RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
RIVERSIDE, CALIFORNIA

WARM SPRINGS CREEK – TRIBUTARY A

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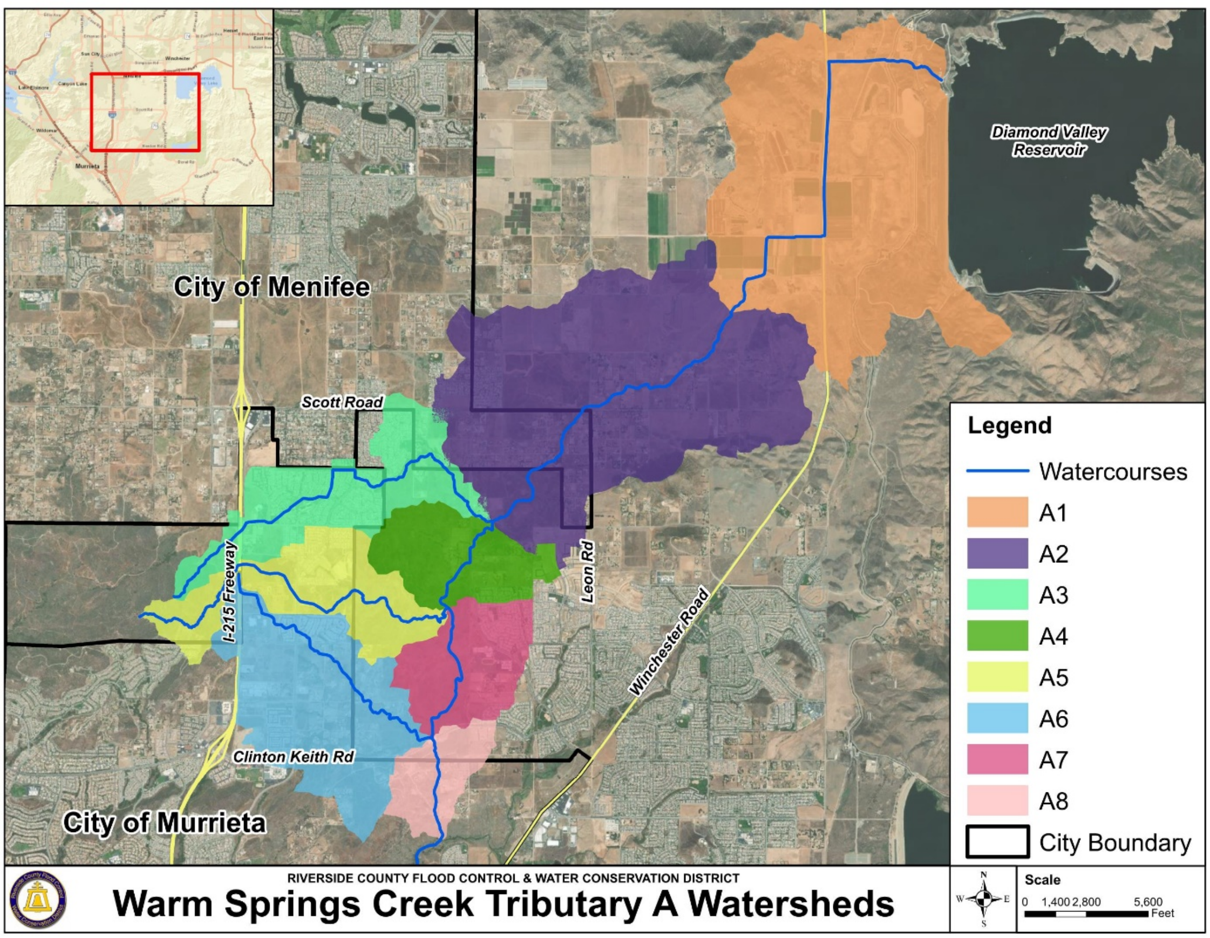
1. Introduction

The Warm Springs Tributary A Watershed is an 18 sq. mile watershed located in unincorporated Riverside County in the area between Diamond Valley Reservoir and the city of Murrieta, California. Warm Springs Tributary A has five reaches dubbed Mainline, Tributary A3, Tributary A5, Tributary A6-1, and Tributary A6-2. Tributary A is part of the overall Warm Springs Creek Watershed, which ultimately confluences with Tributaries A and B and discharges into Murrieta Creek within the city of Murrieta.

Currently, the Warm Springs Tributary A area is mapped as Federal Emergency Agency (FEMA) Zone Unshaded X or Zone D. The Riverside County Flood Control and Water Conservation District's (District) objective in this analysis is to map the floodplain as a FEMA Zone AE and remove the current Zone D designation. The goal is to piggyback on the Warm Springs Tributary C PMR (LOMR Case No. 21-09-0027S, 316-PMR ongoing), which will print the FIRM Panel Numbers 06065C2710G, 06065C2090G, 06065C2095G, 06065C2730G, and 06065C2735G. The FIRM Panels to be revised by Tributary A are 06065C2710G, 06065C2730G, 06065C2070H, and 06065C2090G. Figure 1 shows a vicinity map of the area as well as Tributary A watersheds.

Figure 1: Vicinity Map



2. Hydrology

The FEMA Flood Insurance Study (FIS) does not include any hydrologic information for Warm Springs Creek. The area is currently mapped as a Zone D and Zone Unshaded X.

A new hydrology study was performed by the District to obtain the 100-year flowrate for the various reaches of Tributary A. The study only considers existing conditions of the watersheds. The guidelines in the District's Hydrology Manual were used to prepare a synthetic unit hydrograph rainfall-runoff model for the Tributary A Watersheds using HEC-HMS. Excerpts from the hydrology manual as well as the finalized hydrology study are located in Appendix B. The following sections will describe the hydrology study.

2.1 Watershed Characteristics

Tributary A Mainline extends from the valley just downstream of Diamond Valley Lake Dam all the way to the Murrieta city limits. Mainline passes through watersheds A1, A2, A4, A7, and A8. Tributary A3 extends from the intersection of Carnation Avenue and Coriander Court to a confluence point with the Mainline north or Keller Road. Tributary A5 extends from upstream of Whitewood Road to a confluence point with the Mainline. Tributaries A6-1 and A6-2 extend from upstream of Lee Road and Menifee Road, respectively, to a confluence point with the Mainline. The total watershed area being revised is 18 square miles. All watersheds were composed using District 4-foot topography and tract information for developed areas.

Foothills comprise the majority of each watershed, with valley areas only being present in the mainstem low flow paths. The watercourse for Tributary A3 contains improvements upstream and then outlets to an unimproved natural channel on the downstream end. In all other watercourses, the flow stays mainly in unimproved paths.

Lag: A lag was determined for use in the synthetic unit hydrograph method. The lag was calculated based on the physical characteristics of the drainage area and the empirical formulas in Figure 2.

Watershed parameters: MicroStation was used to determine length of longest watercourses, length of watercourse from centroid, drainage areas, and slopes. See Table 1 for these parameters for each watershed.

Manning's n-value: The visually estimated mean of the Manning's n-values of all collection of streams and channels in each watershed was analyzed. Table 1 shows the n-values used for each watershed. The analysis used aerial imagery and field visits. The values were chosen based on how developed the areas are and how many improvements exist in the area.

Based on the empirical formulas in Figure 2, watershed parameters, and the chosen n-values, each watershed had a calculated lag shown in Table 1.

Figure 2: Hydrology Manual Lag Equations

$$\text{Lag (hours)} = 24\bar{n}\left[\frac{L.Lca}{S^{1/2}}\right]^{(.38)}$$

where:

$\bar{n}$ = The visually estimated mean of the n (Manning's formula) values of all collection streams and channels within the watershed

L = Length of longest watercourse - miles

Lca = Length along longest watercourse, measured upstream to a point opposite the centroid of the area - miles

S = Overall slope of longest watercourse between headwaters and the collection point feet per mile

Warm Springs Tributary A				
Watershed	A1	A2	A3	A4
Drainage Area (sq miles)	5.2	5.2	1.5	1,0
Longest Watercourse (miles)	3.9	4.1	3.9	1.5
Lca (miles)	1.8	1.8	1.9	0.5
Slope (feet/mile)	170.0	78.3	165.7	172.5
N-value	.035	.035	.015	.035
S-graph	Foothill	Foothill	Foothill	Foothill
Lag (hrs)	.667	.783	.300	.283
Watershed	A5	A6	A7	A8
Drainage Area (sq miles)	1.4	2.1	1.0	0.6
Longest Watercourse (miles)	3.8	2.6	2.2	1.5
Lca (miles)	1.70	1.18	0.92	0.58
Slope (feet/mile)	183.0	249.2	118.0	331.0
N-value	.025	.025	.020	.035
S-graph	Foothill	Foothill	Foothill	Foothill
Lag (hrs)	.450	.325	.250	0.261

2.2 Precipitation

The 100-year 3-hr, 6-hr, and 24-hr storm durations were analyzed. Point rainfall data is taken from the District's Hydrology Manual 100-year rainfall isohyets. These represent data from California NOAA Atlas 2, Volume 11. Based on the plates E-5.1 to E-5.6, the 3-hr and 6-hr storms have the same rainfall in all watersheds. For the 24-hr storm, the watershed with the highest rainfall was used for all watersheds. This was 4.5" over 24 hours.

The precipitation depths were taken directly from point rainfall isohyetal maps from the District's Hydrology Manual. All precipitation values are based on "NOAA Atlas 2, Precipitation Frequency Atlas of the Western United States, Volume XI California" by the National Weather Service. Precipitation values are identical to Warm Springs Creek Tributary C PMR (Case 20-09-1023P and 21-09-1620, already approved) and Warm Springs Creek Tributary B (Case 21-09-1716P under review).

A depth area adjustment for the rainfall was not considered for these as each watershed is relatively small and a depth area adjustment would not result in any significant precipitation decrease. Table 2 notes the precipitation values for each storm.

Table 2: Precipitation Values for all Watersheds

Duration	100-year Point Precipitation (inches)
3-hr	1.80
6-hr	2.50
24-hr	4.50

2.3 Soils and Land Uses

In order to determine the infiltration for the Tributary A watersheds, the hydrologic soil groups were determined. These are based on the United States Department of Agriculture – Natural Resources Conservation Service – SSURGO Database. The database provides a map classifying the soil groups from "A" to "D", with "A" having the highest infiltration rate due to coarser soils and "D" having the lowest infiltration rate due to clays or other obstructions. A description of the soil groups from the District's Hydrology Manual is included in Table 3 below.

Table 3: Soil Group Descriptions

Soil Group	Description
A	Low runoff potential. Soils having high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well to excessively drained sands or gravels. These soils have a high rate of water transmission.
B	Soils having moderate infiltration rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.
C	Soils having slow infiltration rates when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.

D	High runoff potential. Soils having very slow infiltration rates when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high-water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

ArcGIS 10.3 was used to intersect the basin and sub-basin boundaries (delineated using MicroStation) with the NRCS soil database map and ultimately calculate the areas of each soil group. Warm Springs Creek Tributary A contains only three of the four soil types. Soil Type A is not present in any of the watersheds. Soil percentages are shown in Table 4 below. The high percentages of soil groups C and D in each watershed indicate a high runoff potential and lower infiltration rates. This indicates that overall the watershed soils are somewhat resistant to infiltration and favor runoff. Figure 4 shows a map of the soil groups throughout the watershed and Table 4 shows the percentage of soils in each watershed.

Table 4: Soil Groups by Watershed

Soil Type	A (%)	B (%)	C (%)	D (%)
A1	0	26	61	13
A2	0	06	78	16
A3	0	21	72	07
A4	0	11	74	15
A5	0	03	88	09
A6	0	08	87	05
A7	0	06	47	47
A8	0	10	90	0

Land use, another factor in determining the watershed's infiltration rate, was determined based on existing condition. Land use can be used to determine the impervious area of each watershed. Existing land use was determined using aerial imagery, google earth street view, and field visits. The areas corresponding to each land use category were drawn out in MicroStation and then exported to an ArcGIS shapefile so they could be intersected with NRCS soil database. A land use map is included in Figure 5. Three of the four watershed variables, watershed, land use, and soils, were intersected within ArcMAP to create a shape with all the attributes in it. Land cover conforms directly to the data given by the District's Hydrology Manual Plate E-6.1. The land cover was added to each shape in ArcMAP after the fact to complete the watershed characteristics. Land Cover map is shown in Figure 3 below. Note that land use parameters are identical to those used in Warm Springs Creek Tributary C and Warm Springs Creek Tributary B (the two cases mentioned above). A shapefile with these watershed attributes is located in Appendix B. Table 5 shows the land uses percentages.

Table 5: Land Use

Land Use Type	Impervious (%)
Basin	0%
Commercial	90%
Apartments/Condominium	80%
Natural Chaparral	0%
Natural Flatland	0%
Natural Foothill	0%
Single Family 1 acre	20%
Single Family 10,000 sq. ft.	50%
Single Family 5 acre	5%
Recreation/Turf	0%

Figure 3: Land Cover Map

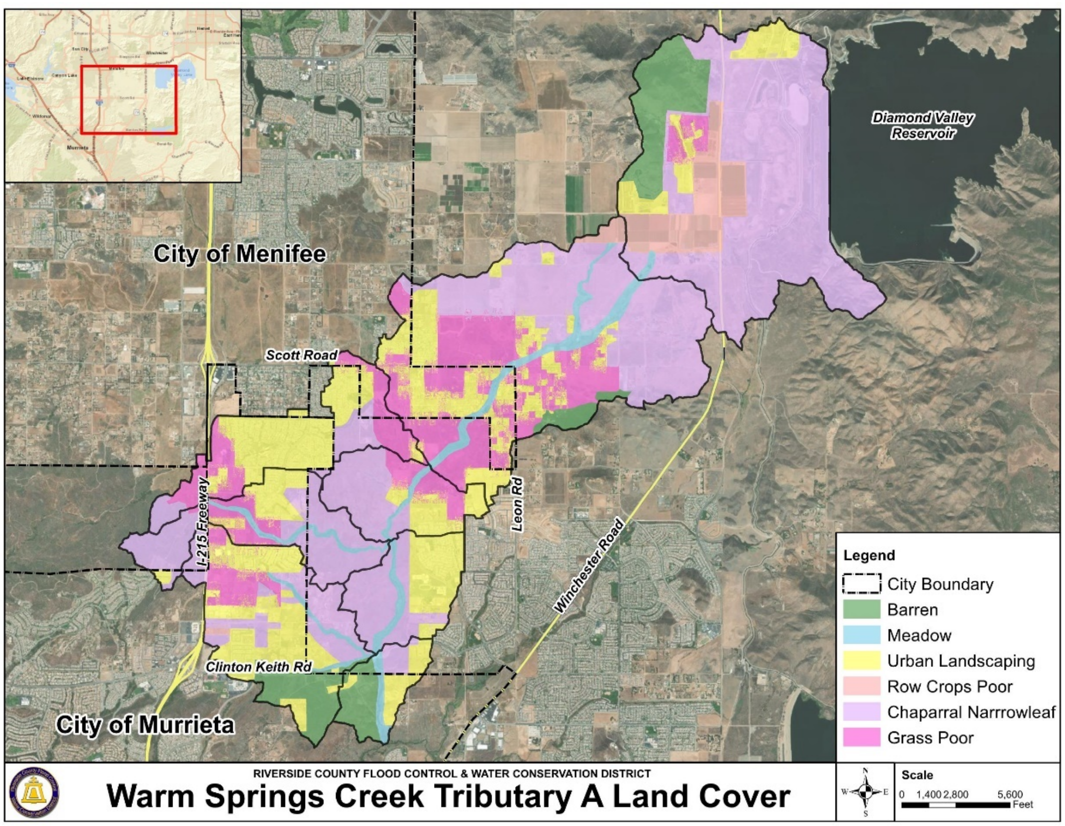


Figure 4: Soils Map

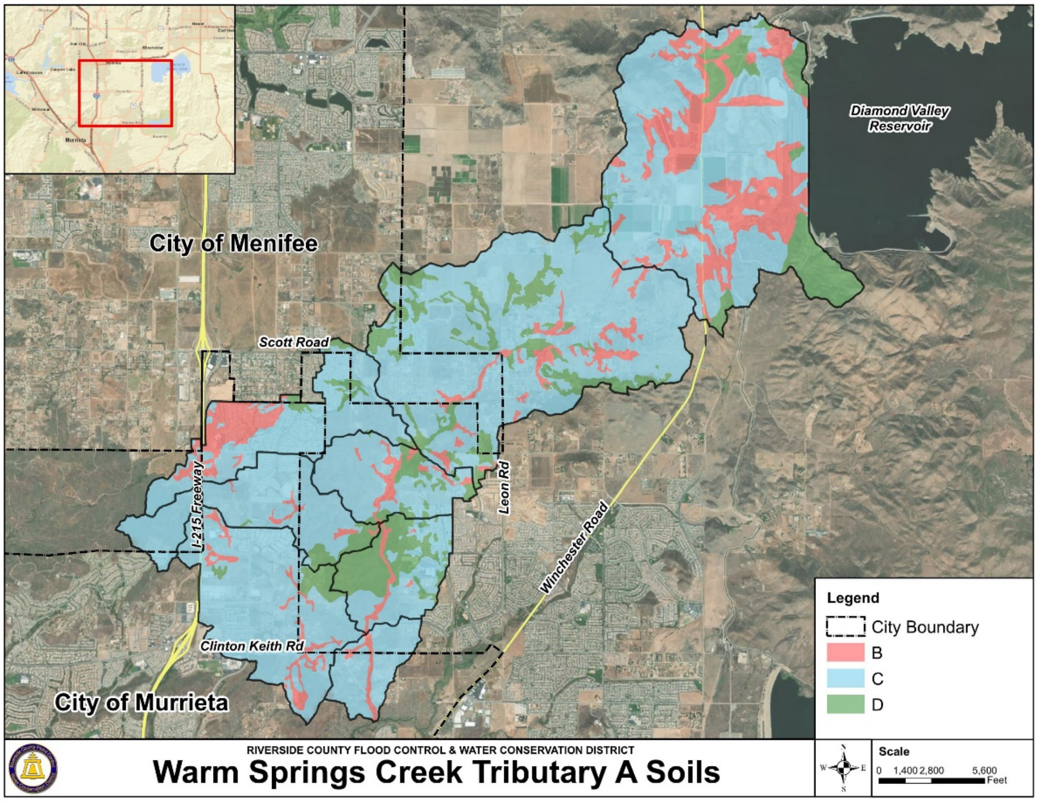
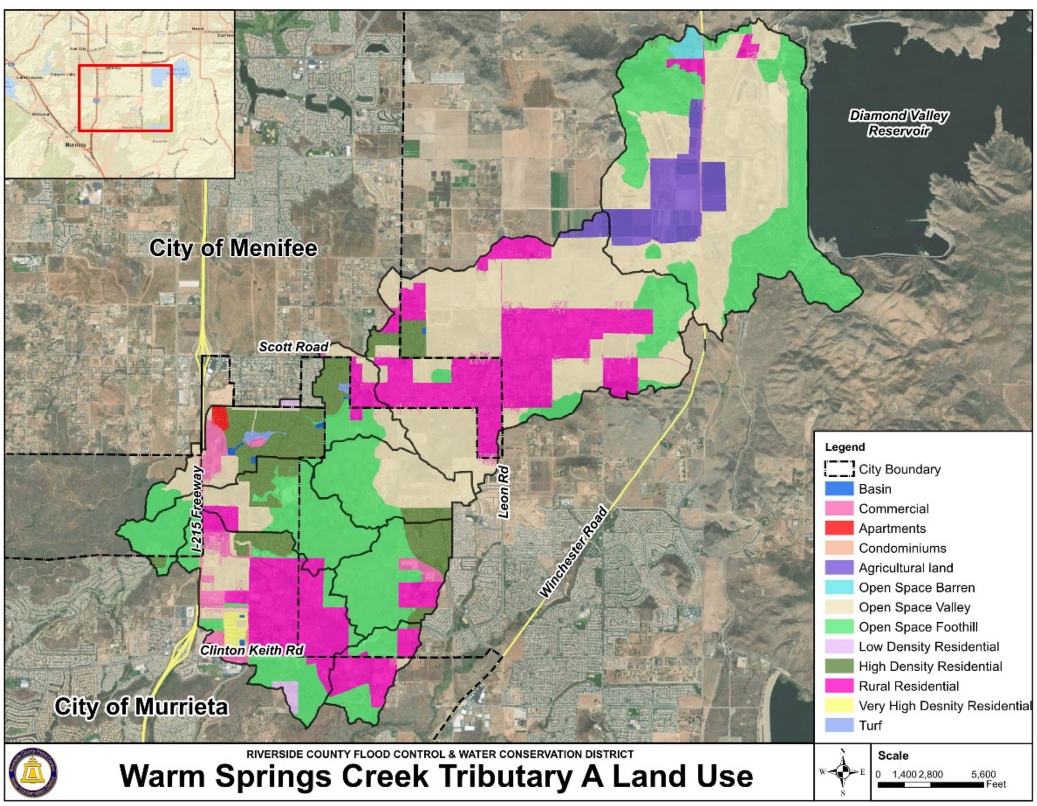


Figure 5: Land Use Map



2.4 Infiltration Losses and Runoff Index

Infiltration losses are also dependent on the Antecedent Moisture Condition (AMC), the degree of soil saturation prior to a flood producing storm event. The AMC ranges from I to III, with AMC III having the highest runoff potential. Per the criteria in the District's Hydrology Manual, AMC II was used for the 100-year frequency storm analyzed in this report. This AMC II condition was used to determine the infiltration rate once the runoff index (RI) was determined.

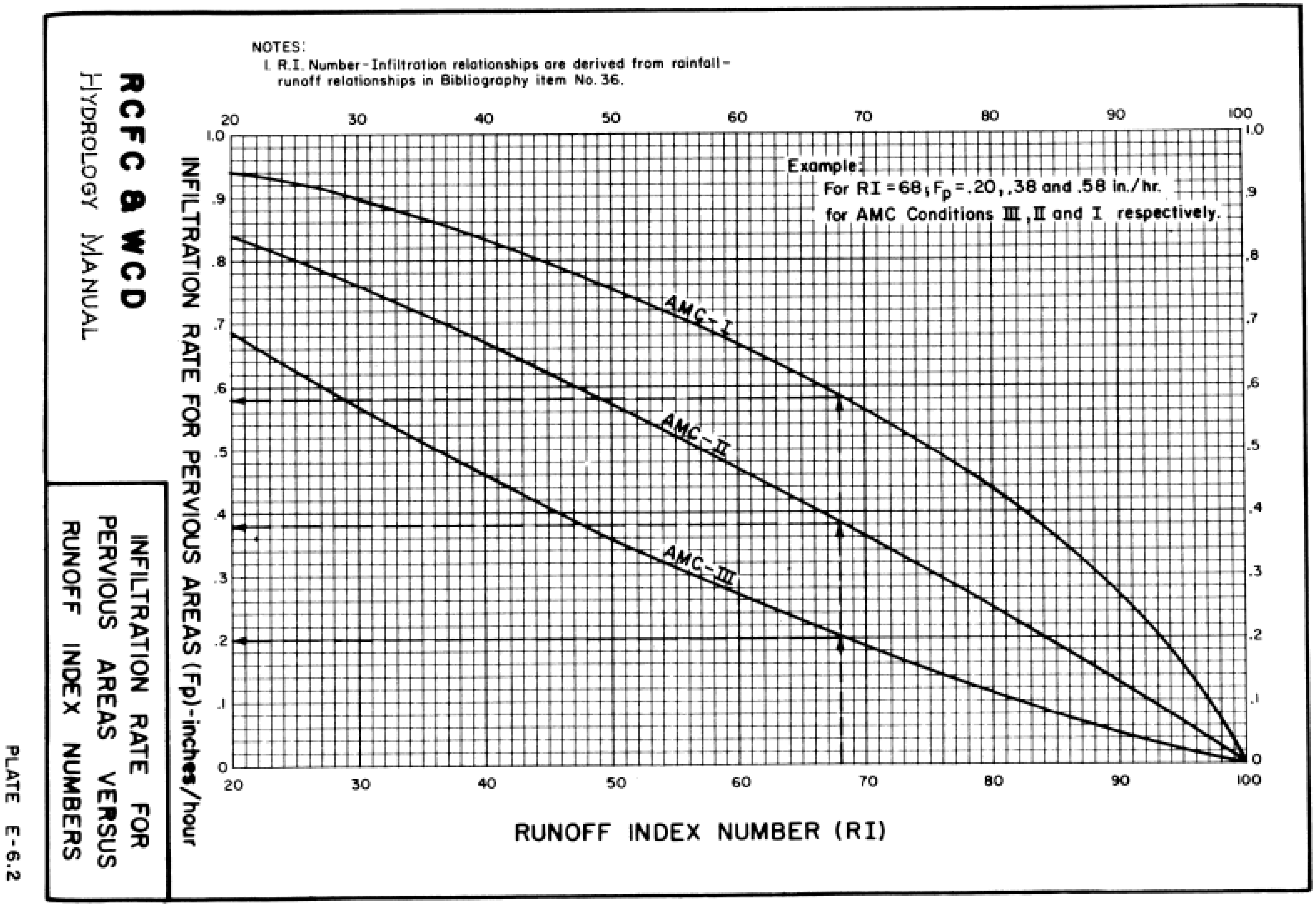
The Soil Conservation Service (now the National Resources Conservation Service) method outlined in the District's Hydrology Manual uses Runoff Index numbers in calculating infiltration rates. The runoff index numbers represent 'runoff potential' and range from 0 to 100 with 100 having the highest runoff potential (i.e., lowest infiltration). Plate E-6.1 (Figure 6 below) of the District's Hydrology Manual tabulates runoff index numbers for AMC II condition for each cover type/quality of cover and each soil group. Plate E-6.2 of the District's Hydrology Manual was then used to determine an infiltration rate (Fp) in inches/hour, Figure 7 below. Calculations for the assigned RI value is included in Appendix B excel spreadsheet.

Figure 6: RI Table from Hydrology Manual Plate E.6-1

RUNOFF INDEX NUMBERS OF HYDROLOGIC SOIL-COVER COMPLEXES FOR PERVIOUS AREAS-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
NATURAL COVERS -					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparrel, Broadleaf (Manzonita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparrel, Narrowleaf (Chamise and redshank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	72	78
Open Brush (Soft wood shrubs - buckwheat, sage, etc.)	Poor	62	76	84	88
	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	28	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
URBAN COVERS -					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79

Figure 7: Infiltration Rate Table Plate E.6-2



Since the SCS method only considers infiltration rates in pervious areas, the infiltration rate (Fp) found was adjusted to account for the percentage of impervious area using the equation on page E-8 of the Hydrology Manual, shown below.

Equation for adjusted infiltration rate, from Page E-8 of the Hydrology Manual:

$$F = Fp(1.00-0.9Ai)$$

where,

Fp = Loss rate for pervious areas in inch/hr. (Plate E-6.2)
F = Adjusted loss rate in inch/hr.
Ai = Impervious area in decimal percent

2.5. Hydrologic Modeling

Finally, the resulting information for each of the above variables was used to generate runoff hydrographs and peak flow rates for each watershed to be used in the modeling. Three different storm scenarios were analyzed to determine which gave the highest runoff potential: 3-hour, 6-hour, and 24-hour storm. The 1-hour storm was not analyzed as it is mainly used in rational hydrology.

2.5.1. HEC-HMS Hydrology

A HEC-HMS V4.3 hydrologic model was developed to calculate runoff and account for routing between all eight watersheds. The information presented in sections 2.1, 2.2, 2.3 and 2.4 are first input into District HEC-HMS preprocessor to generate effective rainfall and S-graph data. Outputs from the preprocessor are then input into HEC-HMS as user defined losses as HEC-HMS does not have an option for the loss method the District uses. Preprocessor outputs can be found in Appendix B.

Routing is required in A2, A4, A7, and A8 as flow from tributaries and upstream must make their way through these watersheds. Muskingum Cunge routing is used in HEC-HMS. The routing is based on the ground characteristics of each watershed. MicroStation V8 was used to generate the slope (ft/ft), length (ft), and average approximate cross section of each watershed. These were then input directly into HEC-HMS. The resulting HEC-HMS model can be viewed in Appendix B. Table 6 below shows the results for each watershed directly from the model. Table 7 shows the routing results directly from the model. Green cells highlight which flow rate is the highest.

Table 6: HEC-HMS Watershed Results

Storm Event	A1	A2	A3	A4	A5	A6	A7	A8
3 HR	2449	2398	1031	646	760	1406	700	400
6 HR	2218	2196	924	578	674	1267	618	353
24 HR	986	107	370	221	286	533	247	142

For each watershed individually, the 3-hour storm governed the flow rate used in the modeling. Note that not all flow rates highlighted in green are used in the modeling.

Table 7: HEC-HMS Routing Results

Storm Event	101	102	103	104	105
3 HR	2449	3336	4170	4790	4921
6 HR	2218	3327	4161	4909	5009
24 HR	986	2186	2552	3079	3166

When routing is considered, the upstream portions of the overall watershed are governed by the 3-hour storm. The downstream portions of the watershed are governed by the 6-hour storm. It is expected that as a watershed increases in size, the governing storm will start to favor a longer storm duration. This is because in a shorter duration storm, peak runoff in a lower watershed may happen long before flow from the upper watershed reaches the lower watersheds.

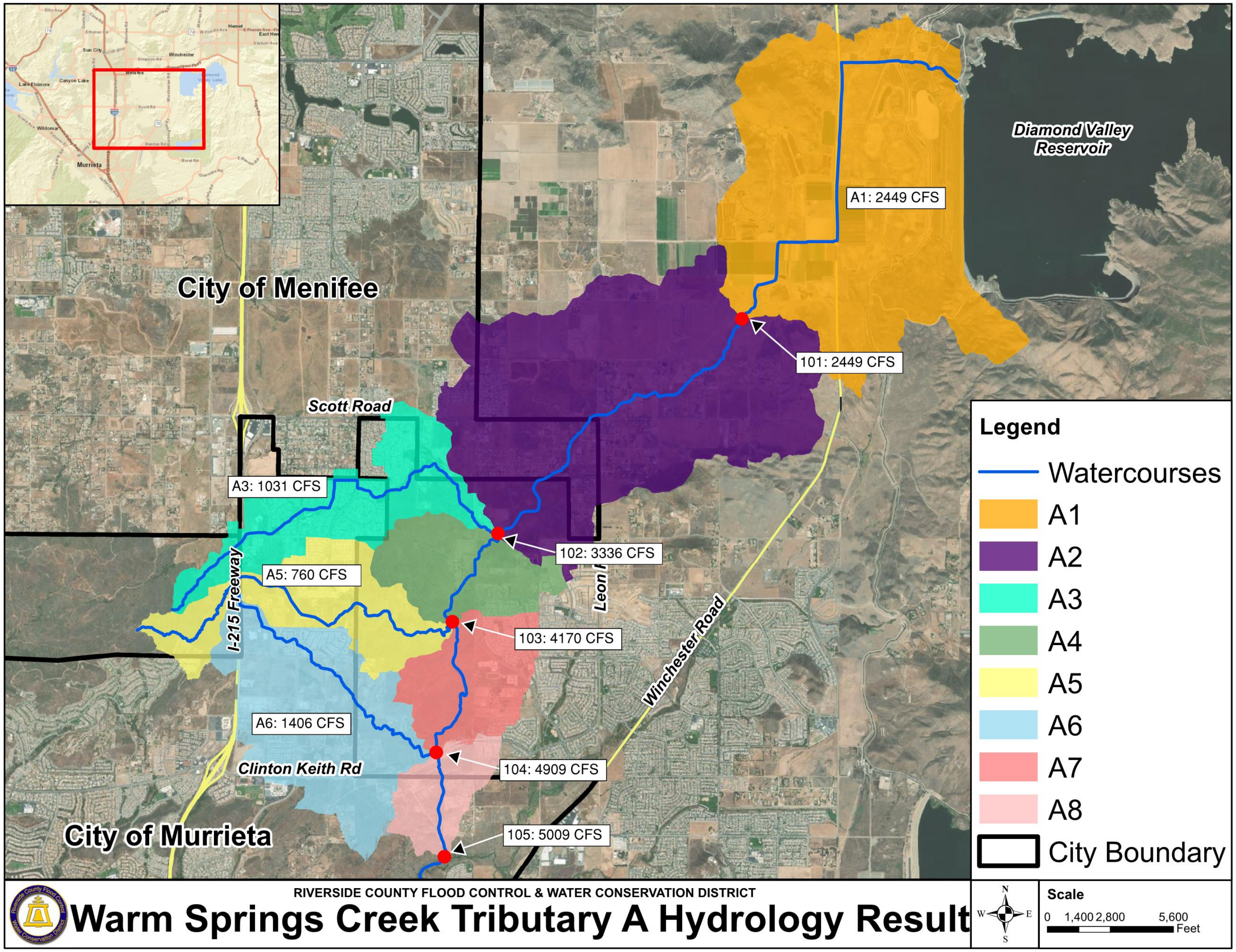
2.5.2 Final Flowrates

Table 8 shows the final flowrates to be used in the hydraulic modeling. Figure 8 shows an exhibit displaying the watersheds and important flow rates.

Table 8: Final Flow Rates Used in Hydraulics

Concentration Point Location	Watersheds	Drainage Area (mi^2)	Flow Rate (CFS)
At 101	A1	5.2	2449
At 102	A1, A2	10.4	3336
At 102	A3	1.6	1031
At 103	A1, A2, A3, A4	13.0	4170
At 103	A5	1.4	760
At 104	A1, A2, A3, A4, A5, A7	15.4	4909
At 104	A6	2.1	1406
At 105	A1, A2, A3, A4, A5, A6, A7, A8	18.0	5009
At A6 Tributary Junction	A6-1	1.0	703
At A6 Tributary Junction	A6-2	1.0	703

Figure 8: Final Flow Rate Exhibit



3. Hydraulic Analysis

The main channels around the majority of Warm Springs Tributary A are deep and ground adjacent to the channels often slope back into the channel. Therefore, the use of a one-dimensional backwater step calculation is appropriate for this mapping analysis. HEC-RAS V5.0.6 is chosen for this 1-D model. HEC-RAS 1-D is capable of utilizing surveyed ground points to generate cross sections to be used in backwater step calculation. The following sections will describe the hydraulic analysis efforts and associated results.

3.1 Effective Model/Duplicate Effective Model

The area is currently mapped as a FEMA Zone D and FEMA Zone Unshaded X. There is no effective model or duplicate effective model. This study will delineate the first FEMA floodplain in the area and piggyback off Warm Springs Tributary C PMR (LOMR Case No. 21-09-0027S, 316-PMR ongoing).

3.2 Existing Conditions model

There is no effective floodplain to mimic with an existing conditions model. This model is the first one to study the area. Therefore, no existing conditions model exists.

3.3 Proposed Conditions Model

The proposed mainline floodplain was modeled from just downstream of Los Alamos Road up until the west dam of Diamond Valley Lake. Tributary A3 goes from just downstream of Briggs Road up until the intersection of Carnation Avenue and Coriander Court. Tributary A5 starts 1,500 feet west of Low Bench Road and terminates 500 feet north of Walt Road. Tributary A6 is split into two reaches, Tributary A6-1 and Tributary A6-2. Both start 500 feet upstream of Clinton Keith Bridge, with Tributary A6-1 ending just upstream of Lee Street and Tributary A6-2 ending just downstream of Capra Road.

The Mainline, Tributary A5, and both reaches in Tributary A6 have no improved channelization, leaving the area open to natural conveyance. Half of Tributary A3 includes some developed channelization or side sloping.

3.3.1 Topography

Digital Terrain Models (DTMs) were created for this region using LiDAR data. The data was collected in 2008 and 2012 and still reflects the existing 2021 condition as very little grading or development has occurred near the flowpaths. No additional mapping was needed. All DTMs were merged and processed in MicroStation and InRoads. All mapping is 4' and meets National Map Accuracy Standards. Vertical datum for all DTM points is NAVD 88.

3.3.2 Section Geometry

Cross sections were cut from the DTMs noted in Section 3.3.1 along the reaches of Tributary A. Since the flow area is natural conveyance, no as-built plans are needed to cut the cross sections. As-built surveys are only used to model hydraulic structures, such as culverts, and the cross sections at their upstream and downstream faces.

Table 9 indicates the various drawing plans that were considered when building the hydraulic model. All pertinent survey information is included in Appendix E. Some plans are highlighted to show the important information used in the modeling process. Benchmarks and datums for each plan set were checked prior to modeling. Model cross section descriptions will also note if plans were used in any part of it.

Table 9: Plans Used in Hydraulic Model

DWG No.	As-built	Title	Reach	Sections Affected
7-0352	11-4-2021	Warm Springs Tributary A LOMR – FEMA exhibits V2	Mainline, Tributary A5, Tributary A3	Lindenberger Road, Whitewood Road, Clinton Keith Road, Tributary RS5800 & 5835, Mainline RS35319 & 35463

Junction structures are placed at all locations where a tributary stream confluences with the mainline stream. There are four junction structures: one at the confluence of the Mainline and Tributary A3, one at the confluence of the Mainline and Tributary A5, and one at the confluence of the Mainline and Tributary A6. There is an additional junction structure placed within Tributary A6 for the confluence between Tributary A6-1 and A6-2. All junctions have their reaches measured in MicroStation. The reaches are measured from the centerline point of a cross section to the centerline point of the next cross section downstream. All junctions also use the default energy equation to calculate water surfaces of both the upstream cross sections.

Conveyance obstructions are used in areas where water would not naturally flow downstream due to a physical obstruction, such as a residential or commercial structure. Ineffective flow areas are used where water will pond or have zero velocity, such as minor tributary stream lows or at culvert/bridge openings.

3.3.3 Manning's N-Value

The n-value was chosen to account for the irregularity of the channel bottom and to model the effects of vegetation. Most main channel areas in the Mainline stream have n-values between 0.05 and 0.08 based on field visits and aerial imagery of the streams at various times of the year. A 0.1 is only used on the upstream half of Tributary A3 as the vegetation is very dense based on field visit. Main channel n-values for Tributary A5 and Tributaries A6-1/6-2 are 0.06. Overbanks are dependent on how much obstruction or vegetation there is, however, most overbank areas are between 0.03 and 0.06. The downstream section of the Mainline uses 0.06 overbanks while the upstream side uses 0.045 as the vegetation is lower.

Table 10 shows the typical n-values for all reaches.

Table 10: Typical N-Values

Cover	N-Value
Mainline Main Channel	0.05 – 0.08
Mainline Overbank	0.045 – 0.06
Tributary A3 Upstream Main Channel	0.1
Tributaries Overbank	0.03 – 0.04
Tributaries A5 & A6-1/A6-2 Main Channel	0.06

3.3.4 Structures

There are multiple structures that were modeled in throughout the reaches. The Mainline has only one modeled crossing, which is Clinton Keith Bridge. Surveyed as-builts are used to model the bridge as noted in the survey document in Table 9. The low chord elevations for the bridge are very high compared to the potential water surface elevations so the only backwater is caused by the piers underneath the bridge, which is still minimal.

In Tributary A3, Lindenberger Road is the only modeled street crossing. The culvert is a dual 3-foot pipe culvert under the roadway. The flows are not contained by the two pipe culverts and the majority of the flows overtop the roadway and falls back into the natural channel.

In Tributary A5, Whitewood Road is the only modeled street crossing. Its dimensions are given by the surveyed as-builts in Table 9. The culvert has a bench within it that cannot be modeled using the culvert feature. As such, Whitewood road is modeled using a bridge feature rather than culvert.

There are multiple minor crossings that exist throughout the Mainline stream that were not modeled due to extremely low capacities or the majority of flow circumventing the crossing. These included Scott Road, Briggs Road, and Leon Road, all of which have culverts/bridges that only contain the low flow. These crossings were modeled as blocked.

3.3.5 Flow Regime and Boundary Conditions

The flow regime for all reaches is defaulted to subcritical using the 1-D HEC-RAS computational window. The downstream boundary condition of the Mainline stream is normal depth with a slope of 0.0087 based on contours and DTM surface. Downstream boundary conditions for the tributaries are based on the centerline reach length and water surface elevations (WSE) calculated by each junction point. These junction points use the energy equation to determine a starting water surface for the upstream tributaries.

Along Warm Springs and its tributaries, flow changes are implemented to ensure that the discharge the channel experiences is accurate. Table 11 below summarizes all the flow rates and the reach and station they start. All flow rates reference Appendix B Hydrology.

Table 11: Summary of Flow Rate Changes

Station (ft)	Reach	Flowrate (CFS)
65040	Mainline	2450
61233	Mainline	3336
46523	Mainline	4170
42191	Mainline	4908
35463	Mainline	5009
8336	Tributary A3	1032
12710	Tributary A5	759
1356	Tributary A6	1406
4538	Tributary A6-1	703
5102	Tributary A6-2	703

Table 12 below summarizes the model parameters associated with Warm Springs Tributary A

Table 12: Model Parameters for Each Reach

Warm Springs Tributary A	Mainline
Geometry Name	Trib A FINAL
Flow Name	Q100 HECHMS
Plan	Tributary A Final
D/S Boundary Cond.	Normal Depth
Flow Regime	Subcritical
D/S Limits	STA 32141
U/S Limits	STA 65040
Warm Springs Tributary A	**Tributary A3**
Geometry Name	Trib A FINAL
Flow Name	Q100 HECHMS
Plan	Tributary A Final
D/S Boundary Cond.	A3 Junction Point
Flow Regime	Subcritical
D/S Limits	STA 1000
U/S Limits	STA 8336
Warm Springs Tributary A	**Tributary A5**
Geometry Name	Trib A FINAL
Flow Name	Q100 HECHMS
Plan	Tributary A Final
D/S Boundary Cond.	A5 Junction Point
Flow Regime	Subcritical
D/S Limits	STA 1000
U/S Limits	STA 12710

Warm Springs Tributary A	Tributary A6
Geometry Name	Trib A FINAL
Flow Name	Q100 HECHMS
Plan	Tributary A Final
D/S Boundary Cond.	A6 Junction Point
Flow Regime	Subcritical
D/S Limits	1000
U/S Limits	1357
Warm Springs Tributary A	**Tributary A6-1**
Geometry Name	Trib A FINAL
Flow Name	Q100 HECHMS
Plan	Tributary A Final
D/S Boundary Cond.	Minor Trib Junction
Flow Regime	Subcritical
D/S Limits	107
U/S Limits	4538
Warm Springs Tributary A	**Tributary A6-2**
Geometry Name	Trib A FINAL
Flow Name	Q100 HECHMS
Plan	Tributary A Final
D/S Boundary Cond.	Minor Trib Junction
Flow Regime	Subcritical
D/S Limits	1505
U/S Limits	5102

4. Resulting Floodplain and Impacts

The HEC-RAS detailed study water surface elevations are shown on the topographic workmap in Appendix D, in the HEC-RAS model, and in an Excel file named "HEC-RAS Results WSE" located in Appendix C. The mapped floodplain will stay within its natural flow path for all reaches.

The resulting floodplain for the Mainline and all tributaries will be mapped as a FEMA Zone AE. A floodway will not be designated in this study. The study will also delineate a new FEMA Zone D boundary just outside of the watershed limits of Warm Springs Tributary A. The mapping does **not** follow the upstream limit of the modeling. Due to internal decisions made at the District, the mapping stops at RS55053. Modeling upstream of RS55053 is submitted, however, unused in the mapping of this FEMA Zone AE. The FEMA Zone AE will be located within the watershed boundaries. The bottom-line impact is an addition of 235 acres of FEMA Zone AE and removal of 2866 acre of FEMA Zone D. It is proposed to change the area within the watersheds that are not changed to a FEMA Zone AE to a FEMA Zone Unshaded X (area of minimal flooding).

Annotated FIRM Panels will only be created for FIRM Panel Number 06065C2070H since that is the only published and printed panel. The remaining panels will be printed via Warm Springs

Tributary C PMR. This revision will operate under the assumption that Warm Springs Tributary C PMR (LOMR Case No. 21-09-0027S, 316-PMR) will become effective sometime in the future. Once the referenced PMR becomes effective, the remaining FIRM panels will be printed with Warm Springs Tributary A, B, and C displayed on them. Therefore, the delineation of the proposed FEMA Zone D and FEMA Zone AE will be only displayed on the topographic workmap and via shapefiles. Figure 9 shows the proposed conditions floodplains. See the topographic workmap in Appendix D to see the mapping versus model extent differences.

Figure 9: Proposed Conditions Exhibit