

# Goldsmith Gulch RoM Pilot

The Goldsmith Gulch Rain-on-Mesh (RoM) Pilot Study was performed by the Mile High Flood District (MHFD) and Michael Baker International to further evaluate how two-dimensional (2D) RoM modeling in HECRAS could support the District's goals to optimize risk reduction and provide enhanced hazard and risk information. Almost all of the District's existing inventory and process is centered around 1D RAS hydraulics informed by SWMM hydrology, so a shift to 2D coupled hydrology and hydraulics via RoM would mark a significant change whose benefits and challenges were further explored in this Goldsmith pilot. This study was conducted between September 2024 and July 2025 and built upon foundational lessons learned from the Niver Creek RoM Pilot, completed in November 2024.

## Model Development

A detailed flood model was developed to accurately represent the physical and urban characteristics of Goldsmith Gulch. Key components and datasets were selected and integrated to ensure the model reflects local conditions and infrastructure:

### Terrain:

Terrain tiles with a 1-meter resolution from 2013 dataset was selected to ensure consistency with previous flood studies. Channel bathymetry and building footprints were also incorporated.

### Land Cover & Infiltration:

The Denver Regional Council of Governments (DRCOG) Land Use/Land Cover (LULC) dataset was used to represent roughness and infiltration losses. The Curve Number method, calibrated with local soils data, was used to model how different surfaces absorb or shed rainfall.

### Hydraulic Structures:

Bridges, culverts, and detention ponds were incorporated using detailed geometry and rating curves, reflecting their influence on water flow and storage during storm events.

### Stormwater Infrastructure:

The model integrated key stormwater inlets and underground pipe networks, using advanced HEC-RAS pipe functionality to simulate how urban drainage systems interact with surface flooding.

## Calibration

The model was calibrated using four historic storm events: August 2022, September 2018, June 2015, and July 2013. Observed data from the Temple, Eastman, and Iliff gage sites were used for comparison. Calibration involved aligning simulated runoff and water levels with measured values, accounting for differences in storm intensity, spatial rainfall distribution, and measurement uncertainties. Adjustments were made for baseflow and gage datum, and performance was balanced across events from different years. Full flow and stage hydrographs were compared to assess volumetric runoff, in addition to peak flow and stage, providing a comprehensive evaluation of model accuracy.

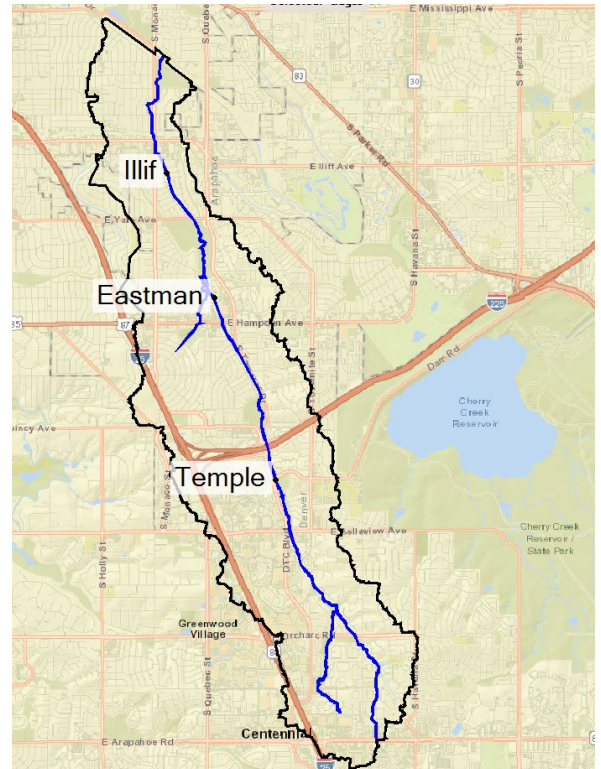


Figure 1. Goldsmith Gulch Boundary and stream reach with Calibration Stream Gages.

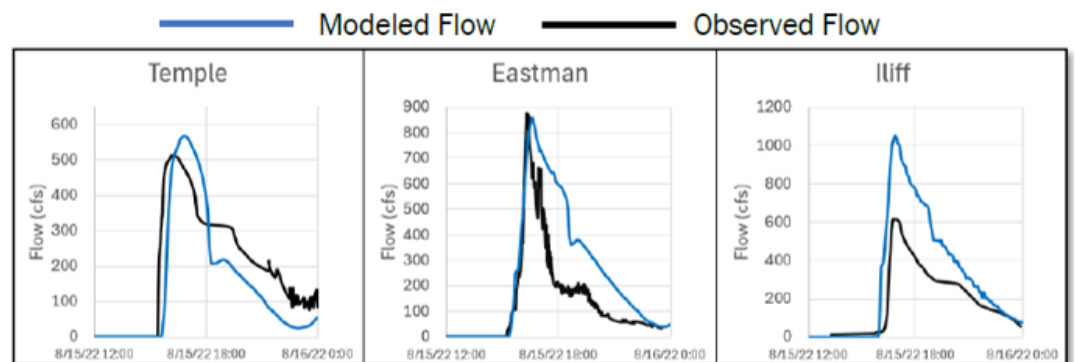


Figure 2. Flow Hydrograph Comparison Plots at the three Stream Gages, August 2022

# Hydrologic Testing and Recommendations

## SWMM vs RoM Comparisons:

A central focus of this pilot study was to compare the accuracy and realism of the new 2D Rain-on-Mesh (RoM) model with the traditional 1D SWMM hydraulic model, which has long been used for flood hazard studies. Detailed analyses were performed across multiple historical and design storm events at the three gages and dozens of evaluation locations along Goldsmith Gulch to evaluate differences in peak flow, runoff volume, and spatial consistency, helping inform MHFD’s future modeling decisions and regulatory practices.

HEC-RAS 2D more closely matched observed hydrographs while SWMM consistently overestimated peak flows and produced earlier, sharper peaks. This difference is due to HEC-RAS’s ability to simulate overbank storage and terrain-driven flow diversions, which SWMM does not capture.

● SWMM >2x higher    ● similar    ● SWMM <2x higher  
● HECRAS >2x higher    ● HECRAS <2x higher

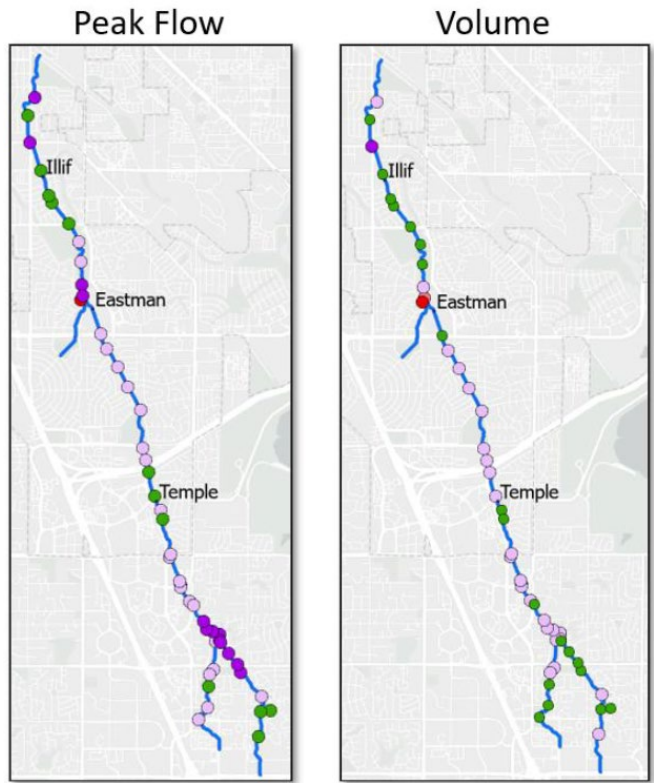


Figure 3. SWMM and HEC-RAS 2D Runoff Peak Flow and Volume Comparisons for 1% Design Event.

Table 1. Best Fit Model Instances to Observed (3 gages, 4 events)

	Temple	Eastman	Illif
Aug 2022	HEC-RAS 2D	Similar	Similar
Sept 2018	HEC-RAS 2D	HEC-RAS 2D	HEC-RAS 2D
June 2015	Similar	Similar	HEC-RAS 2D
July 2013	HEC-RAS 2D	SWMM	HEC-RAS 2D

### Recommendations

HEC-RAS 2D RoM is recommended as the preferred platform for risk-based flood modeling and project prioritization in Goldsmith Gulch. Its ability to simulate overbank storage, terrain-driven flow diversions, and dynamic surface-channel interactions provide a more accurate representation of complex watershed behavior than SWMM, which often overestimates peak flows and ignores distributed storage. While SWMM’s conservative assumptions can support regulatory compliance, they frequently lead to overdesign and inflated mitigation costs.

## Infiltration Method Evaluation

Infiltration method choice in HEC-RAS 2D RoM was assessed using Curve Number, Deficit & Constant, and Green-Ampt approaches. Differences in runoff were analyzed to determine impacts on peak flow, runoff volume, and computational efficiency.

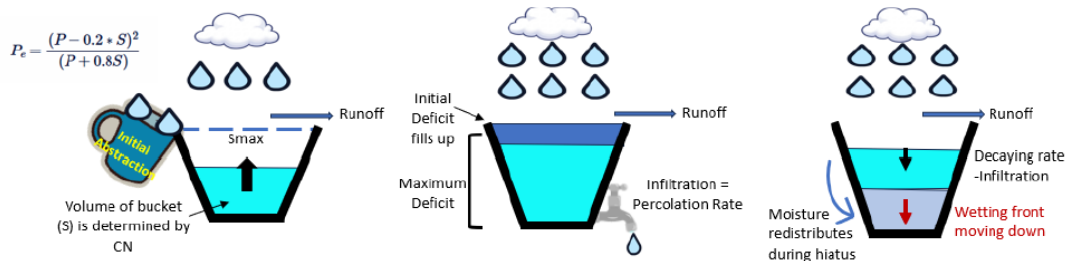


Figure 4. Conceptual Differences in Infiltration Methods; CN (Left), D&C (Middle) and G&A (Right)

### Recommendations

For long, continuous storms, the Green-Ampt method is favored for its ability to restore infiltration capacity during breaks, producing more realistic runoff and lower peak flows despite higher calibration effort. For short, single-peak events, the Curve Number method remains practical, offering reliable peak flow estimates with minimal bias, though it may slightly overestimate recession runoff in developed areas. Given MHFD’s focus on sub-24-hour design storms and peak flow accuracy, a calibrated CN-based model provides an efficient, balanced solution.

## Conservative RoM Modeling Approaches

Differences between SWMM and HEC-RAS 2D Rain-on-Mesh (RoM) models highlight the challenge of aligning 2D hydrologic realism with conservative assumptions used in regulatory floodplain mapping. While SWMM often produces higher peak flows due to simplified assumptions, RoM captures terrain-driven flow and storage effects that attenuate peaks. To address this, techniques such as applying statistical confidence limits to precipitation, pre-filling micro-storage, and modifying terrain to remove storage artifacts were tested in the Goldsmith Gulch watershed. These evaluations aim to identify practical, transparent strategies that maintain physical defensibility while ensuring appropriate conservatism to satisfy local regulatory requirements.

Table 2. Comparative Evaluation of the Three Conservative Options Across Different Decision Criteria.

Criteria	84% CL	Restart File	Terrain Prefilling	Preferred
<b>Simplicity &amp; Communication</b>	✓ Very easy → simple “safety factor”	⚠ Intuitive but setup/linkage risk	⚠ Complex DEM edits, hard to standardize	84% CL
<b>Policy &amp; Regulatory Alignment</b>	✗ Conflicts with MHFD & FEMA	✓ Fully aligned, physically grounded	⚠ Partially aligned, depends on documentation	Restart File
<b>Modeling Realism</b>	✗ Uniform multiplier, not local	✓ Reflects actual infrastructure	⚠ Alters drainage permanently	Restart File
<b>Flexibility &amp; Adaptability</b>	⚠ Works broadly but “double dip” risk	⚠ Restart must regenerate for geometry changes	✗ DEM reprocessing required	84% CL / Restart File
<b>Stakeholder Considerations</b>	⚠ Supports detention, may seem conservative	⚠ Removes storage, less controversial	✗ Fairness concerns, hard to explain	84% CL / Restart File

### Recommendations

The restart file method is recommended as the primary conservative approach for RoM applications because it simulates realistic antecedent conditions by pre-filling micro-storage and allowing natural drainage, ensuring physical defensibility and alignment with MHFD policy. Although it requires additional setup, its transparency and consistency make it suitable for long-term guidance. The 84% confidence limit precipitation method offers simplicity and quick implementation for screening-level studies but lacks watershed-specific realism. Terrain modification was also evaluated but is generally discouraged due to its complexity, need for careful documentation, and potential to alter drainage behavior permanently. Overall, the restart file method stands out as the most robust and defensible option.

## Why This Matters

This pilot demonstrates MHFD’s commitment to innovation, transparency, and community resilience. By adopting advanced modeling techniques and aligning with national standards, MHFD is better equipped to protect people, property, and infrastructure from flood risks. The Goldsmith Gulch RoM Pilot serves as a blueprint for future studies, ensuring that floodplain management is both scientifically rigorous and practically defensible.

### For More Information

Contact MHFD or Michael Baker International for details on the Goldsmith Gulch Rain-on-Mesh Pilot Study, technical documentation, and opportunities to leverage these insights for your community’s flood resilience initiatives.