very good agreement between the models.

We also evaluated the BCWMC trunk system, consisting of 490 nodes representing lakes, wetlands, creek reaches, culverts, and related hydraulic structures separately from the overall watershed. Results showed strong agreement between XP-SWMM and PCSWMM for the trunk system:

- More than 85% of nodes having maximum water surface elevation differences of 0.5 feet or less.

Agreement was particularly strong for major lakes and wetlands, indicating that the PCSWMM model closely replicates hydraulic conditions throughout the Bassett Creek trunk system.

Peak flow rates showed greater variability than water surface elevations, especially within the BCWMC trunk system, largely due to differences in how XP-SWMM and PCSWMM models calculate flow through non-circular culverts. However, the differences are within the expected range for a model conversion, and overall, the PCSWMM model provides hydraulic results comparable to the original XP-SWMM model.

3 Result Instabilities Discussion

Model nodes exhibiting larger differences in simulated MWSEs were investigated in further detail. Geometric conditions such as short channel segments with adverse slopes or abrupt transitions between wide and narrow conveyance features can cause localized numerical instability (this is a known issue within PCSWMM), particularly during larger storm events when higher flow volumes must be routed through the system.

These differences are primarily related to how the two software platforms handle rapidly varying flow conditions rather than differences in the underlying hydraulic network. These areas of instability will be investigated further and modeling inputs adjusted to address these as part of future project tasks.

4 Next Steps

The interim PCSWMM model resultant from the first model conversion task generally produces reliable and defensible results and provides a good foundation for the upcoming model updates to be completed in subsequent tasks of this project. Once approved, the next step for the project (Task 2) will incorporate the following updates into the PCWMM model:

- Incorporate significant watershed improvements completed between 2021 and 2026.
- Update storage representations using 2022 LiDAR data where surface storage conditions have changed since the original 2011 dataset.
- Updates for more recent impervious coverages.
- Updates to address hydraulic stability issues:
    - improving floodplain representation,
    - simplifying short channel segments at culvert and bridge crossings, and
    - replacing wide-weir overflow features with LiDAR-based channel geometry.

Together, these refinements are expected to improve model stability, reduce routing errors, and better reflect current watershed conditions. The updated model will then be recalibrated to more recent monitoring data (Task 3). The recalibrated model will then be used to evaluate NOAA Atlas 15 precipitation events once the data is available (Task 4).

Project Budget: The updated budget for the model conversion project approved in May is $290,500. Although a FEMA grant application was complete and submitted in 2025, no indication that grant funding would be awarded has been received despite numerous attempts at communication with FEMA and outreach to congressional representatives. We recommend that the project move forward using BCWMC Special Projects funding. The administrator will bring information on Special Project Fund balance and projected spending to the meeting.

Recommendation: Approve the TAC's recommendation for the Commission Engineer to begin work on the remaining tasks with the approved BCWMC XP-SWMM to PCSWMM Model Conversion and Update Project scope of work.