EPA SWMM5 for Novice/Advanced Users
EWRI2025 Pre-Conference Workshop, May 17, 2025 (Anchorage AK)

Exercise 3-1: Update Existing Conditions Model to Account for Redevelopment

This is the first in a series of exercises that addresses flooding due to redevelopment within a residential neighborhood. This exercise uses the U.S. Environmental Protection Agency's Storm Water Management Model (SWMM5, 64-bit version of build 5.2.4) and is in U.S. customary units. It is assumed that you are sufficiently familiar with the SWMM5 user interface, so that only the key commands and input values are highlighted in bold.

This exercise set is intended to build skills in working with a neighborhood-scale pipe network model, comprised of the following exercises:

- ANC3-1: Update an existing system model to account for new development;
- ANC3-2: Investigate conveyance improvements; and
- ANC3-3: Investigate LID improvements.

Key Learning Objectives

1. Learn how to update an existing hydrologic/hydraulic model to account for infill development.
2. Quantify the resulting impact on the hydraulic performance (level of service) provided by the municipally-owned stormwater management system.

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1 Review Existing Conditions Model

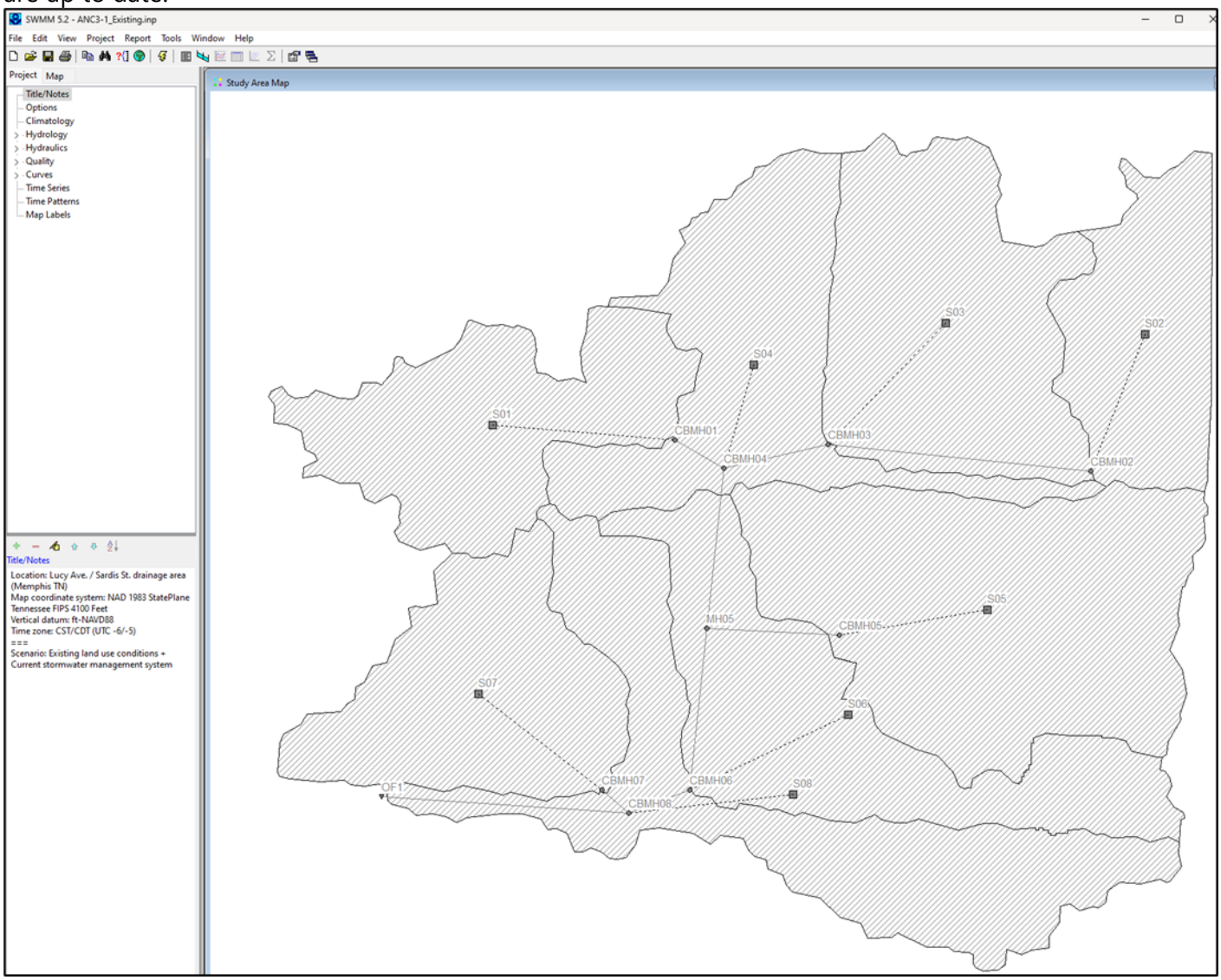
This exercise begins with a model that reflects existing land use conditions and the current stormwater management system, a pipe network that drains a small headwater catchment discharging to the outfall node OF1 (i.e., the trunk storm main) at the intersection of Lucy Avenue and Sardis Street as shown.

The existing conditions model will be used as the basis for comparing the proposed alternatives with respect to impacts on the hydraulic gradeline through the system as well as the discharge rate and volume at the outfall.

1-1 **Unzip** the contents of the file **"ANC3-1_Existing_SW52.zip"** into an empty folder and **launch SWMM 5.2** (executable file "epaswmm5.exe", version 5.2.4, 64-bit edition, downloaded from the EPA website at https://www.epa.gov/water-research/storm-water-management-model-swmm).

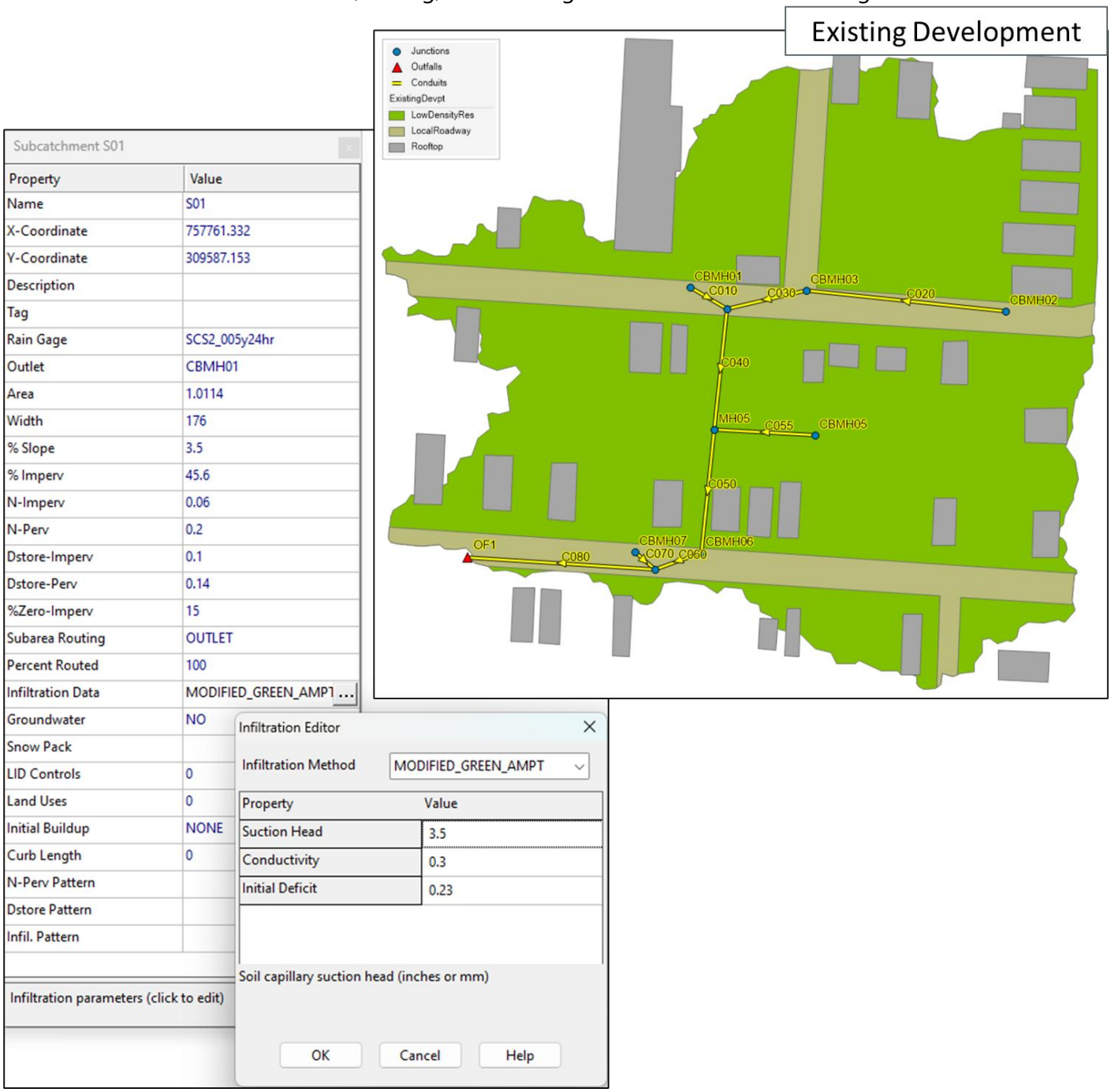
1-2 **Open** the project **"ANC3-1_Existing.inp"** in SWMM 5.2 and **Run** the simulation (icon on the Main toolbar). A popup message will indicate the hydrologic and hydraulic routing continuity errors. Click **OK** to close the message. Note the Run Status in the status bar shows a green flag, indicating that results

are up to date.



1-3 **Select a subcatchment** and review the various hydrology parameters in the **Subcatchment and Infiltration Editors**. Note the average imperviousness value (area-weighted) for all eight subcatchments) is 43.5%, which is typical for mixed use development (i.e., residential/institutional). Subcatchments were delineated using available digital topography and hydrology parameters were

derived from local soil information, zoning, and building locations as shown in the figure below.

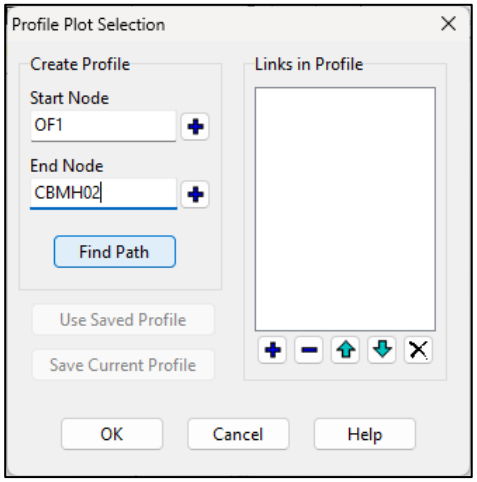


1-4 Select Rain Gages (under Hydrology in the Project panel) and note there are 9 gages that could be applied to a subcatchment:

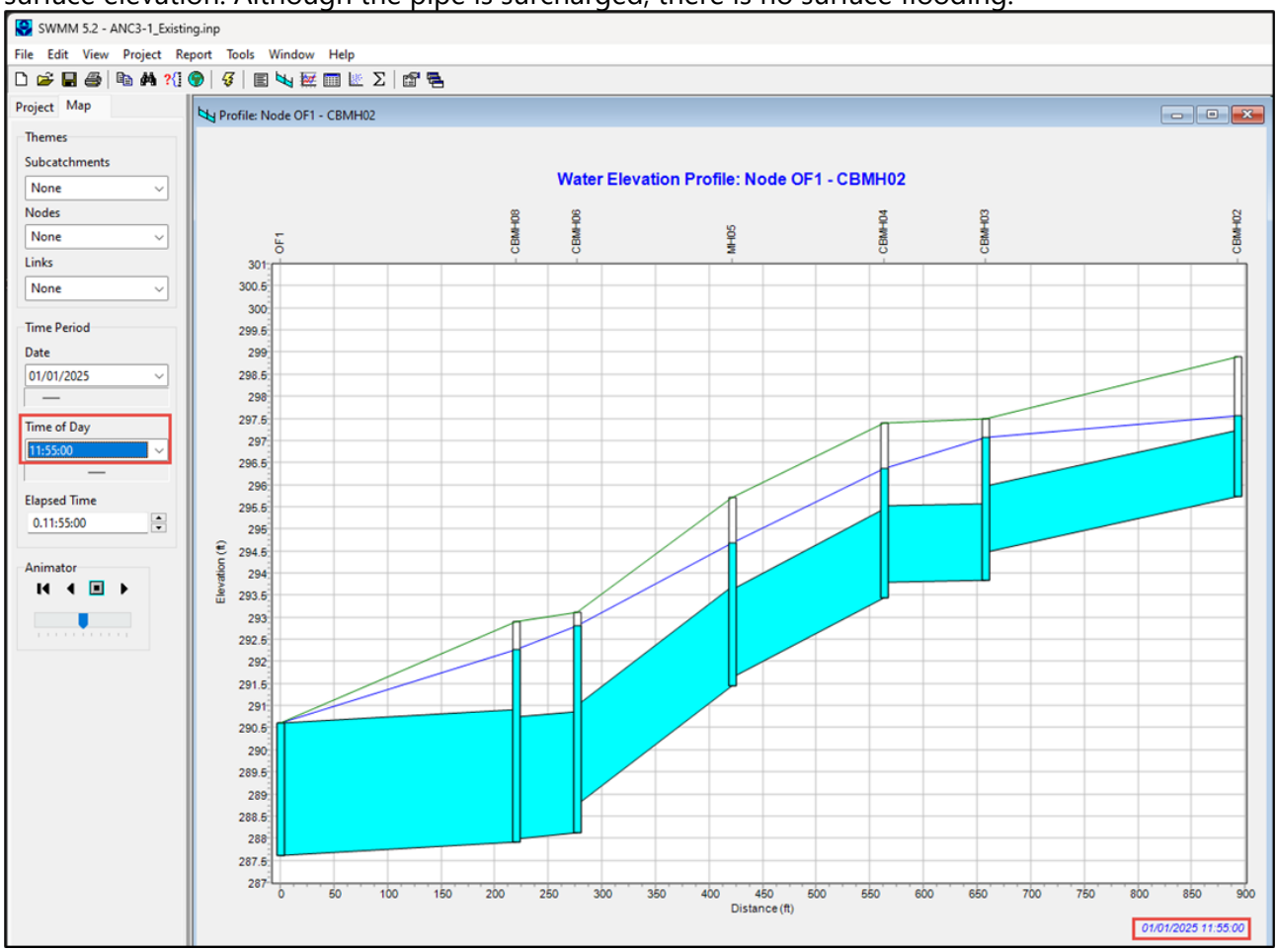
- KMEM_HPCP: The hourly rainfall record from September 1948 through December 2023 at the local airport gage, which could be used for continuous simulation.
- Rain_1in1hr: A single pulse of rain, which could be used for initial model setup and debugging.
- SCS2_001y24hr: A local design storm event that represents the 1-year return period, 24-hour duration event with an SCS Type 2 distribution.
- SCS2_002y24hr: the local 2-year design storm.
- SCS2_005y24hr: the local 5-year design storm. Note this storm has been applied to all subcatchments in the current scenario.

- SCS2_010y24hr: the local 10-year design storm.
- SCS2_025y24hr: the local 25-year design storm.
- SCS2_050y24hr: the local 50-year design storm.
- SCS2_100y24hr: the local 100-year design storm.

1-5 Open the **Profile Plot Selection** tool (icon on the Main toolbar). Enter **OF1 as the Start Node**, and then enter **CBMH02 as the End Node**, select **Find Path**, and then **OK** to draw the profile.



1-6 In the Map panel, select **11:55:00 as the Time of Day** from the drop-down list (alternatively, you can advance the water elevation profile through each reporting timestep with the Animator tool). Note the maximum hydraulic gradeline (HGL) occurs at this reporting timestep and does not reach the ground surface elevation. Although the pipe is surcharged, there is no surface flooding.



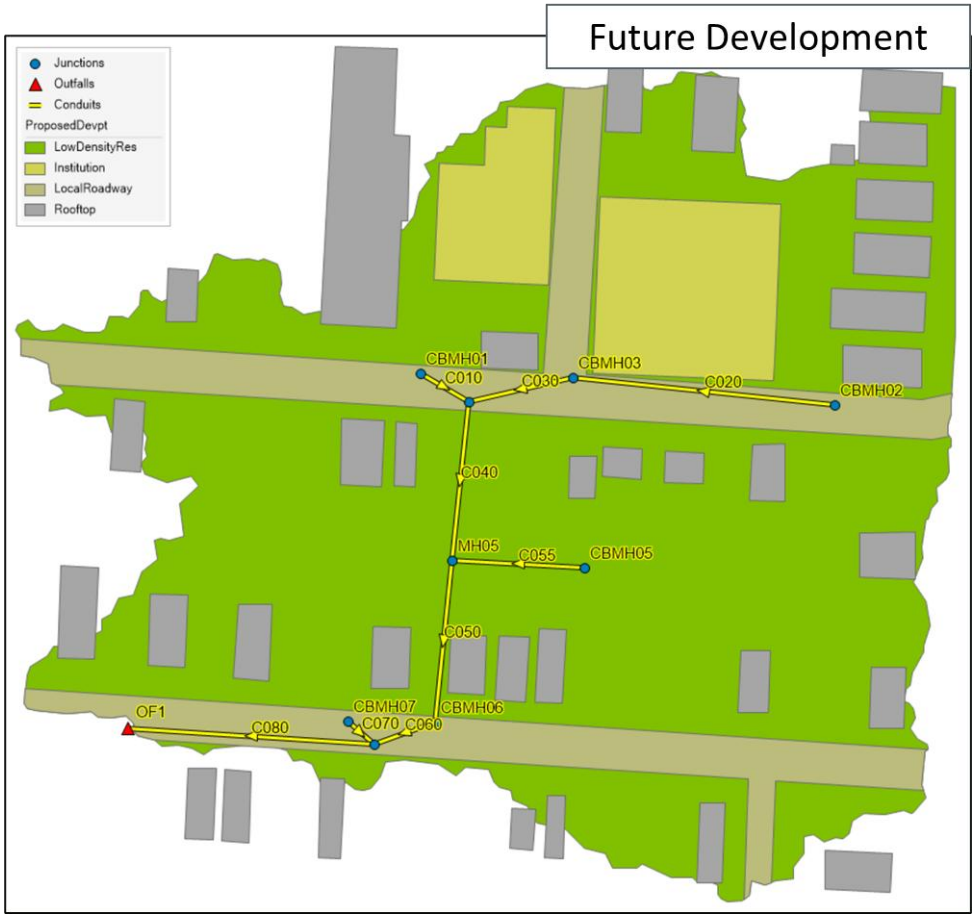
2 Create Future Conditions Model

The first step in the alternatives evaluation process is to impose future land use conditions by revising the hydrology parameters to account for proposed development. By applying the future hydrology to the current pipe network, the resulting "uncontrolled" (i.e., without stormwater management) scenario can serve as a baseline with which to optimize and compare alternative improvement projects.

2-1 **Save** the current project and then **Save As "ANC3-1_Uncontrolled.inp"**.

2-2 In the Title/Notes Editor, change the scenario description to read "Scenario: **Future** land use conditions + Current stormwater management system", and then **OK**.

2-3 Proposed development is shown in the figure below. It includes two new institutionally-zoned properties in which additional building and parking lot footprints will increase the overall imperviousness in two subcatchments: select **subcatchment S03** and change its **imperviousness to 55%** (from 40.4), Select **subcatchment S04** and change its **imperviousness to 55%** (from 45.4). For the purposes of this analysis, assume that the new development will not significantly alter other hydrology parameters.



2-4 Open the **Project Data viewer** (select Project | Details from the Main Menu), select the **Subcatchments** data category and confirm that the edits have been made.

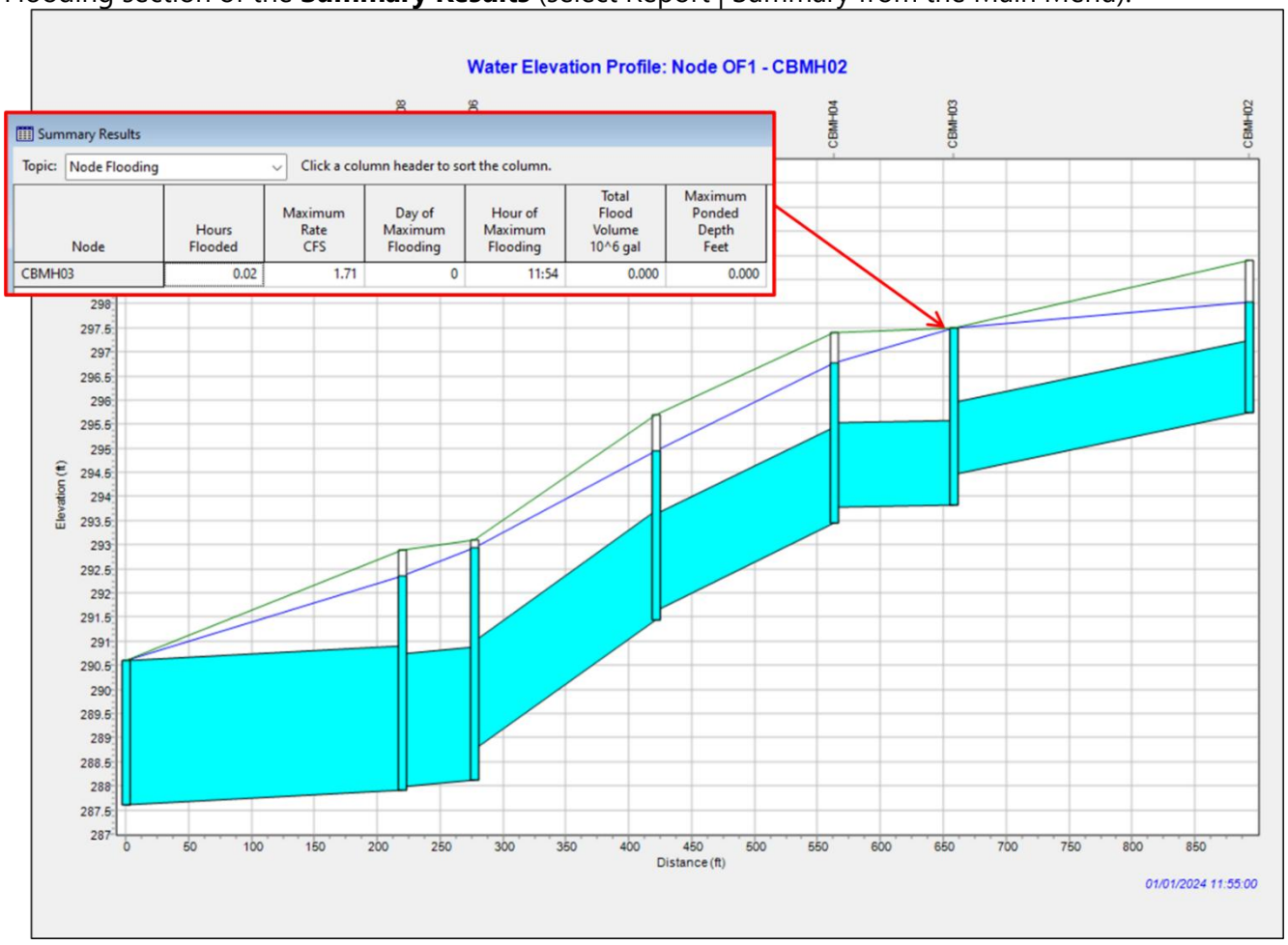
Project Data

Data Category

- [TITLE]
- [OPTIONS]
- [EVAPORATION]
- [RAINGAGES]
- [SUBCATCHMENTS]
- [SUBAREAS]
- [INFILTRATION]
- [JUNCTIONS]
- [OUTFALLS]
- [CONDUITS]
- [XSECTIONS]
- [LOSSES]
- [TIMESERIES]
- [REPORT]

Name	Rain Gage	Outlet	Area	%Imperv	Width	%Slope	CurbLen	SnowPack
S01	SCS2_005y24hr	CBMH01	1.0114	45.6	176	3.5	0	
S02	SCS2_005y24hr	CBMH02	0.7472	50.7	135	3.4	0	
S03	SCS2_005y24hr	CBMH03	1.3011	55	209	3.7	0	
S04	SCS2_005y24hr	CBMH04	1.1422	55	177	3.1	0	
S05	SCS2_005y24hr	CBMH05	1.8313	37.0	249	3	0	
S06	SCS2_005y24hr	CBMH06	1.2385	43.2	179	2.7	0	
S07	SCS2_005y24hr	CBMH07	1.0165	40.9	177	4.5	0	
S08	SCS2_005y24hr	CBMH08	1.3674	44.4	175	3.8	0	

2-5 **Run** the simulation and **plot the profile** as was done previously, by entering **OF1 as the Start Node**, and **CBMH02 as the End Node** and plotting the HGL at **time 11:55:00**. Note in this case that there is surface flooding for the 5-year design storm event at junction CBMH03. This is quantified in the Node Flooding section of the **Summary Results** (select Report | Summary from the Main Menu).



Summary Results

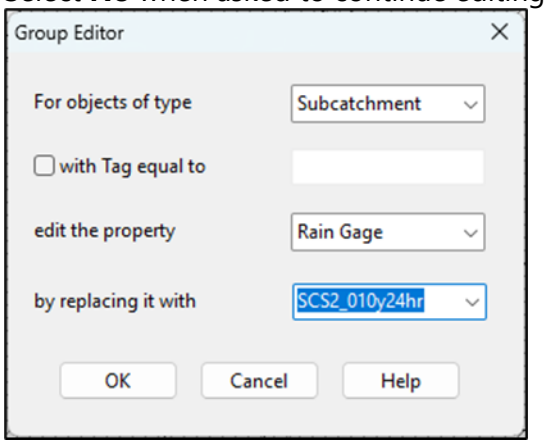
Topic: Node Flooding — Click a column header to sort the column.

Node	Hours Flooded	Maximum Rate CFS	Day of Maximum Flooding	Hour of Maximum Flooding	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
CBMH03	0.02	1.71	0	11:54	0.000	0.000

3 Assess Level of Service

A cost-benefit analysis would likely not justify a capital improvement project to offset such a minor increase in the peak hydraulic gradeline for a 5-year design storm (nor the minor increase in peak flow and total volume at outfall OF1). However, if it was acknowledged that the current level of service in this neighborhood does not meet the watershed goal of providing a 10-year level of flood protection (i.e., no surface flooding for the local 10-year design storm event), then capital improvements would be required to mitigate the impacts of the proposed development.

3-1 **Select Subcatchments** (under Hydrology in the Project panel) and then **select all subcatchments** (Edit | Select All from the Main Menu, or by pressing CTRL+A in the Study Area Map). Open the **Group Edit** tool (select Edit | Group Edit from the Main Menu). Select **Rain Gage** from the drop-down list for the property to edit, and then select **SCS2_010y24hr** as the rain gage to replace the current 5-year storm. Select **No** when asked to continue editing.



3-2 **Run** the model and review results for the 10-year event. Significant flooding is now indicated at multiple locations. Review the Node Flooding section of the **Summary Results** as was done previously.

Summary Results

Topic: Node Flooding — Click a column header to sort the column.

Node	Hours Flooded	Maximum Rate CFS	Day of Maximum Flooding	Hour of Maximum Flooding	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
CBMH02	0.01	1.74	0	11:52	0.000	0.000
CBMH03	0.14	5.82	0	11:54	0.013	0.000
CBMH06	0.14	3.47	0	11:54	0.006	0.000

3-3 **Save** the current project and then **Save As "ANC3-1_Uncontrolled_2yr.inp"**. Use the **Group Edit** tool, change the rain gage for all subcatchments as was done previously, this time applying the 2-year storm **SCS2_002y24hr**.

3-4 **Run** the model and review results. An inspection of the profile plot will confirm that there is no node flooding for the 2-year event.

Using surface flooding as the hydraulic performance criterion, it can be stated that the municipally-owned stormwater management system provides a 2-year level of service for flood protection. The next two exercises in this series will investigate interventions to provide the desired 10-year level of service.