North Central Texas Council of Governments

Integrating Transportation and Stormwater Infrastructure

Hydrology Modeling Updates for the Mary's Creek Watershed

June 2026

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integrating Transportation & Stormwater Infrastructure

Integrating Transportation and Stormwater Infrastructure (TSI)

HEC-HMS Modeling for the Mary's Creek Watershed

U.S. Army Corps of Engineers

1 Executive Summary

An agreement between the Department of the Army represented by the US Army Corps of Engineers (USACE), Fort Worth District, and the North Central Texas Council of Governments (NCTCOG) in connection with the Integrated Watershed Based Planning for Regional Transportation and Stormwater Management in the Upper Trinity River Basin, Texas, was established to perform a pilot study in the Mary's Creek area. The hydrologic study for the Mary's Creek Watershed will be to add detail to the Interagency Flood Risk Management (InFRM) Trinity Watershed Hydrologic Assessment (WHA) Hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS) model by adding additional subbasin and reach locations where flows will be developed with the additional subbasins and calibrated to match the InFRM WHA HEC-HMS results at their common locations. Then, the existing conditions basin model will be updated to match 2020 impervious conditions and one future condition basin model will be created representing the year 2070, based on future conditions data provided by the NCTCOG and Environmental Protection Agency Integrated Climate and Land use Scenarios (EPA ICLUS). These models will be used for two purposes: (1) to feed flows into the TSI Hydrologic Engineering Center-River Analysis System (HEC-RAS) models, and (2) to optimize project alternatives such as possible detention locations. The alternatives analysis will be performed by the University of Texas Arlington (UTA).

2 Data Sources

This section describes the data that was collected /reviewed for the hydrologic study effort, including geospatial and climatic information, field observations and previous reports for the pilot study area.

2.1 GIS Data

Data from different sources were gathered and processed using the latest Geographic Information System (GIS) tool.

Table 2-1. GIS Data Sources

Data Type	Description
Study Area	Polygon of the TSI West Study Area
InFRM WHA Subbasins	Subbasins from the Trinity InFRM WHA HEC-HMS model
DEM	DEM of the West TSI study area with a 30-ft cell size that was generated from the 2021 TWDB seamless statewide LiDAR data.
Approximate Subbasin Outlet Locations	Point shapefile of the approximate locations of the proposed HMS subbasin outlets that have been reviewed and agreed upon by the TSI team.
Stream Centerlines FFRD	A terrain derived stream centerline layer from the Trinity FFRD study.
Stream Centerlines NHD	NHD flow lines. Use this layer to find stream names.
Existing Bridge Locations	Locations of existing TXDOT bridges
Future Road Locations (2045)	Locations of future TXDOT roads
WHA Percent Impervious (2016)	Percent impervious raster that was used in the InFRM WHA
Current Percent Impervious (2020)	Percent impervious raster for the year 2020 provided by NCTCOG for the TSI project.
Future Percent Impervious (2070)	Percent impervious raster for the year 2070 made the Combined Land Use data from the NCTCOG and EPA ICLUS
Future Percent Urban (2070)	Percent Urban raster for the year 2070 made from the Combined Land Use data from the NCTCOG and EPA ICLUS
Existing Dam Locations	Dam locations from the National Inventory of Dams
Reservoirs from the Trinity WHA	A polygon shapefile of the major lakes and reservoirs in the Trinity River basin.

2.2 HEC-HMS data from Existing models

A watershed model was built for the Trinity River Basin with input parameters that represented the physical characteristics of the watershed. The rainfall-runoff model for the Mary's Creek pilot area was completed using the basin-wide HEC-HMS model developed for the 2021 Interagency Flood Risk Management (InFRM) Watershed Hydrology Assessment (WHA) for the Trinity River as a starting point. The InFRM model was calibrated to multiple recent flood events, including those similar in magnitude to a 1% annual chance (100-yr) storm. Finally, frequency storms were incorporated into the InFRM HEC-HMS model using the latest published frequency rainfall depths from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 (NOAA, 2018). These frequency storms were run through the verified model, yielding consistent estimates of the 1% annual chance (100-yr) and other frequency peak flows at various locations throughout the basin (InFRM, WHA for the Trinity River Basin, July 2021).

3 HEC-HMS Initial Model Development

For this study, additional detail was added to the InFRM Trinity WHA HEC-HMS model by adding additional subbasins and reach locations, where flows will be calculated for the TSI hydraulic modeling. First, an existing conditions (2016) basin model was developed with the additional subbasins and "calibrated" to match the InFRM WHA HEC-HMS results at their common locations. Then, the existing conditions basin model was updated to match 2020 impervious conditions and one future condition basin model was created representing the year 2070, based on future conditions data provided by the NCTCOG. These models will be used for two purposes: (1) to feed flows into the TSI HEC-RAS models, and (2) to optimize project alternatives such as possible detention locations. The alternatives analysis will be performed by UTA.

3.1 HEC-HMS Subbasin Locations

Approximate points for subbasin outlet locations were developed prior to the initiation of the Mary's Creek pilot modeling. These subbasin locations were reviewed and approved by the rest of the TSI H&H team, including UTA, Tarrant Regional Water District (TRWD) and the NCTCOG. The guidelines and priorities for placing subbasin outlet locations are described below.

A subbasin outlet point was placed where each of the features listed below intersected with the stream centerlines layer. Engineering judgment was applied to keep the relative drainage areas and number of subbasins reasonable. At attempt was made to keep the subbasin areas in the range of 1 to 5 square miles with subbasins at the smaller end of that range being used in the areas with more urban development for existing or future conditions.

1. USGS Gages and/or WHA subbasin outlets
2. Above Significant Stream Confluences – points were placed on each stream just above the confluences, according to the stream centerlines file.
3. At Existing Dams – points were placed at the locations of existing dams, according to the NID layer, unless the dam did not appear to significantly impact flow or the NID attributes showed negligible flood storage capacity.
4. At Existing Bridges - points were placed where the streams intersected with the Existing TxDOT bridge layer. Engineering judgement was used to select bridge locations with the potential for upstream detention.
5. At Future Roads - points were placed where the streams intersected with the Future Road locations 2045 layer. Engineering judgement was used to select bridge locations with the potential for upstream detention.

The resulting points shapefile of subbasin outlets was used as a guide for the approximate number and desired locations of the subbasin outlets for the Mary's Creek Pilot area, as shown in Figure 3-1.

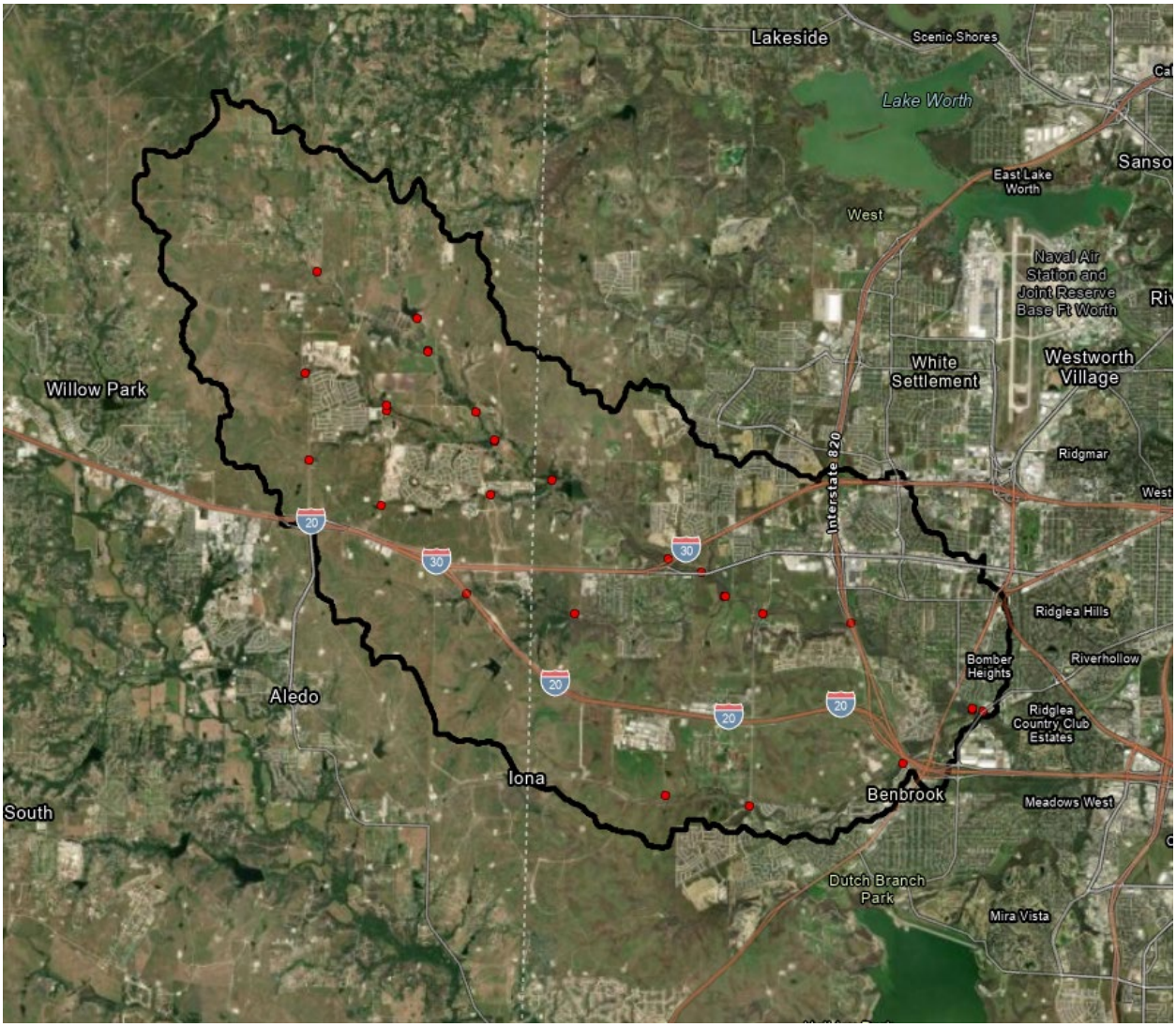


Figure 3-1. HEC-HMS Subbasin Location for TSI Mary's Creek Area.

3.2 HEC-HMS Subbasin Delineations

HEC-HMS version 4.11 was used to delineate the Mary's Creek Watershed from a 30-ft cell size DEM layer to 29 subbasins. HEC-HMS is provided with several capabilities such as terrain reconditioning, Preprocess sinks and drainage, and identify stream, as well as, the use of break points, which can be placed at locations of downstream outlets. They are also used to split basins at bridges and detention basins. The goal is to refine the WHA larger basins to smaller subbasins and capture critical infrastructure in the model and assess impacts during flood events. The delineated Mary's Creek subbasins are shown in Figure 3-2.

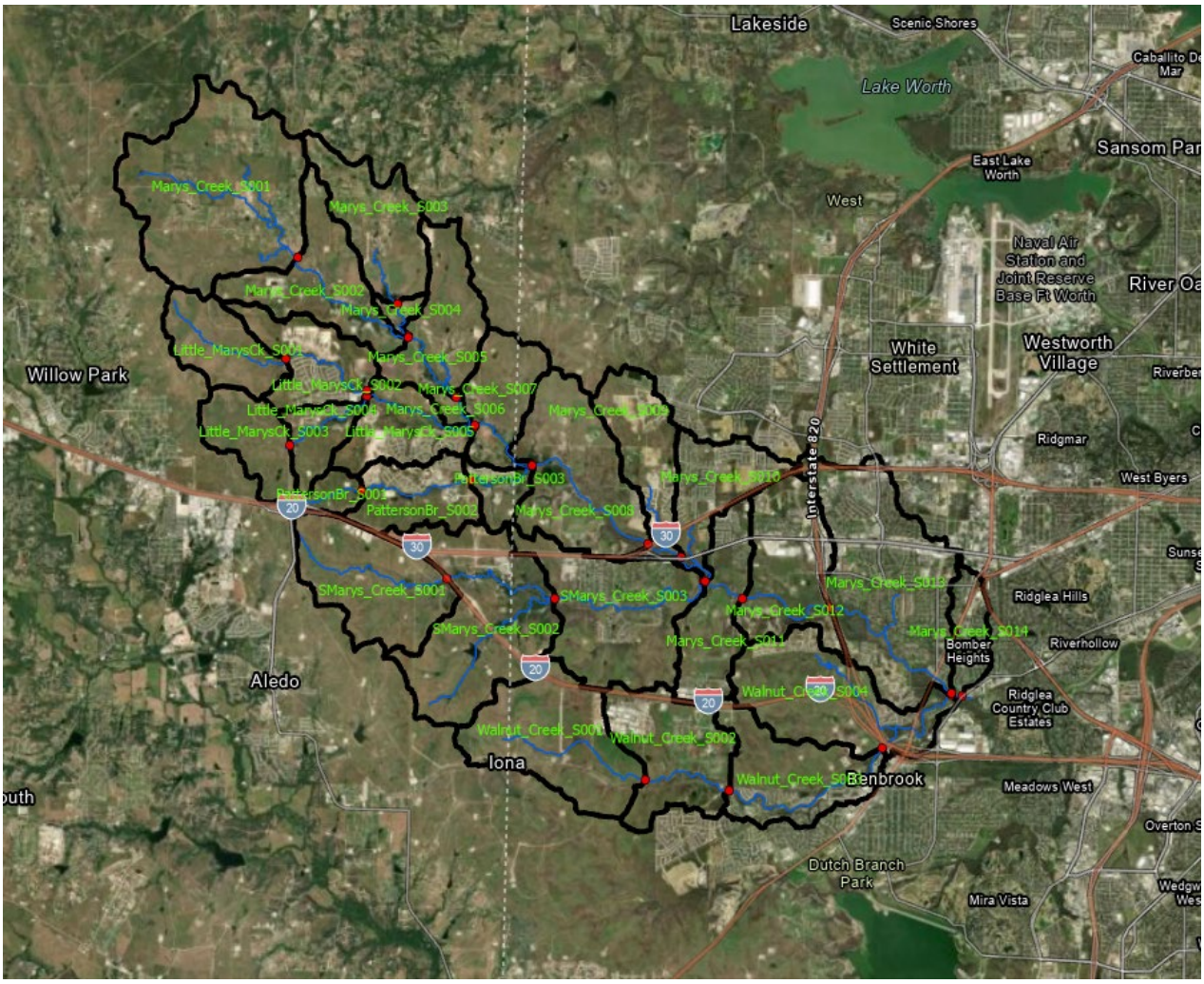


Figure 3-2. HEC-HMS Final Subbasin Delineation for TSI Mary's Creek Area.

Table 3-2. Initial HEC-HMS Subbasins

Subbasin	Area (s.q. mi.)	Subbasin	Area (s.q. mi.)
Little_MarysCk_S001	1.35	Marys_Creek_S011	1.67
Little_MarysCk_S002	1.52	Marys_Creek_S012	2.17
Little_MarysCk_S003	1.16	Marys_Creek_S013	4.19
Little_MarysCk_S004	0.73	Marys_Creek_S014	0.71
Little_MarysCk_S005	1.33	PattersonBr_S001	0.38
Marys_Creek_S001	4.81	PattersonBr_S002	1.36
Marys_Creek_S002	2.09	PattersonBr_S003	0.50
Marys_Creek_S003	1.83	SMarys_Creek_S001	2.45
Marys_Creek_S004	0.19	SMarys_Creek_S002	3.61
Marys_Creek_S005	1.79	SMarys_Creek_S003	3.09
Marys_Creek_S006	0.17	Walnut_Creek_S001	2.83
Marys_Creek_S007	1.35	Walnut_Creek_S002	2.15
Marys_Creek_S008	2.86	Walnut_Creek_S003	2.11
Marys_Creek_S009	1.60	Walnut_Creek_S004	2.82
Marys_Creek_S010	1.46		

3.3 HEC-HMS Initial Parameters

First, an existing conditions (2016) basin model was developed with the new subbasin delineation and "calibrated" to match the InFRM WHA HEC-HMS results at their common locations. The 1% Annual Chace of Exceedance (ACE) or 100-year HEC-HMS initial hydrologic parameters were copied from the calibrated WHA HEC-HMS models and presented in the below tables. The WHA larger basins were overlayed on top of the delineated subbasins to validate the use of copied parameters for the new model. The following parameter tables in this section reflect 2016 conditions that coincide with the 100-yr WHA HEC-HMS model. These parameters were later updated for 2020 and 2070 conditions.

3.3.1 Initial Subbasin Parameters

Percent Imperviousness

Imperviousness for the entire watershed was extracted from the NLCD database for 2016 conditions, which was the same dataset used in the InFRM WHA. then applied to the individual subbasins. Table 3-2 shows the calculated subbasin impervious values for 2016.

Initial and Constant Losses

The initial losses and loss rate parameters were assumed the same for the delineated basins that coincided with the WHA basins.

Table 3-2. HEC-HMS Subbasin 100-yr Loss Parameters for 2016 (WHA) conditions

Subbasin	Initial Loss (in)	Constant Loss (in/hr)	Impervious (%)
Little_MarysCk_S001	0.86	0.09	0
Little_MarysCk_S002	0.86	0.09	4
Little_MarysCk_S003	0.86	0.09	1
Little_MarysCk_S004	0.86	0.09	2
Little_MarysCk_S005	0.86	0.09	1
Marys_Creek_S001	0.86	0.09	2
Marys_Creek_S002	0.86	0.09	2
Marys_Creek_S003	0.86	0.09	2
Marys_Creek_S004	0.86	0.09	2
Marys_Creek_S005	0.86	0.09	1
Marys_Creek_S006	0.86	0.09	1
Marys_Creek_S007	0.86	0.09	0
Marys_Creek_S008	0.86	0.09	4
Marys_Creek_S009	0.86	0.09	5
Marys_Creek_S010	0.86	0.09	20
Marys_Creek_S011	0.86	0.09	11
Marys_Creek_S012	0.86	0.09	22
Marys_Creek_S013	0.86	0.09	35
Marys_Creek_S014	0.86	0.09	34
PattersonBr_S001	0.86	0.09	5
PattersonBr_S002	0.86	0.09	2
PattersonBr_S003	0.86	0.09	1
SMarys_Creek_S001	0.86	0.09	3
SMarys_Creek_S002	0.86	0.09	3
SMarys_Creek_S003	0.86	0.09	10
Walnut_Creek_S001	0.86	0.09	1
Walnut_Creek_S002	0.86	0.09	7
Walnut_Creek_S003	0.86	0.09	13
Walnut_Creek_S004	0.86	0.09	12

Snyder's Transform Parameters

The Snyder's Unit Hydrograph method was used to route excess precipitation to the outlet of each subbasin. Initial estimates for unit hydrograph parameters for the subbasins were made using a Snyder's lag time equation which utilizes measured watershed characteristics in addition to a calibrated coefficient (Ct). The below equation from the Texas Commission on Environmental Quality (TCEQ), Hydrologic and Hydraulic Guidelines for Dams in Texas, was

used to estimate the Snyder lag time based on measurable watershed characteristics and the coefficient Ct that is assumed to be consistent for a watershed and can thus be used to develop lag times for any additional subbasins within the watershed.

$$T_L = C_T(L \cdot L_{CA}/S^{0.5})^{0.38}$$

T_L = Lag Time (hr)
C_T = coefficient
L = hydraulic length of watershed along the longest flow path (mi)
L_{CA} = hydraulic length along the longest water course from the point under consideration to a point opposite the centroid of the drainage basin (mi)
S = weighted slope of the basin (ft/mi), measured from the 85% to the 10% points along the longest stream path in the basin (EM 1110-2-1405)

Equation 1 – Snyder Unit Hydrograph Equation

The calibrated Ct and peaking coefficient for this watershed were back calculated from the InFRM WHA calibrated HEC-HMS model for the Trinity River Basin. The Snyder Unit Hydrograph (UH) parameters were transformed from the WHA basins by utilizing the calibrated C_t coefficient value (0.4445) to recompute lag time for each delineated subbasin with the new physical hydrologic parameters (L, Lcs and S) for each new subbasin.

Table 3-3. HEC-HMS Subbasin Snyder's Transform Parameters

Subbasin	Lag Time (hr)	Peaking Coefficient
Little_MarysCk_S001	0.306	0.76
Little_MarysCk_S002	0.354	0.76
Little_MarysCk_S003	0.289	0.76
Little_MarysCk_S004	0.299	0.76
Little_MarysCk_S005	0.393	0.76
Marys_Creek_S001	0.451	0.76
Marys_Creek_S002	0.433	0.76
Marys_Creek_S003	0.407	0.76
Marys_Creek_S004	0.149	0.76
Marys_Creek_S005	0.421	0.76
Marys_Creek_S006	0.145	0.76
Marys_Creek_S007	0.361	0.76
Marys_Creek_S008	0.417	0.76
Marys_Creek_S009	0.475	0.76
Marys_Creek_S010	0.411	0.76
Marys_Creek_S011	0.155	0.76
Marys_Creek_S012	0.314	0.76

Subbasin	Lag Time (hr)	Peaking Coefficient
Marys_Creek_S013	0.531	0.76
Marys_Creek_S014	0.277	0.76
PattersonBr_S001	0.146	0.76
PattersonBr_S002	0.257	0.76
PattersonBr_S003	0.219	0.76
SMarys_Creek_S001	0.329	0.76
SMarys_Creek_S002	0.375	0.76
SMarys_Creek_S003	0.467	0.76
Walnut_Creek_S001	0.396	0.76
Walnut_Creek_S002	0.340	0.76
Walnut_Creek_S003	0.467	0.76
Walnut_Creek_S004	0.564	0.76

Baseflows

Baseflows were assumed the same for the delineated basins that coincided with the WHA basins.

Table 3-4. HEC-HMS Subbasin Baseflow Parameters

Subbasin	Initial Discharge (cfs/sqmi)	Recession Constant	Ratio to Peak
Little_MarysCk_S001	0.54	0.71	0.02
Little_MarysCk_S002	0.54	0.71	0.02
Little_MarysCk_S003	0.54	0.71	0.02
Little_MarysCk_S004	0.54	0.71	0.02
Little_MarysCk_S005	0.54	0.71	0.02
Marys_Creek_S001	0.54	0.71	0.02
Marys_Creek_S002	0.54	0.71	0.02
Marys_Creek_S003	0.54	0.71	0.02
Marys_Creek_S004	0.54	0.71	0.02
Marys_Creek_S005	0.54	0.71	0.02
Marys_Creek_S006	0.54	0.71	0.02
Marys_Creek_S007	0.54	0.71	0.02
Marys_Creek_S008	0.54	0.71	0.02
Marys_Creek_S009	0.54	0.71	0.02
Marys_Creek_S010	0.54	0.71	0.02
Marys_Creek_S011	0.54	0.71	0.02
Marys_Creek_S012	0.54	0.71	0.02
Marys_Creek_S013	0.54	0.71	0.02

Subbasin	Initial Discharge (cfs/sqmi)	Recession Constant	Ratio to Peak
Marys_Creek_S014	0.54	0.71	0.02
PattersonBr_S001	0.54	0.71	0.02
PattersonBr_S002	0.54	0.71	0.02
PattersonBr_S003	0.54	0.71	0.02
SMarys_Creek_S001	0.54	0.71	0.02
SMarys_Creek_S002	0.54	0.71	0.02
SMarys_Creek_S003	0.54	0.71	0.02
Walnut_Creek_S001	0.54	0.71	0.02
Walnut_Creek_S002	0.54	0.71	0.02
Walnut_Creek_S003	0.54	0.71	0.02
Walnut_Creek_S004	0.54	0.71	0.02

3.3.2 Initial Routing Parameters

The initial routing parameters for all the HEC-HMS reaches were estimated using the modified Puls method.

Modified Puls Routing

The storage-discharge curves were calculated from the 2D HEC-RAS model. A stepped inflow hydrograph that covers the range of expected flows were applied as an inflow boundary condition at the upstream end of each reach, and the storage-discharge curves were extracted for the reaches of interest. The number of sub-reaches for each reach were determined using the reach type criteria that is stream slope dependent. In the case of this study, the number of sub reaches was between 1 and 8. Subreaches were assigned dividing the reach length (miles) by 0.4 for the steep reaches, and dividing by 2 for the average and flatter reaches. These values were established by testing the attenuation through routing reaches using the unsteady 2D HEC-RAS model.

Table 3-5. HEC-HMS Modified Puls Routing Parameters

Reach Name	Length (mi)	Subreach
Little_MarysCk_R001	1.65	4
Little_MarysCk_R002	1.73	4
Little_MarysCk_R003	1.96	5
Marys_Creek_R001	2.35	6
Marys_Creek_R002	0.62	2
Marys_Creek_R003	1.30	3
Marys_Creek_R004	0.60	1
Marys_Creek_R005	1.19	1

Reach Name	Length (mi)	Subreach
Marys_Creek_R006	2.30	1
Marys_Creek_R007	0.55	2
Marys_Creek_R008	0.66	1
Marys_Creek_R009	0.65	2
Marys_Creek_R010	1.56	1
Marys_Creek_R011	2.42	1
Marys_Creek_R012	0.14	1
PattersonBr_R001	1.88	5
PattersonBr_R002	1.24	3
SMarys_Creek_R001	2.01	5
SMarys_Creek_R002	2.90	7
Walnut_Creek_R001	1.48	4
Walnut_Creek_R002	3.01	8
Walnut_Creek_R003	1.72	4

4 HEC-HMS Model Calibration

After calculating initial model parameters, the calibration analyses were performed to assess whether adjustments were necessary so that the results of the detailed HEC-HMS model match the results of the original InFRM WHA HEC-HMS model as closely as possible.

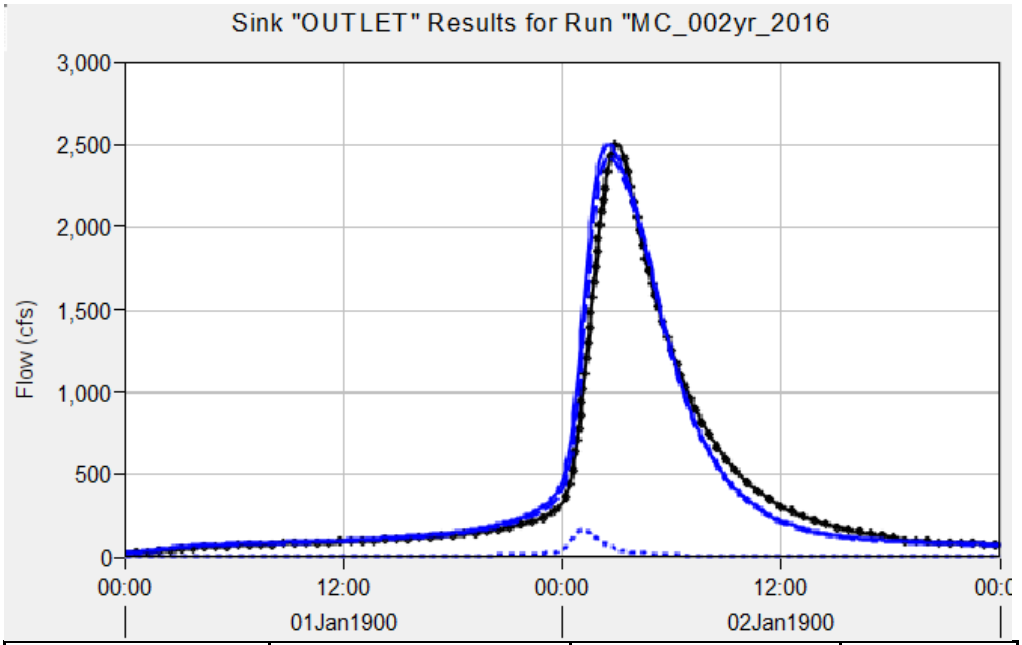
4.1 Calibration Methodology

The calibration criteria for the Mary's Creek Watershed are satisfied once model parameters produced the best matching results between the detailed WHA model and the InFRM WHA HEC-HMS model. A performance rating of statistics was also used as an indicator of how well the model performed during calibration. The following calibration performance metrics from the WHA was used as a guide to give results the appropriate rating.

Performance Rating	NSE	RSR	PBIAS
Very Good	0.80 ≤ NSE < 1.00	0 ≤ RSR ≤ 0.50	0 ≤ PBIAS ≤ ±5
Good	0.70 ≤ NSE < 0.80	0.50 < RSR ≤ 0.60	±5 < PBIAS < ±10
Satisfactory	0.50 ≤ NSE < 0.70	0.60 < RSR ≤ 0.70	±10 ≤ PBIAS ≤ ±25
Unsatisfactory	NSE < 0.50	RSR > 0.70	PBIAS > ±25

4.2 Calibration Results

The best 50% ACE (2-year) through 0.2%ACE (500-year) calibration results at Mary's Creek flow are shown through Figure 4-1 to Figure 4-10 below.



Performance Rating	RMSE Std Dev	Nash-Sutcliffe	Percent Bias
Very Good	0.2	0.97	3%

Figure 4-1 2-year calibrated hydrograph at Mary's Creek Outlet

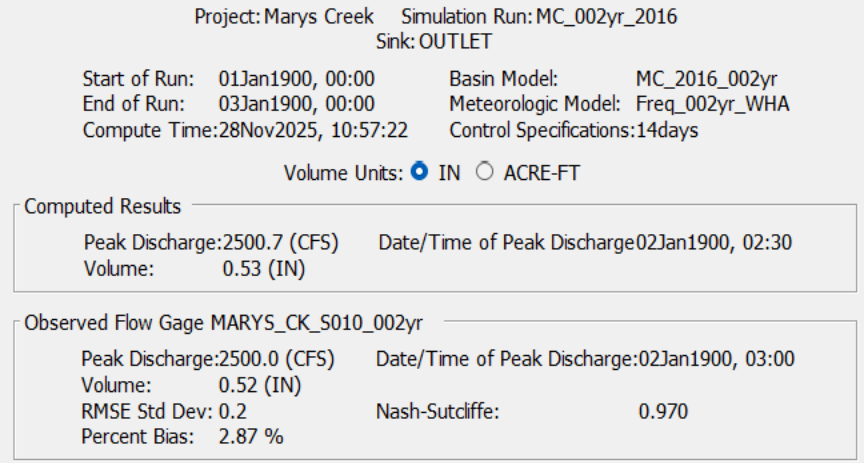
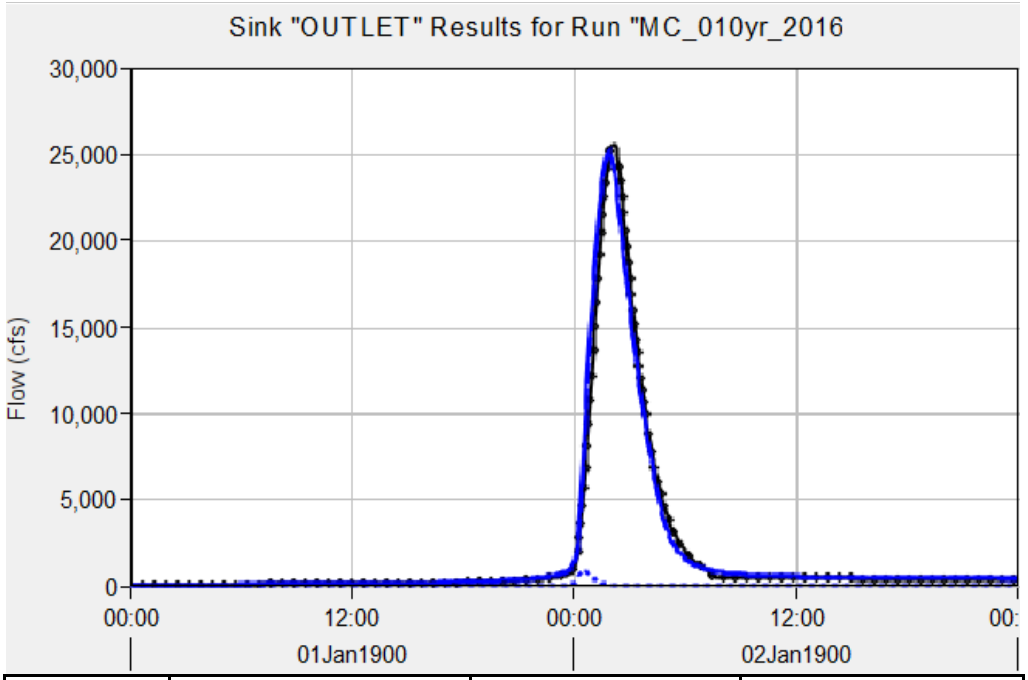


Figure 4-2 2-year HMS results at Mary's Creek Outlet



Performance Rating	RMSE Std Dev	Nash-Sutcliffe	Percent Bias
Very Good	0.1	0.98	2%

Figure 4-3 10-year calibrated hydrograph at Mary's Creek Outlet

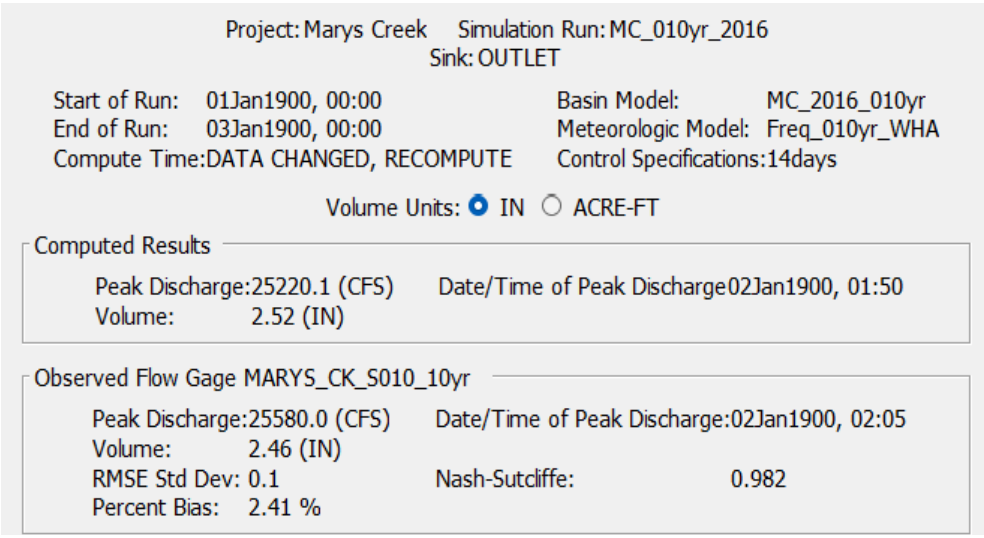
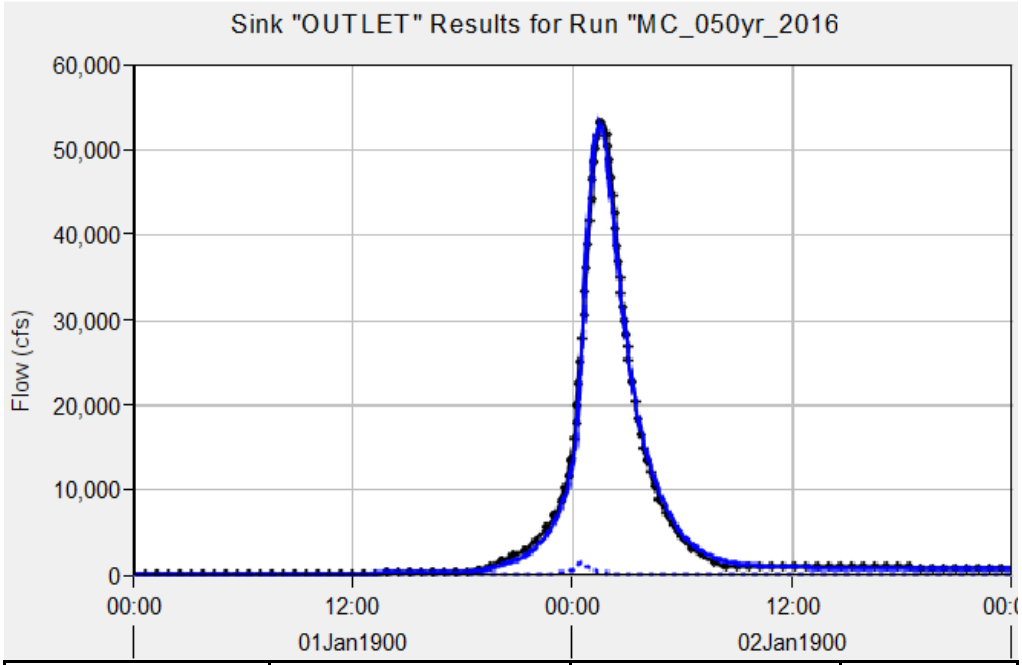


Figure 4-4 10-year HMS results at Mary's Creek Outlet



Performance Rating	RMSE Std Dev	Nash-Sutcliffe	Percent Bias
Very Good	0.0	1.00	-1%

Figure 4-5 50-year calibrated hydrograph at Mary's Creek Outlet

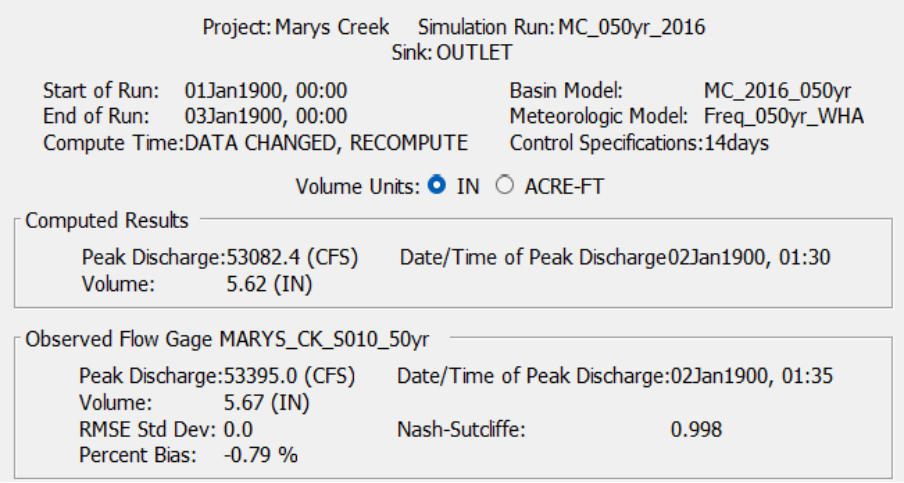
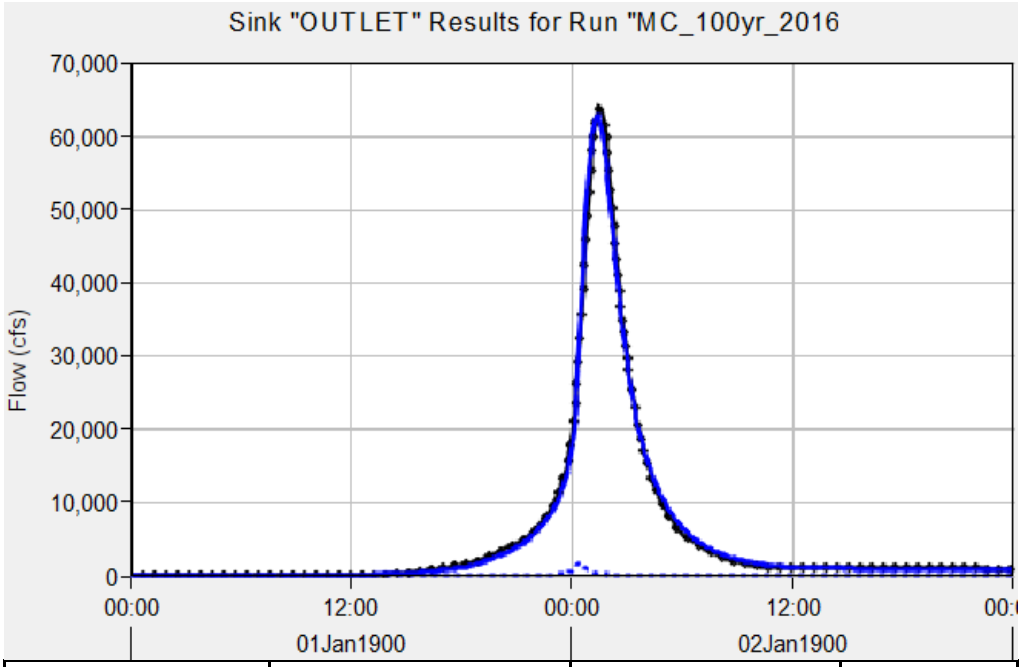


Figure 4-6 50-year HMS results at Mary's Creek Outlet



Performance Rating	RMSE Std Dev	Nash-Sutcliffe	Percent Bias
Very Good	0.1	1.00	-1%

Figure 4-7 100-year calibrated hydrograph at Mary's Creek Outlet

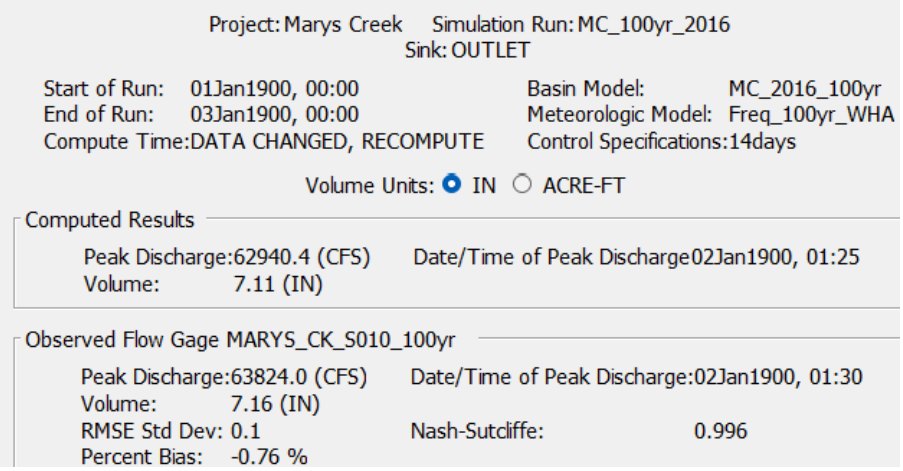
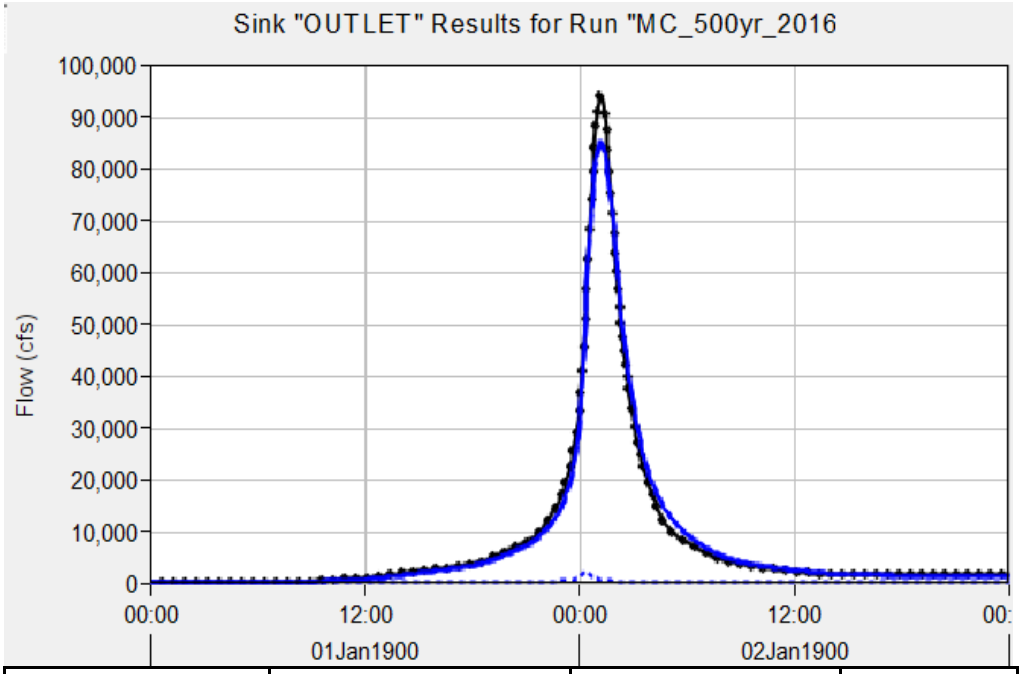


Figure 4-8 100-year HMS results at Mary's Creek Outlet



Performance Rating	RMSE Std Dev	Nash-Sutcliffe	Percent Bias
Very Good	0.1	0.99	-1%

Figure 4-9 500-year calibrated hydrograph at Mary's Creek Outlet

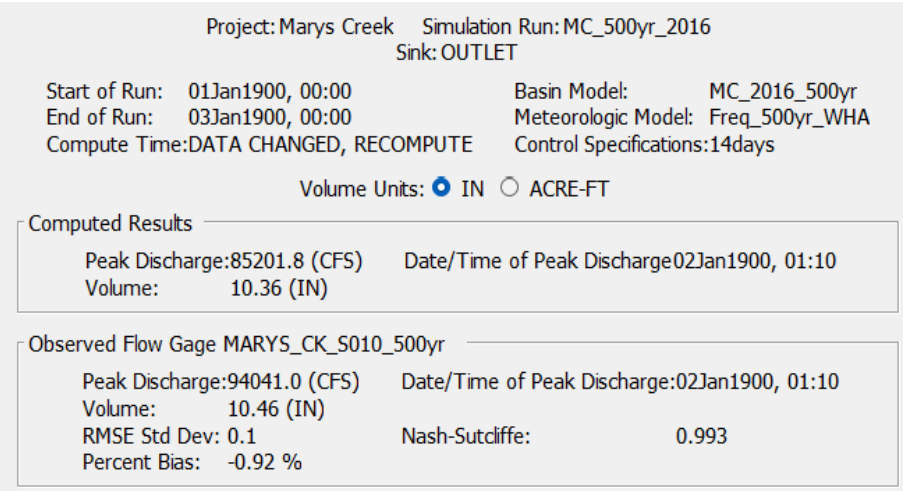


Figure 4-10 500-year HMS results at Mary's Creek Outlet

4.3 Calibrated HEC-HMS Parameters

After calculating initial model parameters, the model was calibrated. The model's parameters were then adjusted so that the final results of the detailed HEC-HMS model match the results of the original InFRM WHA HEC-HMS model as closely as possible. For this effort, the 2-yr through 500-yr uniform rain storm events from the InFRM model were used as the basis of

comparison. Subbasin parameters were adjusted during calibration included the lag time, baseflow and routing parameters. The value of 0.01 base flow ratio to peak was applied to each subbasin. The lag time parameters were adjusted by multiplying the initial lag times by a factor. Similar to the WHA model, the lag times decreased with the frequency of the storm event. For the Modified Puls routing, the reach storages were adjusted. A 0.5 multiplier was applied to the reach storages on the mainstem. The peaking coefficients were modified to 0.57 for the 2-yr event and 0.76 for the remaining events.

The calibrated parameters that were adjusted can be seen in Tables 4.1 to Table 4.6.

Table 4-1. 2-yr HEC-HMS Calibrated Snyder's Lag Time Parameters

Subbasin	Lag Time (hrs)	Subbasin	Lag Time (hrs)
Little_MarysCk_S001	0.979	Marys_Creek_S011	0.496
Little_MarysCk_S002	1.133	Marys_Creek_S012	1.006
Little_MarysCk_S003	0.923	Marys_Creek_S013	1.698
Little_MarysCk_S004	0.958	Marys_Creek_S014	0.888
Little_MarysCk_S005	1.258	PattersonBr_S001	0.468
Marys_Creek_S001	1.444	PattersonBr_S002	0.821
Marys_Creek_S002	1.387	PattersonBr_S003	0.701
Marys_Creek_S003	1.301	SMarys_Creek_S001	1.054
Marys_Creek_S004	0.478	SMarys_Creek_S002	1.199
Marys_Creek_S005	1.347	SMarys_Creek_S003	1.495
Marys_Creek_S006	0.463	Walnut_Creek_S001	1.268
Marys_Creek_S007	1.155	Walnut_Creek_S002	1.087
Marys_Creek_S008	1.333	Walnut_Creek_S003	1.494
Marys_Creek_S009	1.520	Walnut_Creek_S004	1.805
Marys_Creek_S010	1.314		

Table 4-2. 10-yr HEC-HMS Calibrated Snyder's Lag Time Parameters

Subbasin	Lag Time (hrs)	Subbasin	Lag Time (hrs)
Little_MarysCk_S001	0.520	Marys_Creek_S011	0.264
Little_MarysCk_S002	0.602	Marys_Creek_S012	0.535
Little_MarysCk_S003	0.491	Marys_Creek_S013	0.902
Little_MarysCk_S004	0.509	Marys_Creek_S014	0.472
Little_MarysCk_S005	0.669	PattersonBr_S001	0.249
Marys_Creek_S001	0.767	PattersonBr_S002	0.436
Marys_Creek_S002	0.737	PattersonBr_S003	0.372
Marys_Creek_S003	0.691	SMarys_Creek_S001	0.560
Marys_Creek_S004	0.254	SMarys_Creek_S002	0.637
Marys_Creek_S005	0.715	SMarys_Creek_S003	0.794
Marys_Creek_S006	0.246	Walnut_Creek_S001	0.673
Marys_Creek_S007	0.614	Walnut_Creek_S002	0.578
Marys_Creek_S008	0.708	Walnut_Creek_S003	0.794
Marys_Creek_S009	0.807	Walnut_Creek_S004	0.959
Marys_Creek_S010	0.698		

Table 4-3. 50-yr HEC-HMS Calibrated Snyder's Lag Time Parameters

Subbasin	Lag Time (hrs)	Subbasin	Lag Time (hrs)
Little_MarysCk_S001	0.490	Marys_Creek_S011	0.248
Little_MarysCk_S002	0.566	Marys_Creek_S012	0.503
Little_MarysCk_S003	0.462	Marys_Creek_S013	0.849
Little_MarysCk_S004	0.479	Marys_Creek_S014	0.444
Little_MarysCk_S005	0.629	PattersonBr_S001	0.234
Marys_Creek_S001	0.722	PattersonBr_S002	0.410
Marys_Creek_S002	0.693	PattersonBr_S003	0.351
Marys_Creek_S003	0.651	SMarys_Creek_S001	0.527
Marys_Creek_S004	0.239	SMarys_Creek_S002	0.600
Marys_Creek_S005	0.673	SMarys_Creek_S003	0.747
Marys_Creek_S006	0.232	Walnut_Creek_S001	0.634
Marys_Creek_S007	0.578	Walnut_Creek_S002	0.544
Marys_Creek_S008	0.666	Walnut_Creek_S003	0.747
Marys_Creek_S009	0.760	Walnut_Creek_S004	0.902
Marys_Creek_S010	0.657		

Table 4-4. 100-yr HEC-HMS Calibrated Snyder's Lag Time Parameters

Subbasin	Lag Time (hrs)	Subbasin	Lag Time (hrs)
Little_MarysCk_S001	0.428	Marys_Creek_S011	0.217
Little_MarysCk_S002	0.495	Marys_Creek_S012	0.440
Little_MarysCk_S003	0.404	Marys_Creek_S013	0.743
Little_MarysCk_S004	0.419	Marys_Creek_S014	0.388
Little_MarysCk_S005	0.551	PattersonBr_S001	0.205
Marys_Creek_S001	0.632	PattersonBr_S002	0.359
Marys_Creek_S002	0.607	PattersonBr_S003	0.307
Marys_Creek_S003	0.569	SMarys_Creek_S001	0.461
Marys_Creek_S004	0.209	SMarys_Creek_S002	0.525
Marys_Creek_S005	0.589	SMarys_Creek_S003	0.654
Marys_Creek_S006	0.203	Walnut_Creek_S001	0.555
Marys_Creek_S007	0.505	Walnut_Creek_S002	0.476
Marys_Creek_S008	0.583	Walnut_Creek_S003	0.654
Marys_Creek_S009	0.665	Walnut_Creek_S004	0.790
Marys_Creek_S010	0.575		

Table 4-5. 500-yr HEC-HMS Calibrated Snyder's Lag Time Parameters

Subbasin	Lag Time (hrs)	Subbasin	Lag Time (hrs)
Little_MarysCk_S001	0.337	Marys_Creek_S011	0.171
Little_MarysCk_S002	0.389	Marys_Creek_S012	0.346
Little_MarysCk_S003	0.317	Marys_Creek_S013	0.584
Little_MarysCk_S004	0.329	Marys_Creek_S014	0.305
Little_MarysCk_S005	0.433	PattersonBr_S001	0.161
Marys_Creek_S001	0.496	PattersonBr_S002	0.282
Marys_Creek_S002	0.477	PattersonBr_S003	0.241
Marys_Creek_S003	0.447	SMarys_Creek_S001	0.362
Marys_Creek_S004	0.164	SMarys_Creek_S002	0.412
Marys_Creek_S005	0.463	SMarys_Creek_S003	0.514
Marys_Creek_S006	0.159	Walnut_Creek_S001	0.436
Marys_Creek_S007	0.397	Walnut_Creek_S002	0.374
Marys_Creek_S008	0.458	Walnut_Creek_S003	0.514
Marys_Creek_S009	0.522	Walnut_Creek_S004	0.620
Marys_Creek_S010	0.452		

Table 4-6. HEC-HMS Calibrated Subreach Parameters

Reach Name	Subreach
Little_MarysCk_R001	4
Little_MarysCk_R002	4
Little_MarysCk_R003	5
Marys_Creek_R001	6
Marys_Creek_R002	2
Marys_Creek_R003	3
Marys_Creek_R004	1
Marys_Creek_R005	1
Marys_Creek_R006	1
Marys_Creek_R007	2
Marys_Creek_R008	1
Marys_Creek_R009	2
Marys_Creek_R010	1
Marys_Creek_R011	1
Marys_Creek_R012	1
PattersonBr_R001	5
PattersonBr_R002	3
SMarys_Creek_R001	5
SMarys_Creek_R002	7
Walnut_Creek_R001	4
Walnut_Creek_R002	8
Walnut_Creek_R003	4

5 HEC-HMS Model for TSI

The existing conditions (2016) basin model has been developed with the additional subbasins and calibrated to match the InFRM WHA HEC-HMS results at the Mary's Creek outlet. The additional basin models will be created representing the year 2020 (TSI existing conditions) and the year 2070 (TSI future conditions).

5.1 TSI 2020 Existing Conditions HEC-HMS Model

For the 2020 existing conditions basin model, all HMS model parameters will remain the same as were completed in section 4 except for the percent impervious and the initial losses. For the percent impervious, the 2020 impervious data provided by the NCTCOG was used to update the values in the HEC-HMS detailed model.

Table 5-1. Existing Conditions Percent Imperviousness

Subbasin	2016 % Impervious	2020 % Impervious
Little_MarysCk_S001	0	1
Little_MarysCk_S002	4	4
Little_MarysCk_S003	1	2
Little_MarysCk_S004	2	3
Little_MarysCk_S005	1	6
Marys_Creek_S001	2	4
Marys_Creek_S002	2	3
Marys_Creek_S003	2	4
Marys_Creek_S004	2	2
Marys_Creek_S005	1	2
Marys_Creek_S006	1	2
Marys_Creek_S007	0	2
Marys_Creek_S008	4	4
Marys_Creek_S009	5	13
Marys_Creek_S010	20	24
Marys_Creek_S011	11	15
Marys_Creek_S012	22	25
Marys_Creek_S013	35	40
Marys_Creek_S014	34	48
PattersonBr_S001	5	5
PattersonBr_S002	2	5
PattersonBr_S003	1	1
SMarys_Creek_S001	3	3
SMarys_Creek_S002	3	6
SMarys_Creek_S003	10	11
Walnut_Creek_S001	1	5
Walnut_Creek_S002	7	10
Walnut_Creek_S003	13	18
Walnut_Creek_S004	12	16

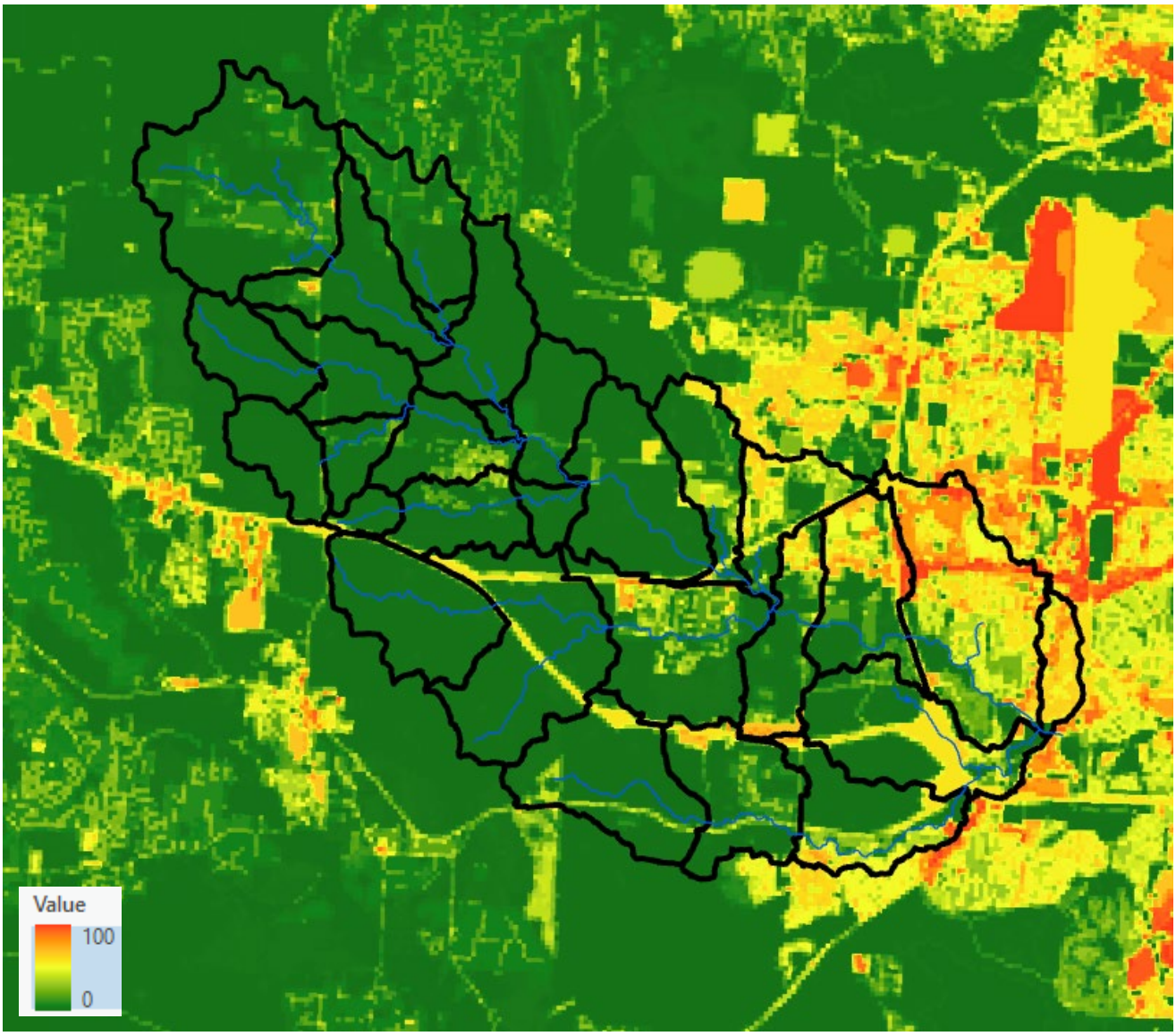


Figure 5-1. Map of Existing 2020 Percent Imperviousness from NCTCOG

5.1.2 2020 Conditions Loss Rates

The default frequency loss rates are used for the 2020 basin models for the 1% ACE (100-yr) frequency storm as well as the 2% ACE (50-yr) and 0.2% ACE (500-yr) storms. For the 50% ACE (2-yr) and 10% ACE (10-yr) storms, the final WHA frequency loss rates are used since those were calibrated to the downstream gages records.

Table 5-2. 2020 Existing Conditions Loss Rates

Loss Rates									
50% ACE (2-yr)		10% ACE (10-yr)		2% ACE (50-yr)		1% ACE (100-yr)		0.2% ACE (500-yr)	
Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)
2.4	0.25	2.36	0.21	1.04	0.12	0.86	0.09	0.58	0.07

5.2 TSI 2070 Future Conditions HEC-HMS Model

For the 2070 future conditions basin model, all HMS model parameters will remain the same as were completed for 2020 conditions except for the percent impervious, Snyder's lag times, and routing reach storage values. For the percent impervious, the 2070 impervious data provided by the NCTCOG and EPA ICLUS was used to update the impervious values in the HEC-HMS existing conditions model for future conditions.

The Snyder's lag times were reduced to account for the 2070 future conditions percent urbanization. Regional studies in North Texas have shown that as a watershed is transformed from rural to urban, its Snyder's lag time also decreases. Therefore, reduction ratios were applied to the existing conditions lag times for each subbasin. The reduction rations, which are based on the percent of urbanization increases, were developed from the Fort Worth District urban studies.

For the 2070 routing reach data, the storage values were reduced to account for anticipated development within the FEMA floodplain fringe, which is allowed under the FEMA National Flood Insurance Program (NFIP). While there was no change to the storage volume for flows confined to the channel, the storage volume was significantly reduced for flows that extend into the floodplain fringe. For the 100-yr event or larger along Mary's Creek, volume reductions can be 20% or greater. See Figure 5-2 as an example. Refer to the TSI HMS SOP Appendix A for a more detailed description about how 2070 storage volumes were developed.

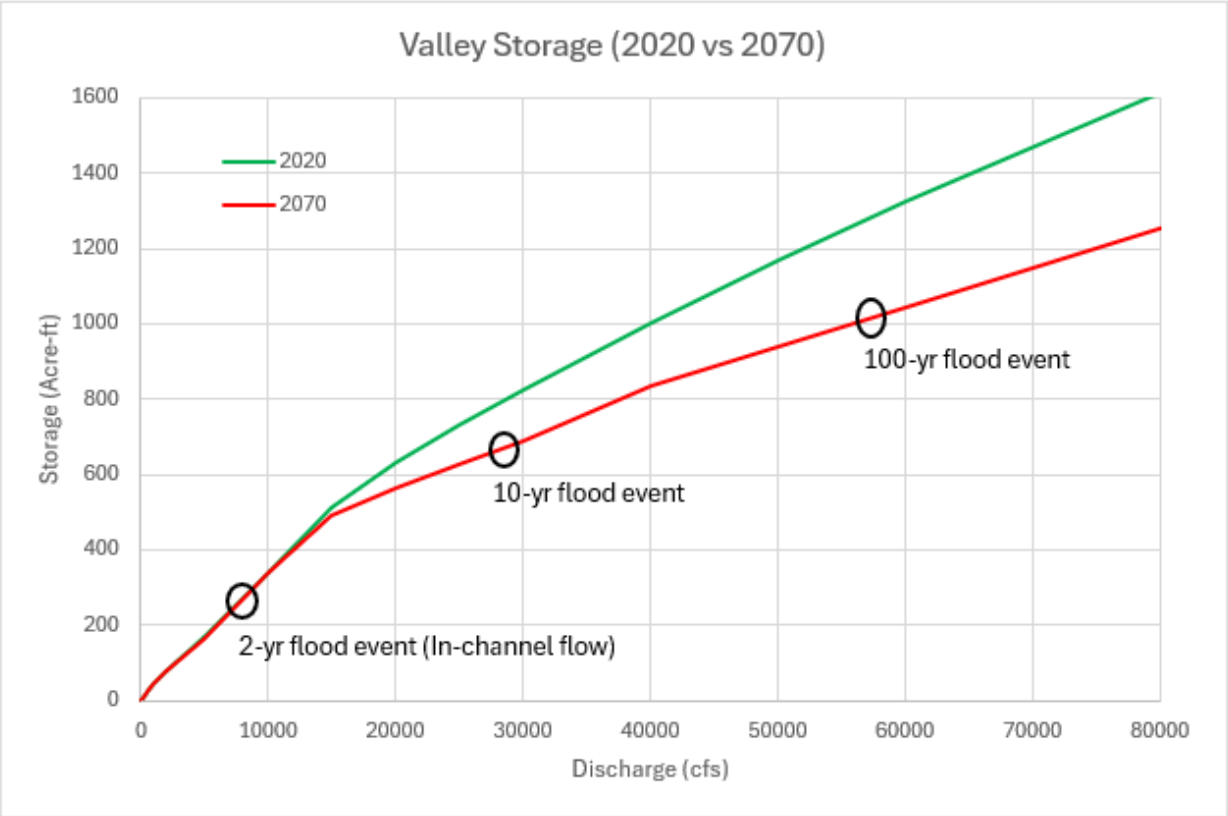


Figure 5-2. Example comparing 2020 vs 2070 routing reach storage volumes

5.2.1 Future Conditions 2070 Percent Imperiousness

The watershed 2070 percent imperviousness was extracted from ArcGIS. The future values are listed in Table 5.3.

Table 5-3. 2070 Future Conditions Percent Imperviousness

Subbasin	2020 % Impervious	2070 % Impervious
Little_MarysCk_S001	1	41
Little_MarysCk_S002	4	38
Little_MarysCk_S003	2	45
Little_MarysCk_S004	3	45
Little_MarysCk_S005	6	37
Marys_Creek_S001	4	30
Marys_Creek_S002	3	35
Marys_Creek_S003	4	35
Marys_Creek_S004	2	27
Marys_Creek_S005	2	29
Marys_Creek_S006	2	36
Marys_Creek_S007	2	35
Marys_Creek_S008	4	45
Marys_Creek_S009	13	50
Marys_Creek_S010	24	61
Marys_Creek_S011	15	49
Marys_Creek_S012	25	71
Marys_Creek_S013	40	79
Marys_Creek_S014	48	78
PattersonBr_S001	5	61
PattersonBr_S002	5	41
PattersonBr_S003	1	41
SMarys_Creek_S001	3	44
SMarys_Creek_S002	6	45
SMarys_Creek_S003	11	41
Walnut_Creek_S001	5	44
Walnut_Creek_S002	10	51
Walnut_Creek_S003	18	61
Walnut_Creek_S004	16	57

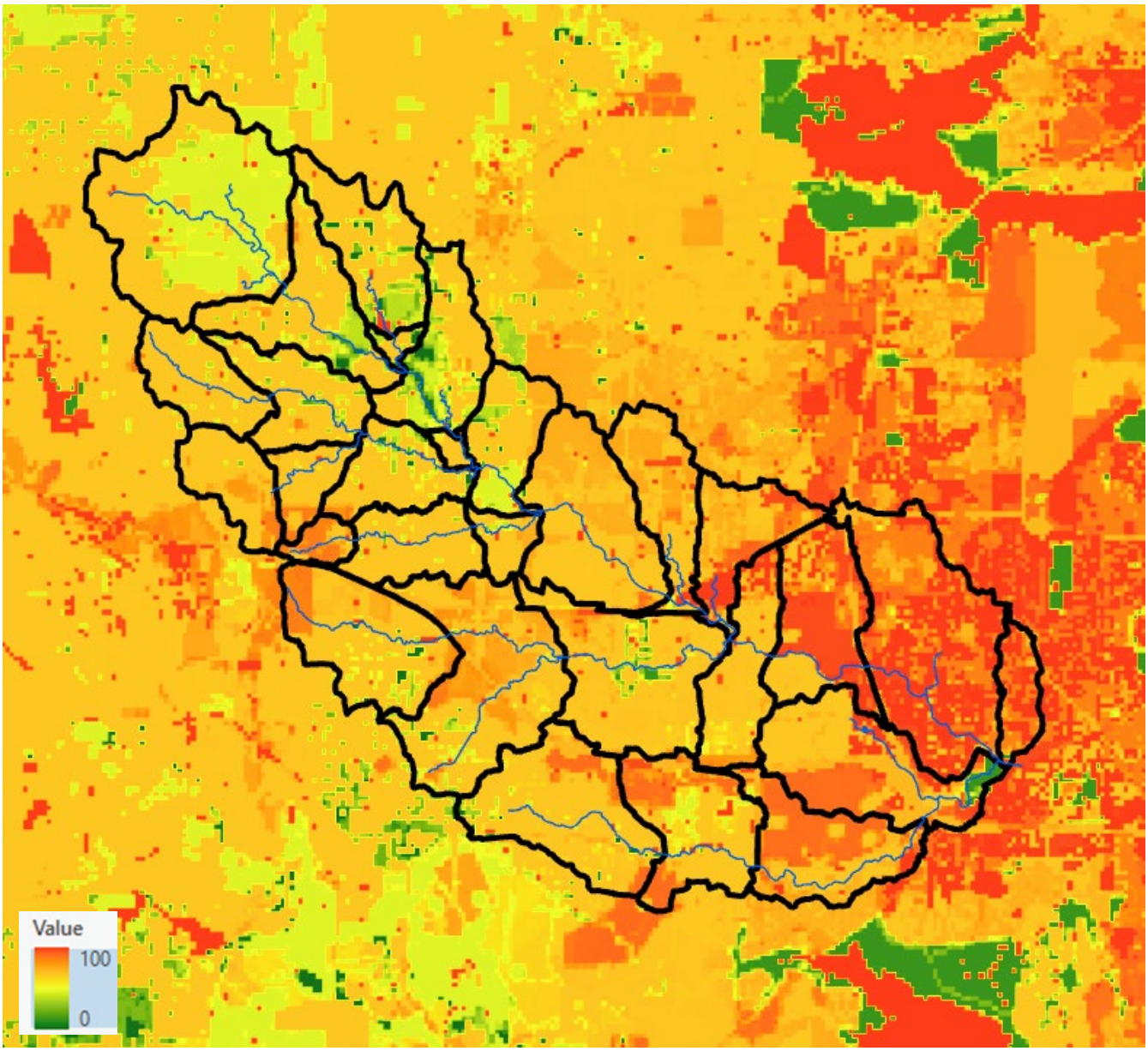


Figure 5-3. Map of Future Conditions 2070 Percent Imperviousness from the combined NCTCOG and EPA dataset

5.2.2 Future Conditions 2070 Lag Times

Estimates of future conditions Lag Times are anticipated to be reduced due to urbanization, where future imperiousness will increase. Future Lag Times are estimated by utilizing a reduction that can be obtained from a Lag Time reduction ratio table, which relates the urbanization percentage to a ratio of lag time over 0% urban lag time. The reduction ratios were based on percent of urbanization increase, which were developed from the Fort Worth District urban studies (Nelson, 1979) (Rodman, 1977) (USACE, 1989). Future lag times can be found in Tables 5-4 through 5-8

Table 5-4. 2-yr Future Conditions Snyder's Lag Times

Subbasin	Existing (2020) %Urban	Existing (2020) Lag Time (hr)	Future (2070) %Urban	Future (2070) Lag Time (hr)
Little_MarysCk_S001	27	0.979	80	0.709
Little_MarysCk_S002	27	1.133	78	0.829
Little_MarysCk_S003	27	0.923	84	0.646
Little_MarysCk_S004	27	0.958	83	0.676
Little_MarysCk_S005	27	1.258	78	0.926
Marys_Creek_S001	27	1.444	77	1.068
Marys_Creek_S002	27	1.387	77	1.022
Marys_Creek_S003	27	1.301	78	0.958
Marys_Creek_S004	27	0.478	67	0.381
Marys_Creek_S005	27	1.347	71	1.040
Marys_Creek_S006	27	0.463	75	0.348
Marys_Creek_S007	27	1.155	73	0.879
Marys_Creek_S008	27	1.333	79	0.970
Marys_Creek_S009	27	1.520	81	1.094
Marys_Creek_S010	27	1.314	83	0.930
Marys_Creek_S011	27	0.496	83	0.353
Marys_Creek_S012	27	1.006	89	0.681
Marys_Creek_S013	27	1.698	92	1.123
Marys_Creek_S014	27	0.888	92	0.585
PattersonBr_S001	27	0.468	88	0.316
PattersonBr_S002	27	0.821	82	0.587
PattersonBr_S003	27	0.701	85	0.489
SMarys_Creek_S001	27	1.054	83	0.744
SMarys_Creek_S002	27	1.199	84	0.843
SMarys_Creek_S003	27	1.495	76	1.115
Walnut_Creek_S001	27	1.268	81	0.912

Subbasin	Existing (2020) %Urban	Existing (2020) Lag Time (hr)	Future (2070) %Urban	Future (2070) Lag Time (hr)
Walnut_Creek_S002	27	1.087	81	0.780
Walnut_Creek_S003	27	1.494	85	1.045
Walnut_Creek_S004	27	1.805	81	1.296

Table 5-5. 10-yr Future Conditions Snyder's Lag Times

Subbasin	Existing (2020) %Urban	Existing (2020) Lag Time (hr)	Future (2070) %Urban	Future (2070) Lag Time (hr)
Little_MarysCk_S001	27	0.520	80	0.373
Little_MarysCk_S002	27	0.602	78	0.444
Little_MarysCk_S003	27	0.491	84	0.344
Little_MarysCk_S004	27	0.509	83	0.360
Little_MarysCk_S005	27	0.669	78	0.489
Marys_Creek_S001	27	0.767	77	0.569
Marys_Creek_S002	27	0.737	77	0.543
Marys_Creek_S003	27	0.691	78	0.508
Marys_Creek_S004	27	0.254	67	0.201
Marys_Creek_S005	27	0.715	71	0.554
Marys_Creek_S006	27	0.246	75	0.184
Marys_Creek_S007	27	0.614	73	0.466
Marys_Creek_S008	27	0.708	79	0.517
Marys_Creek_S009	27	0.807	81	0.579
Marys_Creek_S010	27	0.698	83	0.496
Marys_Creek_S011	27	0.264	83	0.186
Marys_Creek_S012	27	0.535	89	0.361
Marys_Creek_S013	27	0.902	92	0.596
Marys_Creek_S014	27	0.472	92	0.313
PattersonBr_S001	27	0.249	88	0.167
PattersonBr_S002	27	0.436	82	0.312
PattersonBr_S003	27	0.372	85	0.257
SMarys_Creek_S001	27	0.560	83	0.397
SMarys_Creek_S002	27	0.637	84	0.449
SMarys_Creek_S003	27	0.794	76	0.593
Walnut_Creek_S001	27	0.673	81	0.484
Walnut_Creek_S002	27	0.578	81	0.415
Walnut_Creek_S003	27	0.794	85	0.556

Subbasin	Existing (2020) %Urban	Existing (2020) Lag Time (hr)	Future (2070) %Urban	Future (2070) Lag Time (hr)
Walnut_Creek_S004	27	0.959	81	0.686

Table 5-6. 50-yr Future Conditions Snyder's Lag Times

Subbasin	Existing (2020) %Urban	Existing (2020) Lag Time (hr)	Future (2070) %Urban	Future (2070) Lag Time (hr)
Little_MarysCk_S001	27	0.490	80	0.354
Little_MarysCk_S002	27	0.566	78	0.418
Little_MarysCk_S003	27	0.462	84	0.326
Little_MarysCk_S004	27	0.479	83	0.341
Little_MarysCk_S005	27	0.629	78	0.463
Marys_Creek_S001	27	0.722	77	0.531
Marys_Creek_S002	27	0.693	77	0.511
Marys_Creek_S003	27	0.651	78	0.476
Marys_Creek_S004	27	0.239	67	0.187
Marys_Creek_S005	27	0.673	71	0.520
Marys_Creek_S006	27	0.232	75	0.171
Marys_Creek_S007	27	0.578	73	0.440
Marys_Creek_S008	27	0.666	79	0.485
Marys_Creek_S009	27	0.760	81	0.547
Marys_Creek_S010	27	0.657	83	0.465
Marys_Creek_S011	27	0.248	83	0.174
Marys_Creek_S012	27	0.503	89	0.337
Marys_Creek_S013	27	0.849	92	0.562
Marys_Creek_S014	27	0.444	92	0.295
PattersonBr_S001	27	0.234	88	0.161
PattersonBr_S002	27	0.410	82	0.293
PattersonBr_S003	27	0.351	85	0.244
SMarys_Creek_S001	27	0.527	83	0.372
SMarys_Creek_S002	27	0.600	84	0.418
SMarys_Creek_S003	27	0.747	76	0.554
Walnut_Creek_S001	27	0.634	81	0.453
Walnut_Creek_S002	27	0.544	81	0.390
Walnut_Creek_S003	27	0.747	85	0.519
Walnut_Creek_S004	27	0.902	81	0.648

Table 5-7. 100-yr Future Conditions Snyder's Lag Times

Subbasin	Existing (2020) %Urban	Existing (2020) Lag Time (hr)	Future (2070) %Urban	Future (2070) Lag Time (hr)
Little_MarysCk_S001	27	0.428	80	0.310
Little_MarysCk_S002	27	0.495	78	0.367
Little_MarysCk_S003	27	0.404	84	0.283
Little_MarysCk_S004	27	0.419	83	0.298
Little_MarysCk_S005	27	0.551	78	0.405
Marys_Creek_S001	27	0.632	77	0.466
Marys_Creek_S002	27	0.607	77	0.446
Marys_Creek_S003	27	0.569	78	0.418
Marys_Creek_S004	27	0.209	67	0.166
Marys_Creek_S005	27	0.589	71	0.452
Marys_Creek_S006	27	0.203	75	0.151
Marys_Creek_S007	27	0.505	73	0.386
Marys_Creek_S008	27	0.583	79	0.427
Marys_Creek_S009	27	0.665	81	0.478
Marys_Creek_S010	27	0.575	83	0.409
Marys_Creek_S011	27	0.217	83	0.155
Marys_Creek_S012	27	0.440	89	0.296
Marys_Creek_S013	27	0.743	92	0.492
Marys_Creek_S014	27	0.388	92	0.255
PattersonBr_S001	27	0.205	88	0.137
PattersonBr_S002	27	0.359	82	0.256
PattersonBr_S003	27	0.307	85	0.214
SMarys_Creek_S001	27	0.461	83	0.329
SMarys_Creek_S002	27	0.525	84	0.369
SMarys_Creek_S003	27	0.654	76	0.489
Walnut_Creek_S001	27	0.555	81	0.396
Walnut_Creek_S002	27	0.476	81	0.340
Walnut_Creek_S003	27	0.654	85	0.458
Walnut_Creek_S004	27	0.790	81	0.566

Table 5-8. 500-yr Future Conditions Snyder's Lag Times

Subbasin	Existing (2020) %Urban	Existing (2020) Lag Time (hr)	Future (2070) %Urban	Future (2070) Lag Time (hr)
Little_MarysCk_S001	27	0.337	80	0.241
Little_MarysCk_S002	27	0.389	78	0.283
Little_MarysCk_S003	27	0.317	84	0.221
Little_MarysCk_S004	27	0.329	83	0.236
Little_MarysCk_S005	27	0.433	78	0.315
Marys_Creek_S001	27	0.496	77	0.369
Marys_Creek_S002	27	0.477	77	0.349
Marys_Creek_S003	27	0.447	78	0.328
Marys_Creek_S004	27	0.164	67	0.132
Marys_Creek_S005	27	0.463	71	0.358
Marys_Creek_S006	27	0.159	75	0.118
Marys_Creek_S007	27	0.397	73	0.300
Marys_Creek_S008	27	0.458	79	0.332
Marys_Creek_S009	27	0.522	81	0.377
Marys_Creek_S010	27	0.452	83	0.322
Marys_Creek_S011	27	0.171	83	0.124
Marys_Creek_S012	27	0.346	89	0.231
Marys_Creek_S013	27	0.584	92	0.388
Marys_Creek_S014	27	0.305	92	0.203
PattersonBr_S001	27	0.161	88	0.107
PattersonBr_S002	27	0.282	82	0.200
PattersonBr_S003	27	0.241	85	0.171
SMarys_Creek_S001	27	0.362	83	0.254
SMarys_Creek_S002	27	0.412	84	0.289
SMarys_Creek_S003	27	0.514	76	0.385
Walnut_Creek_S001	27	0.436	81	0.315
Walnut_Creek_S002	27	0.374	81	0.270
Walnut_Creek_S003	27	0.514	85	0.360
Walnut_Creek_S004	27	0.620	81	0.447

5.2.3 Future Conditions 2070 Loss Rates

The same loss rates will be for 2070 conditions as were used for 2020 conditions.

6 Final HEC-HMS Results

Five discharge frequency results for the 2020, and 2070 (existing and future conditions) are illustrated in the following sections.

6.1 Frequency Storms

The WHA study uniform storms NOAA14 precipitation depths were applied to the entire watershed. For this study, The WHA Mary's Creek S010 subbasin had the same precipitation depths with a 2-day duration. The 1%ACE (100-year) 2016 existing conditions simulation run utilized an area reduction of 54.161 square miles, but all other simulated future conditions' frequencies were simulated as depth-area-analyses with each analysis point having an area reduction based on the drainage area above the analysis point. Five frequencies were generated for this study: 50% ACE (2-year), 10% ACE (10-year), 2% ACE (50-year), 1%ACE (100-year), and 0.2% ACE (500-year).

6.2 Frequency Discharge Results for Existing 2020 Conditions

Table 6-1 illustrates the 2020 future conditions discharge frequency peaks for the Mary's Creek Watershed.

Table 6-1. Summary of Existing 2020 Conditions Discharges for the Mary's Creek

HMS Hydrologic Element	Drainage Area (sq mi)	2020 Existing Conditions Peak Discharge (cfs)				
		50% ACE (2-yr)	10% ACE (10-yr)	2% ACE (50-yr)	1% ACE (100-yr)	0.2% ACE (500-yr)
Little_MarysCk_J001	1.4	187	2,123	3,303	4,025	5,741
Little_MarysCk_J002	2.9	208	3,661	6,288	7,536	10,558
Little_MarysCk_J003	1.2	173	1,865	2,939	3,564	5,083
Little_MarysCk_J004	1.9	250	2,676	4,303	5,194	7,166
Little_MarysCk_J005	4.8	443	6,146	10,445	12,552	17,464
Little_MarysCk_J006	6.1	551	7,120	12,250	15,113	20,806
Marys_Creek_J001	4.8	507	5,652	9,197	11,264	16,362
Marys_Creek_J002	1.8	219	2,363	3,794	4,642	6,735
Marys_Creek_J003	6.9	610	6,649	11,173	13,312	18,324
Marys_Creek_J004	2.0	221	2,119	3,868	4,733	6,731
Marys_Creek_J005	8.9	760	8,542	14,245	16,957	23,489
Marys_Creek_J006	10.7	822	8,784	15,619	18,715	26,017
Marys_Creek_J007	10.9	806	8,470	15,325	18,333	25,587
Marys_Creek_J008	17.0	1,102	12,433	23,914	28,548	40,545
Marys_Creek_J009	18.3	1,091	11,891	23,363	28,103	39,509
Marys_Creek_J010	20.6	1,163	12,428	24,715	29,698	41,733
Marys_Creek_J011	23.4	1,142	12,247	24,272	28,895	39,827

HMS Hydrologic Element	Drainage Area (sq mi)	2020 Existing Conditions Peak Discharge (cfs)				
		50% ACE (2-yr)	10% ACE (10-yr)	2% ACE (50-yr)	1% ACE (100-yr)	0.2% ACE (500-yr)
Marys_Creek_J012	25.0	1,212	12,762	25,496	30,348	41,726
Marys_Creek_J013	35.6	1,741	19,310	38,543	45,992	63,359
Marys_Creek_J014	37.3	1,741	19,379	38,936	46,497	64,303
Marys_Creek_J015	39.5	1,818	19,667	39,695	47,291	64,577
Marys_Creek_J016	43.7	2,211	19,993	41,859	49,770	67,434
Marys_Creek_J017	53.6	2,879	25,481	52,858	62,733	84,755
OUTLET	54.3	2,961	25,586	53,154	62,969	85,178
PattersonBr_J001	0.4	99	933	1,347	1,584	2,198
PattersonBr_J002	1.7	319	2,716	4,775	5,704	8,076
PattersonBr_J003	2.2	345	3,647	5,927	7,174	10,344
SMarys_Creek_J001	2.5	335	3,595	5,750	6,959	9,981
SMarys_Creek_J002	6.1	619	7,275	12,058	14,401	19,635
SMarys_Creek_J003	9.2	802	8,014	15,118	18,130	25,329
Walnut_Creek_J001	2.8	352	3,673	5,929	7,225	10,451
Walnut_Creek_J002	5.0	552	5,806	9,785	11,872	16,685
Walnut_Creek_J003	7.1	804	6,680	11,496	13,760	19,104
Walnut_Creek_J004	9.9	1,076	8,267	14,507	17,085	22,992

6.3 Frequency Discharge Results for Future 2070 Conditions

Table 6-2 illustrates the 2070 future conditions discharge frequency peaks for the Mary's Creek Watershed.

Table 6-2. Summary of Future 2070 Conditions Discharges for the Mary's Creek

HMS Hydrologic Element	Drainage Area (sq mi)	2070 Future Conditions Peak Discharge (cfs)				
		50% ACE (2-yr)	10% ACE (10-yr)	2% ACE (50-yr)	1% ACE (100-yr)	0.2% ACE (500-yr)
Little_MarysCk_J001	1.4	549	2,722	3,987	4,746	6,786
Little_MarysCk_J002	2.9	951	4,801	7,378	8,763	12,639
Little_MarysCk_J003	1.2	531	2,480	3,588	4,270	5,941
Little_MarysCk_J004	1.9	831	3,390	5,139	5,864	8,137
Little_MarysCk_J005	4.8	1,665	8,055	12,333	14,416	20,392
Little_MarysCk_J006	6.1	1,956	9,361	15,070	17,616	24,183
Marys_Creek_J001	4.8	1,220	7,197	11,142	13,416	19,097
Marys_Creek_J002	1.8	559	3,066	4,596	5,547	7,934
Marys_Creek_J003	6.9	1,585	8,597	13,516	16,464	22,941

HMS Hydrologic Element	Drainage Area (sq mi)	2070 Future Conditions Peak Discharge (cfs)				
		50% ACE (2-yr)	10% ACE (10-yr)	2% ACE (50-yr)	1% ACE (100-yr)	0.2% ACE (500-yr)
Marys_Creek_J004	2.0	541	3,029	4,688	5,626	7,968
Marys_Creek_J005	8.9	2,056	10,916	17,185	20,754	29,442
Marys_Creek_J006	10.7	2,270	11,330	19,231	23,000	32,318
Marys_Creek_J007	10.9	2,226	11,006	18,851	22,643	31,879
Marys_Creek_J008	17.0	3,640	16,239	28,905	34,493	49,008
Marys_Creek_J009	18.3	3,657	15,608	28,459	33,874	48,069
Marys_Creek_J010	20.6	4,047	16,431	29,962	35,509	50,594
Marys_Creek_J011	23.4	4,300	16,392	29,174	34,581	48,005
Marys_Creek_J012	25.0	4,602	17,077	30,622	36,208	49,826
Marys_Creek_J013	35.6	7,011	26,326	45,599	53,924	74,498
Marys_Creek_J014	37.3	7,095	26,567	46,162	54,830	76,014
Marys_Creek_J015	39.5	7,287	26,873	46,569	54,303	76,065
Marys_Creek_J016	43.7	7,888	28,238	49,242	57,668	79,567
Marys_Creek_J017	53.6	10,002	36,081	61,749	72,805	99,406
OUTLET	54.3	10,100	36,270	62,119	73,112	99,865
PattersonBr_J001	0.4	317	1,146	1,579	1,832	2,415
PattersonBr_J002	1.7	823	3,342	5,468	6,686	9,084
PattersonBr_J003	2.2	1,043	4,425	7,020	8,597	11,637
SMarys_Creek_J001	2.5	1,003	4,727	6,995	8,397	11,850
SMarys_Creek_J002	6.1	2,097	9,366	14,247	16,939	23,065
SMarys_Creek_J003	9.2	2,663	11,089	18,779	22,183	30,253
Walnut_Creek_J001	2.8	1,015	4,842	7,252	8,721	12,288
Walnut_Creek_J002	5.0	1,707	7,547	11,932	14,502	20,610
Walnut_Creek_J003	7.1	2,235	8,679	13,877	16,741	23,156
Walnut_Creek_J004	9.9	2,951	10,605	17,184	20,215	27,204

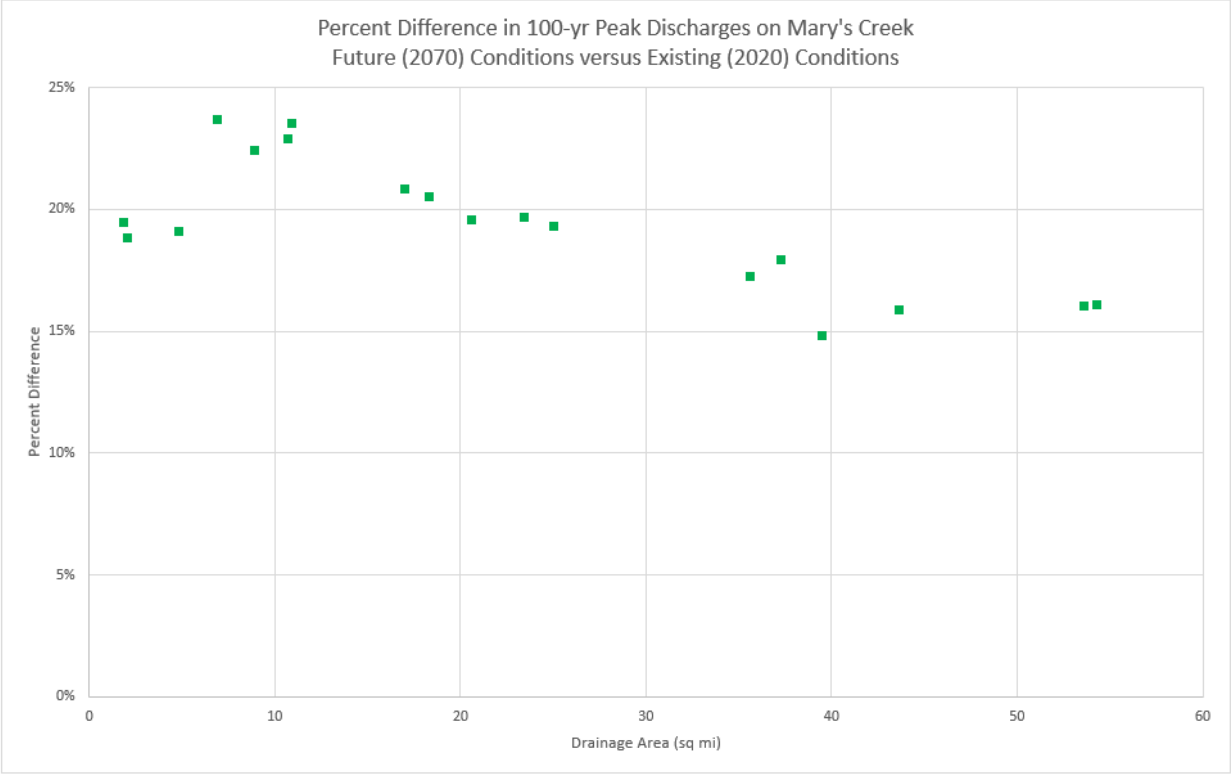


Figure 6-1. Percent Differences between Existing and Future Conditions 100-year Peak Discharges

7 Conclusions

The general trend of runoff when taking to account urbanization or future conditions imperviousness, increase the discharge peaks on the watershed. Although watershed response is consistent with all the precipitation depth frequencies, on the main stem, the 50% ACE (2-year) event is the most sensitive to 2020 to 2070 urbanization with an increase in discharge peak of 241%. The difference drops to 42% for the 10%ACE (10-year) event. The 2-, 1-, and 0.2% ACE peak events increased by 17%, 16%, and 17%. Figure 6-2 and Table 6-3 illustrate the future conditions percent increase in runoff discharge peaks over the watershed for specific frequencies throughout the Mary's Creek watershed including the tributaries.

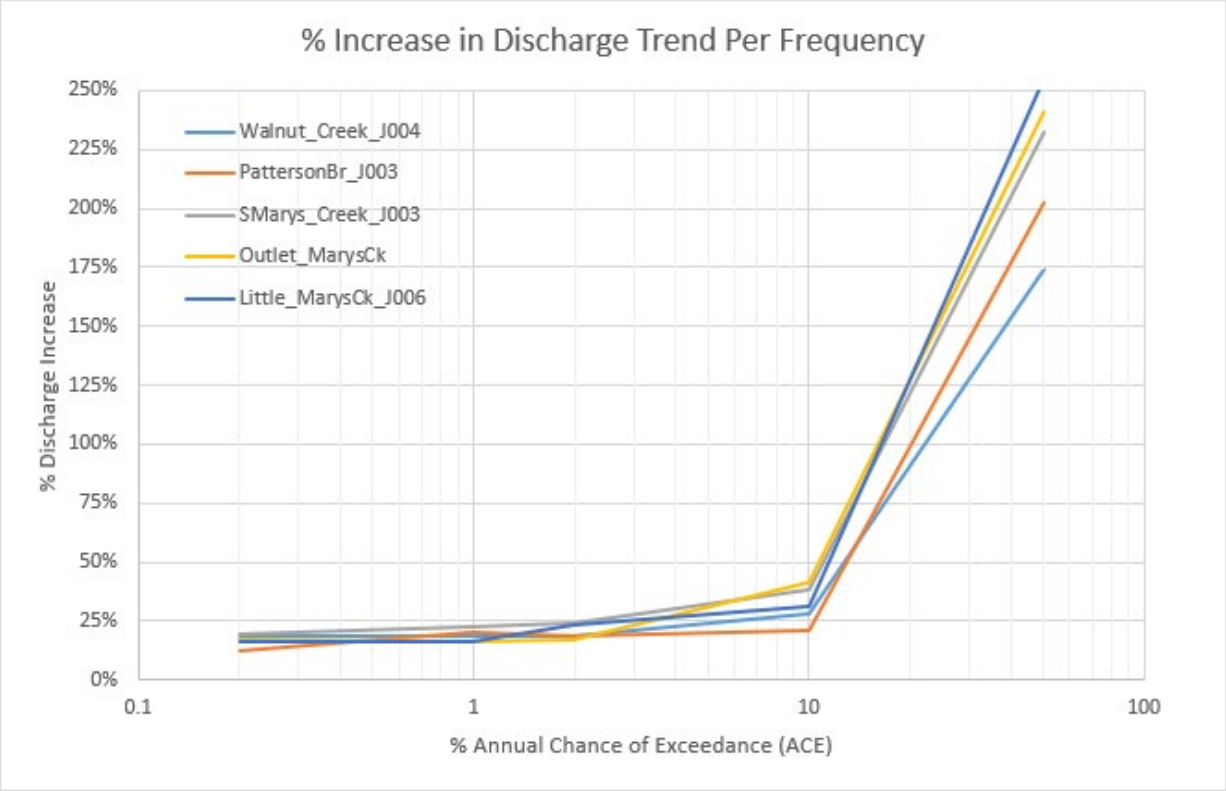


Figure 6-2 2070 Discharge Increase from 2020

Table 6-3 2070 Discharge Percent Increase from 2020 Conditions

HMS Hydrologic Element	% Discharge Increase from Existing to Future Conditions				
	50% ACE (2-yr)	10% ACE (10-yr)	2% ACE (50-yr)	1% ACE (100-yr)	0.2% ACE (500-yr)
Little_MarysCk_J006	255%	31%	23%	17%	16%
PattersonBr_J003	202%	21%	18%	20%	12%
SMarys_Creek_J003	232%	38%	24%	22%	19%
Walnut_Creek_J004	174%	28%	18%	18%	18%
OUTLET	241%	42%	17%	16%	17%

8 References

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