elm creek
Watershed Management Commission

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Technical Advisory Committee Meeting
Minutes – May 18, 2022
(Attendees updated)

I. A virtual meeting of the **Technical Advisory Committee (TAC)** of the Elm Creek Watershed Management Commission was convened at 9:32 a.m., Wednesday, May 18, 2022.

In attendance: Heather Nelson, Champlin; Nico Cantarero, Stantec, Dayton; Derek Asche, Maple Grove; Matt Danzl, Hakanson-Anderson, Medina; Ben Scharenbroich, Plymouth; Andrew Simmons, Rogers; Diane Spector and Erik Megow, Stantec; James Kujawa, Surface Water Solutions; Rebecca Carlson, Resilience Resources; Kris Guentzel and Kevin Ellis, Hennepin County Dept. of Environment and Energy (HCEE); Brian Vlach, Three Rivers Park District; and Judie Anderson, JASS.

Not represented: Corcoran.

II. Motion by Scharenbroich, second by Cantarero to approve the **revised agenda.*** *Motion carried unanimously.*

III. Motion by Scharenbroich, second by Nelson to approve the **minutes*** of the April 13, 2022, meeting. *Motion carried unanimously.*

IV. HUC 8 Watershed Floodplain Modeling and Mapping Project.*

A. The Minnesota Department of Natural Resources (MNDNR) is partnering with the Federal Emergency Management Agency (FEMA) to update the base flood elevation across the watershed for a future Flood Insurance Study (FIS). Member cities of the Elm Creek Commission have noted significant differences between the flood elevations in the 2016 FIS and the preliminary Elm Creek Floodplain Modeling and Mapping HUC-8 Study (HUC-8 Study). In some locations, the HUC-8 results show a base flood ("100-year" or 1%-annual-exceedance probability) elevation that is up to 8' higher than the reported 2016 FIS elevations. Based on historic flooding reports and historic knowledge in the watershed, these results are outside of expected flooding conditions.

The base flood elevation published in the FIS sets the floodplain inundation extents and is particularly important as there are local, state, and federal regulations governing development. For example, existing single-family homes with a federally backed mortgage (approximately 95% of all mortgages) are required to buy subsidized flood insurance that may cost between a few hundred to tens of thousands of dollars per year. The floodplain also substantially increases costs for new construction due to the increased cost associated with bringing in fill (i.e., raising ground level) to reduce flood risk.

The purpose of Staff's May 10, 2022, memorandum is to summarize the work completed to revise and update the HUC-8 Study based on the findings of the Third-Party Review (Stantec, January 2022) through the Tasks outlined in Stantec's Response to Request for Proposal for Revisions to HUC-8 Model (March 2022). The following sections provide an overview of the revisions made to the hydrologic (HEC-HMS) and hydraulic (HEC-RAS) models, along with a discussion of the calibration analysis.

B. Stantec updated the HEC-HMS (US Army Corps of Engineers **H**ydrologic **E**ngineering **C**enter – **H**ydrologic **M**odeling **S**ystem) model (received from the DNR January 24, 2022) to provide better estimates of peak streamflows for input into the hydraulic (HEC-RAS) model. After the updates were completed, the model was assessed through the same calibration methodology, and for the same calibration events, that were included in "*Elm Creek Narrative and QAQC Documentation*" (Barr Engineering 2021.) Three major updates were made to the HEC-HMS model to improve hydrology and estimate new streamflows:

1. The model was updated from HEC-HMS Version 4.3 to Version 4.7, the latest version.

2. Natural storage and cross-sections were updated to replace areas where a Muskingham-Cunge shortened simplified trapezoidal bank-width cross section was modeled.

3. Watershed areas and hydrologic connections between the watersheds and reach segments were updated and a methodology was produced to input the calculated flows into the HEC-RAS Model.

The following sections provide an overview of these updates. Appendices A and B provide additional details.

The original HEC-HMS model was transitioned from Version 4.3 to Version 4.7 for storage, cross-section, and routing updates. Using Version 4.7 made it possible to easily integrate the required updates, but this update required defining an Index Method (Celerity). According to the HEC-HMS User's Manual, the Index Method (Celerity) is used in conjunction with the physical properties of the channel to discretize the routing reach in both space and time. A celerity, or reference flow, equal to 5 ft/s was assumed uniformly across the model as recommended by the HEC-HMS User's Manual. Assuming a celerity of 5 ft/s, no negligible change in the 100-year flows was seen between the runs in Version 4.3 and 4.7.

The 55 sub-basins highlighted in the Third-Party Review were examined to determine whether storage or updated cross-section definitions would be beneficial to updating flow calculations. Storage considerations included depressions in the Digital Elevation Model (DEM), imagery, and how/if the storage could then be accounted for in the HMS routing. Storage was calculated by first creating polygons around the depression areas seen in imagery and LiDAR. These polygons were then used along with the DEM to create storage capacity curves (elevation-area). The calculated curves were then applied to an existing or added associated reservoir. Added reservoirs were assumed to have outlets estimated by measuring culvert or bridge openings and inlet and outlet elevations. Rise was calculated using engineering judgement based on the size of the structure to subtract 2.5-4 feet from the differential of the structure deck and inlet elevations.

Cross-section updates were made by pulling terrain data for the whole cross section in HEC-RAS and then filtering them to 8 point cross sections. The left and right Manning's coefficient settings were applied by reviewing common overbank channel along the reach. Overall, 47 sub-basins were updated by adding natural storage areas or updating storage reservoir curves within 37 sub-basin and updating cross-section within the other 10 sub-basins. A summary of the updates is included as Appendix A of the memo.

With the added natural storages and updated cross-sections, junctions were added as needed to properly join and route flows within the model. For example, if more than one component (i.e., reach, basin, reservoir, etc.) were joining together and Staff deemed a potential need to collect flows in that location, a junction was added. Junction components do not contribute to the program calculations. They serve a dual purpose of more accurately modeling the routing of the watershed and making it easier to import flows into HEC-RAS.

C. The subbasin (watershed) areas were calculated in GIS and compared to the drainage areas represented in the HMS model. Eight subbasins had areas that differed by greater than 2% and were updated. These basins were DC1, DC4, DC5, EC11, EC12, EC17, and EC8. Every attempt was made to mimic the methodology used previously to route flows from the HMS results to the HEC-RAS cross-sections. The routing method used in the January 24, 2022 HEC-HMS Model, was not replicable and had inconsistencies on where the flows were applied. Without further sub-delineations, Stantec was required to compute ratios for some reaches based on the percentage of drainage area and reach length routed within each sub-basin. A spreadsheet was used to calculate the routed flows and an example (for the 100-year flows) of the methodology used is shown in Appendix B.

D. Following the HEC-HMS updates, the model was assessed through the same calibration methodology, and for the same calibration events, that were included in "*Elm Creek Narrative and QAQC Documentation.*" The updated model was evaluated using the historical flow record at the gage co-operated with the USGS on Elm Creek in Elm Creek Park Preserve, and two Three Rivers Park District-operated flow monitoring gages *ECER (Elm Creek at Elm Road* near the Plymouth-Maple Grove municipal border), and *RT* (Rush Creek at Territorial Road). The precipitation events that were used to assess the calibration of the updated model are:

1. June 23 – July 5, 2003 (rainfall). Data for RT was not available before 2006.

2. September 22 – October 1, 2016 (rainfall)

3. March 6 – April 3, 2010 (snowmelt). Data for RT and ECER was not available for winter months

4. March 18 – March 28, 2011 (snowmelt). Data for RT and ECER was not available for winter months.

As outlined in "*Elm Creek Narrative and QAQC Documentation,*" the calibration targets for the June 2003 and September 2016 rainfall events were to achieve a Nash-Sutcliffe Efficiency (NSE) index of 0.6, which is a measure of model fit compared to observed data. With an NSE of 0.6, a model is deemed satisfactorily accurate and with an index >0.75, the model is considered excellent. A summary of the calibration results is as follows:

1. For Figures 1, 2, and 5 the calculated NSE Index was > 0.8 showing that our updated HEC-HMS model matched these storm events very well.

2. For Figure 3, Staff did not have enough data points to calculate an NSE Index, but the modeled peak flow (159 cfs) was within 12.5% of the observed flow (181.5 cfs).

3. For the September 16 RT comparison (Figure 4), the HEC-HMS modeled flows were higher than the observed. After a conversation with Brian Vlach at Three Rivers Park District, it was determined that the rating curve at this location was not accurate for high flows (56.7 cfs, or water levels above 3.13 ft).

4. For the snowmelt events, the modeled (HMS) peak flows continue to occur close to the measured peak flow for both events, so no further lag time adjustments were made.

Based on the acceptable NSE Indexes (> 0.75) and the accurate timing of the peak flows, no further changes were made to curve numbers or lag times of the HEC-HMS Model. After calibration, flows for the 10%, 2%, 1%, and 0.2% rain events were calculated in the HEC-HMS model and imported into the HEC-RAS model to calculate elevations and hydraulics for the floodplain mapping task.

E. Stantec updated hydraulic connections and downstream boundary conditions within the HEC-RAS model to calculate better estimates of peak water surface elevations. Three groups of updates were made to the HEC-RAS Model: Hydraulic crossings (bridges, culverts, weirs, and dams), Stream alignments, and Downstream boundary conditions. Following is an overview of these updates, Appendix C provides additional details.

1. Fifty-three (53) hydraulic crossings, including the Elm Creek Dam, were updated in the HEC-RAS model based on construction drawings, surveys, photos, and as-built information. These 53 structures were highlighted in the Third-Party Review. The updates included upstream/downstream inverts, road overflow elevation, pipe size, pipe material, and ground elevation (based on LiDAR). The details and any assumptions for these updates are listed in Appendix .C

2. Two major stream alignments were updated in the HEC-RAS Model, as follows:

a. County Ditch 16 east of Brockton Lane (County Road 101). The alignment of County Ditch 16 was updated to match the record plans from Maple Grove. The ditch is routed through a series of storm sewer pipes beneath Vagabond Lane and Bass Lake Road. The outlet is on the north side of Bass Lake Road where the ditch line then continues north. The storm sewer was modeled as a culvert without any bends for simplicity. The upstream invert elevation is where the ditch enters the storm sewer, and the downstream invert is where it leaves the storm sewer.

b. Unnamed Tributary to Elm Creek (HEC-RAS Reach *ElmCreek_BR4*) just southeast of the intersection of Hackamore Road (CR 47) and Brockton Lane (CR 101) in Plymouth. The modeled stream alignment appeared to show a temporary construction alignment of the creek. The alignment was updated to follow the permanent alignment of the watercourse, per record drawings from the City of Plymouth. The watercourse is routed through a culvert crossing CR 47, and then through a storm sewer pipe, modeled as a culvert, under a new residential development. The storm sewer outlets to a wetland where the watercourse realigns with the natural flow path of the stream.

F. As directed by the MNDNR, the downstream boundary conditions were modeled using a 'normal depth' in HEC-RAS. Each of the normal depth boundary conditions were reviewed and the upstream/downstream slopes were changed when necessary. In addition, the most downstream cross section of each tributary and the nearest downstream cross-section of the main stem were reviewed to confirm that the tributary cross-section had a lower water surface elevation than the main stem cross-section. By verifying each tributary had a lower water surface elevation than the main stem, an appropriate tie-in could be made. The elevations along each flooding source could be evaluated independently and the water surface elevation at the confluences would be dictated by the main flooding source elevations.

G. After the hydrologic (HEC-HMS) and hydraulic (HEC-RAS) models were updated, the updated fows for the 10%, 2%, 1%, 0.2%-annual-exceedance-events were exported from the hydrologic model (HECHMS) and imported into the HEC-RAS Model. Results from the 1% and 0.2%-annual-exceedance-events are shown in Appendix D of Staff's memo, along with a comparison to the effective 2016 FIS flood elevations at road crossings, lettered FEMA cross sections, and other pertinent locations across the watershed. In addition to the updated models and results, floodplain inundation maps were created at a scale of 1:10,000 for Elm Creek, Diamond Creek, North Fork Rush Creek, and South Fork Rush Creek. The HECRAS Mapper routine was used to automatically generate output and create maps. The maps were then reviewed to correct any issues the initial mapping had at bridge and culvert crossing, sharp turns in the watercourse, and other common automated mapping output issues to display accurate maps. During the mapping iterations, updates needed to be made to the HEC-RAS model. The inundation maps are shown in Appendix E. Appendix F provides a summary of the HEC-RAS model updates that were required for mapping.

H. **Discussion.**

Reach out to Corcoran to get feedback, especially at border with Pioneer-Sarah Creek watershed.

Make sure numbers in Appendix D and maps correspond in Champlin.

Add Maple Grove 17-24-25 (Maple Creek).

Check cross-section at Peony in Dayton 225-48-58-46 Troy Lane, Trojan Trail.

V. The next Technical Advisory Committee meeting is tentatively scheduled for June 8, 2022.

VI. There being no further business, the meeting was adjourned at 11:02 a.m.

Respectfully submitted,

Judie A. Anderson
Recording Secretary
JAA:tim

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