RIVERSIDE COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT
RIVERSIDE, CALIFORNIA

WARM SPRINGS CREEK TRIBUTARY B

May 27, 2021

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RIVERSIDE COUNTY FLOOD CONTROL WATER CONSERVATION DISTRICT

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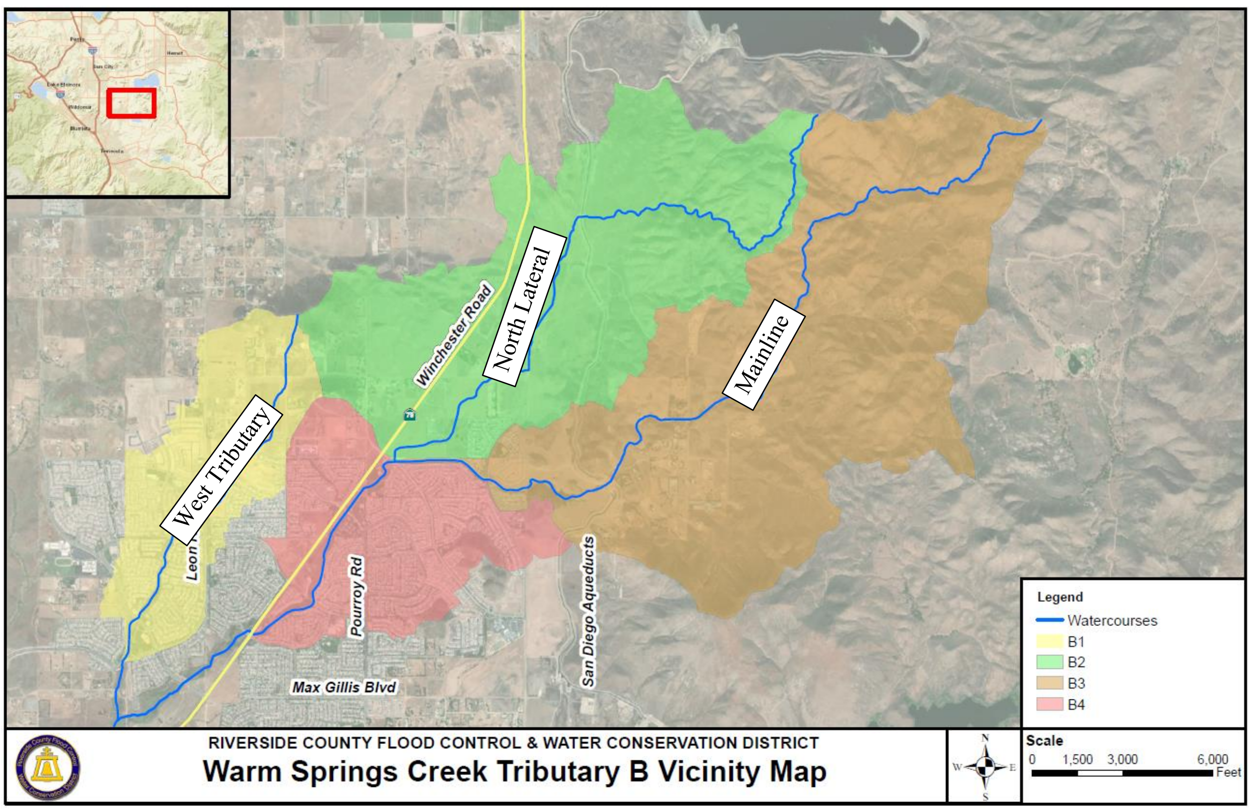
1. Introduction

The Warm Springs Tributary B Watershed is a 12.3 square mile watershed located in unincorporated Riverside County in the area between Winchester and the city of Murrieta, California. Warm Springs Tributary B has three reaches dubbed Mainline (French Valley Channel), North Lateral, and West Tributary. Tributary B is part of the overall Warm Springs Creek Watershed, which ultimately discharges into Murrieta Creek within the city of Murrieta.

Currently, the Warm Springs area is mapped as Zone Unshaded X or Zone D. The Riverside County Flood Control and Water Conservations District's (District) objective in this analysis is to map the floodplain as a Federal Emergency Management Agency (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. 20-19-1023P, 316-PMR ongoing), which will print the FIRM Panel Numbers 06065C2710G, 06065C2090G, 06065C2095G, 06065C2730G, and 06065C2735G. These same FIRM Panels are proposed to be revised as a part of Warm Springs Tributary B. Figure 1 shows a vicinity map of the area as well as watersheds B1, B2, B3, and B4. B1 is the West Tributary, B2 is the North Lateral, and the combination of B2, B3, and B4 make up the Mainline.

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 flow rate for the various reaches of Tributary B. The study only considers existing conditions of the watersheds. The guidelines in the District's Hydrology Manual were used to prepare a synthetic unity hydrograph rainfall-runoff model for the Tributary B Watersheds using both Civil D and 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 B French Valley Channel (dubbed as Mainline hereon) extends from the foothills just south of Diamond Valley Lake in the northeast to State Route 79 (SR-79). The French Valley Channel Mainline includes watersheds B3 and B4 which combine for 7.0 square miles. The North Lateral also extends from the foothills just south of Diamond Valley Lake to a confluence point with Mainline just upstream of Abelia Street. The North Lateral watershed is 3.8 square miles. The combination of the North Lateral and Mainline watersheds is 10.8 square miles. The West Tributary extends from the hills north of Keller Road to Leon Road.

The West Tributary is mostly composed of valley-like topography. The upstream portion of the Mainline is composed mostly of foothill like regions. The downstream portions of the Mainline are developed and have valley topography. In all watercourses, the flow goes from unimproved foothill/valley regions at the upstream end to improved and developed downstream areas. The West Tributary watershed is 1.5 square miles. The total watershed (B1, B2, B3, and B4) area being revised is 12.3 square miles. All watersheds were composed using District 4-foot topography and tract information where there are developed areas.

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 2 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

Table 1: Watershed Parameters

Warm Springs Tributary B				
Watershed	B1	B2	B3	B4
Drainage Area (sq. miles)	1.5	3.8	5.3	1.7
Longest Watercourse (miles)	2.6	4.7	5.9	1.5
Lca (miles)	1.4	1.8	3.2	1.0
Slope (feet/mile)	206.8	222.3	210.3	26.9
n value	.015	.040	.035	.015
S-graph	Valley	Valley/Foothill	Foothill	Valley
Lag (hrs)	0.214	.781	.933	.234

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 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.

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.

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 B 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 classifications "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 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 Tributary B contains all four soil groups. 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. Only watershed B3 had soil group A with a very low percentage (0.41%), which indicates that overall, the watershed soils are slightly resistant to infiltration. Figure 3 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	B1(%)	B2(%)	B3(%)	B4(%)
A	0	0	0.41	0
B	21	22	12	18
C	43	25	30	57
D	36	53	58	25

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. Land cover conforms directly to the data given by the District Hydrology Manual Plate E6-1. A land use map is included in Figure 4. 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. The land cover was added to each shape in ArcMAP after the fact to complete the watershed characteristics. This shapefile with three watershed attributes is located in Appendix B. Table 5 shows the land uses and land covers.

Table 5: Land Use and Cover Types

Land Use Type	Land Cover Type	Impervious (%)
Basin	Urban landscaping	0%
Commercial	Urban landscaping	90%
Apartments	Urban landscaping	80%
Natural Chaparral	Chaparral broadleaf, fair	0%
Natural Flatland	Grass fair	0%
Natural Foothill	Open brush fair	0%
Single Family 1 acre	Urban landscaping	20%
Single Family 10,000 sq. ft.	Urban landscaping	50%
Single Family 5 acre	Grass poor	5%
Turf	Turf	0%

Figure 3: Soils Map

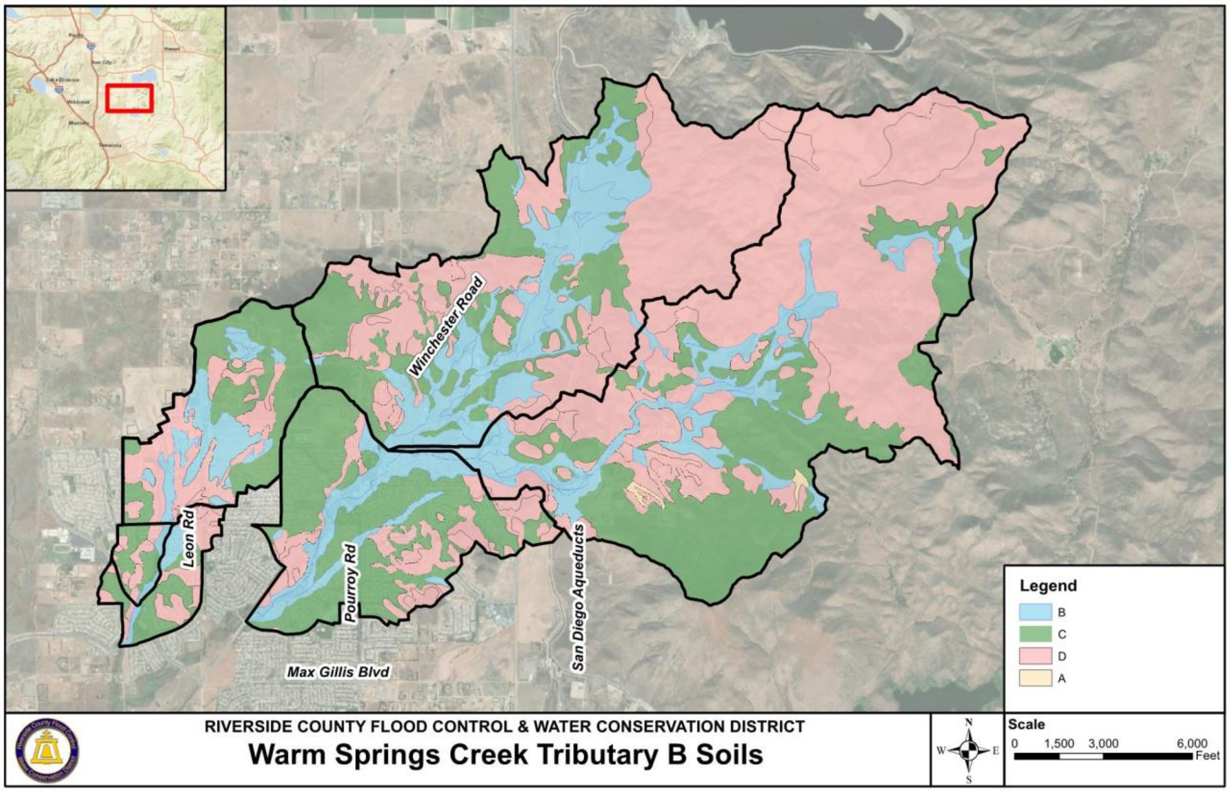
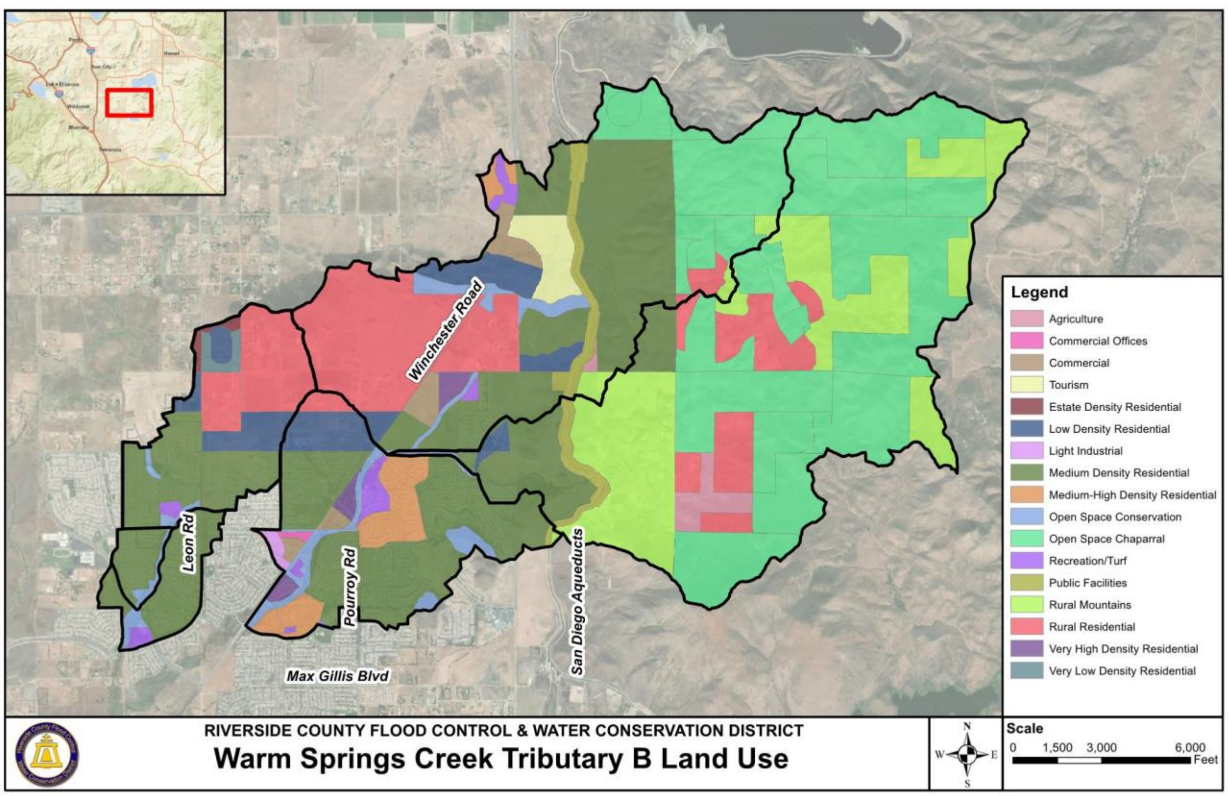


Figure 4: Land Use Map



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 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.

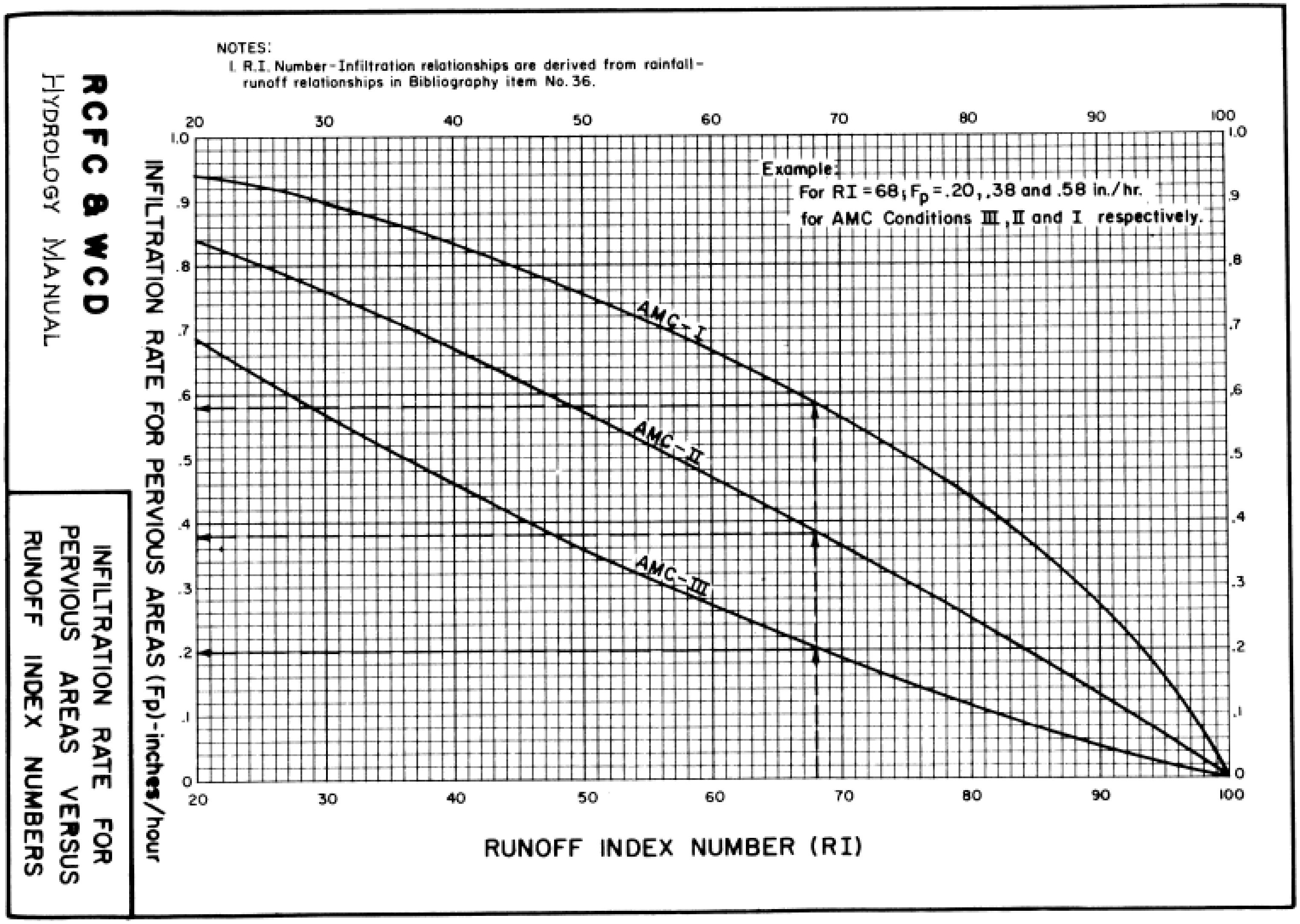
The Soil Conservation Service (now the National Resources Conservation Service) method outlined in the Hydrology Manual uses runoff index numbers in calculating infiltration rates. The runoff index numbers represent 'runoff potential' and range from zero to 100 with 100 having the highest runoff potential (i.e., lowest infiltration). Plate E-6.1 (Figure 5 below) of the District 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 Hydrology Manual was then used to determine an infiltration rate (Fp) in inches/hour, Figure 6 below. The infiltration rate (Fp) for pervious areas was calculated to be 0.31 inches/hour. The calculations for the assigned RI values are included in Appendix B excel spreadsheet.

Figure 5: 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 6: 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. Resulting Flow Rates

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-hr, 6-hr, and 24-hr storm. The 1-hr storm was not analyzed as it is mainly used in rational hydrology.

2.5.1. HEC-HMS Hydrology

Watersheds B2, B3, and B4 are analyzed in a HEC-HMS V4.3 model to account for routing between the three 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.

Watersheds B2 and B3 confluence with each other. Watershed B4 is downstream of the concentration point for both B2 and B3 and requires routing analysis to determine accurate hydrographs and peak flow rates. Muskingum Cunge routing is used in HEC-HMS. The routing uses an approximate cross section (8 points) for the single routed reach as well as an n value of 0.06 (approximately matching what is used in HEC-RAS), and a slope of .00523 calculated in MicroStation. The resulting HEC-HMS model can be viewed in Appendix B. Table 6 below shows the results directly from the model. Green cells highlight which flow rates are the highest.

Table 6: HEC-HMS Results

Storm Event	B2	B3	B4	JX1	JX2
3-hr	2,054	2,752	1,149	4,632	4,606
6-hr	1,452	1,923	1,351	3,280	3,357
24-hr	698	920	412	1,601	1,890

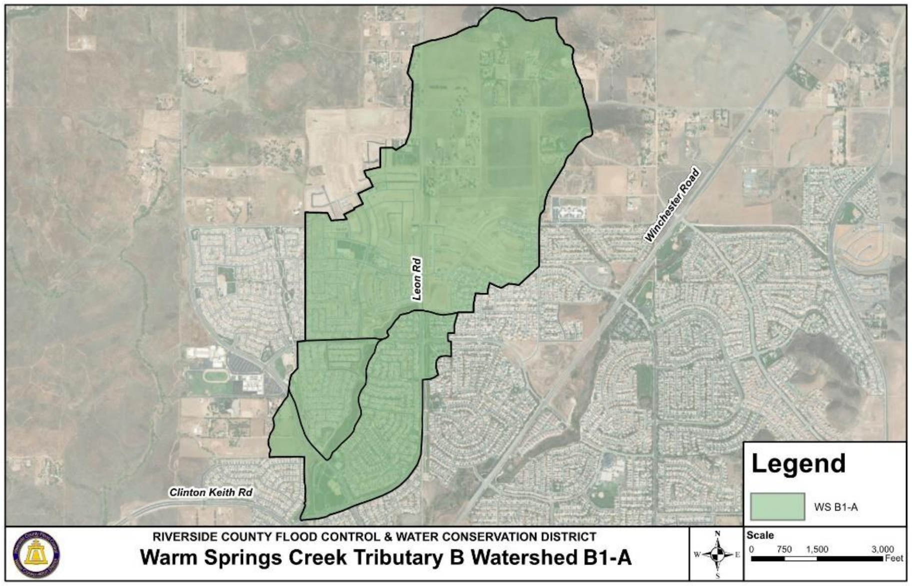
As seen from the table above, the 3-hr storm does not govern for watershed B4 and instead the 6-hr storm governs. Therefore, to include the governing storm into the hydrology and ensure the flow rates are conservative, it was assumed that a 3-hr storm would occur everywhere in the watershed except for B4, which would experience a 6-hr storm. To account for this, the 3-hr Reach 3.1 hydrograph was added to the 6-hr B4 hydrograph in order to create a new JX2 peak flow rate of 4727 cfs. This hydrograph addition can be found in Appendix B excel sheet titled "Watershed Data and Hydrograph Addition."

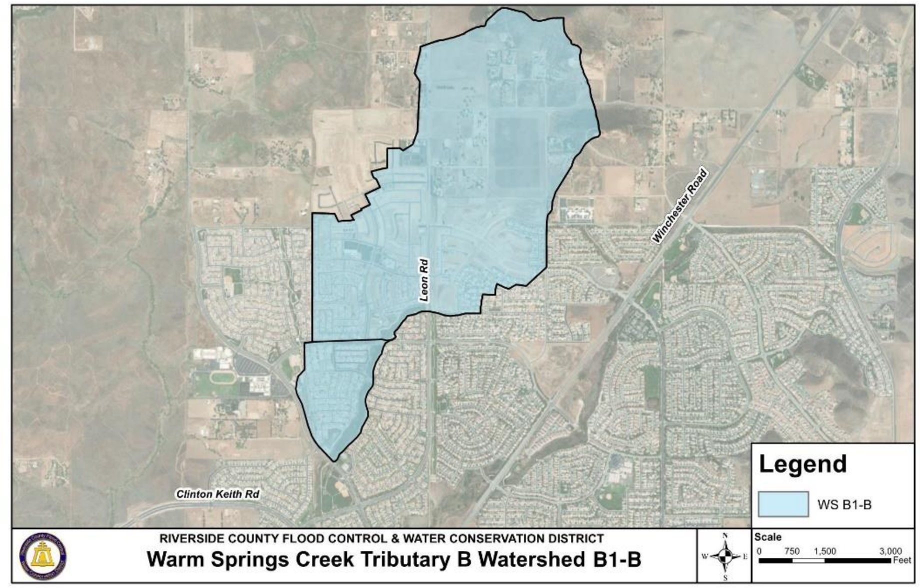
2.5.2. Civil D Hydrology

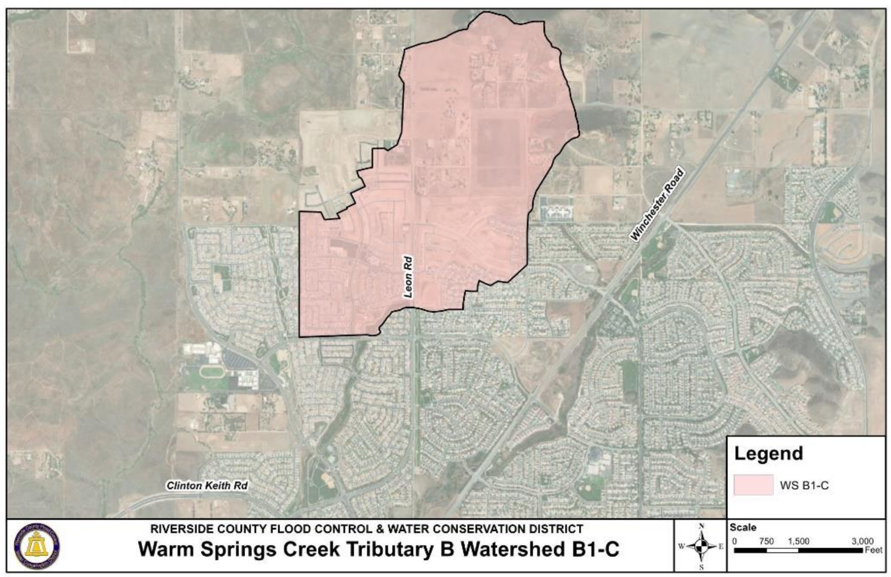
Watershed B1 was analyzed in Civil D as it was disconnected from the rest of the watersheds, and the watershed needed to be fragmented to get correct flow rates. Originally, there was only one concentration point at the downstream end of B1, however, the flow rate that was produced was causing Prairie Sun Way and Baxter Road to overtop during hydraulic modeling. It was then decided that two more concentration points were to be added at Briggs and Baxter bridges to produce more accurate and lower flow rates for those crossings. The area between the concentration points were not larger than 300 acres, therefore, using HEC-HMS to generate routing would be inaccurate. Therefore, it was decided to take the entire watershed at each concentration point and create individual Civil D runs for each resulting watershed.

The information given in Sections 2.2, 2.3, and 2.4 were input directly into Civil D software to generate effective rainfall and runoff hydrographs for each of the fragmented watersheds. Figure 7 shows how watershed B1 was fragmented.

Figure 7: Watershed B1 Fragmentation







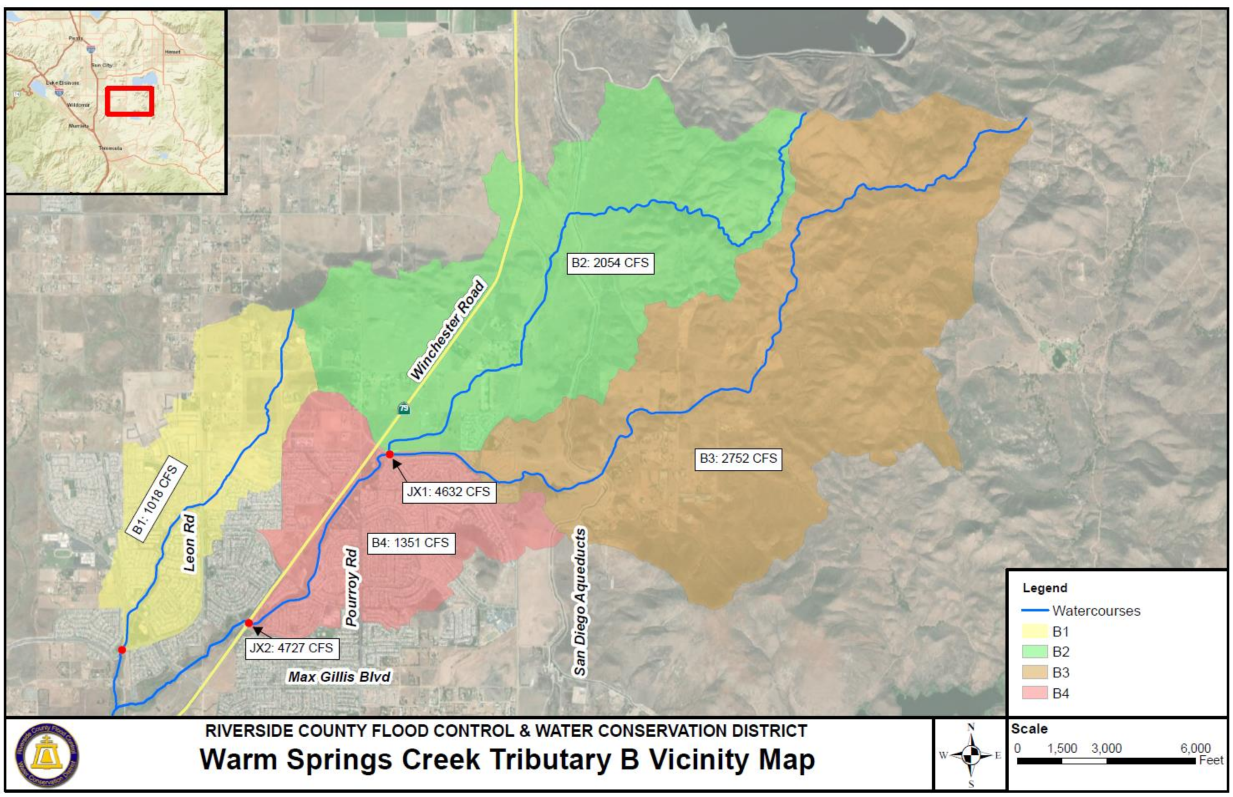
2.5.3 Final Flow Rates

Table 7 shows the final flow rates to be used in the hydraulic modeling. Figure 8 shows an exhibit displaying the watersheds and flow rates.

Table 7: Final Flow Rates Used in Hydraulics

Concentration Point Location	Watersheds	Flow Rate (cfs)
At Abelia Street	B3	2752
At Abelia Street	B2	2054
At Baxter Road	B1-C	716
At Briggs Road	B1-B	838
At Leon Road	B1-A	1018
DS Abelia Street	JX1: B2 & B3	4632
US Winchester Road	JX2: B2, B3, & B4	4727

Figure 8: Final Flow Rate Exhibit



3. Hydraulic Analysis

The main channels around Warm Springs Tributary B are deep and ground adjacent to the channels and 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. 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 B PMR (LOMR Case No. 20-19-1023P, 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 Winchester Road up to the foothills just south of Diamond Valley Lake. West Tributary goes from one side of Leon Road downstream to the other side of Leon Road. North Lateral goes from downstream of Keller Road until confluence with the Mainline.

The downstream portion of the Mainline is comprised mostly of French Valley Channel. The French Valley Channel was constructed over time in design stages as a part of multiple different housing tracts. These improvements to French Valley Channel were built mainly from 2003 and 2008 and were built for the purpose of containing the 100-year flood flows. In some places, the channel is a graded earthen channel with straight low flow direction and a densely vegetated strip due to a conservation easement. In other places, the channel is a soft bottom channel with concrete or earthen sideslopes to protect the adjacent property. Channel width varies by location.

3.3.1 Topography

Digital Terrain Models (DTMs) were created for this region using LiDAR data. The data was collected in 2002, 2003, 2008, and 2012 and mostly reflects the existing 2021 condition. In areas where the DTMs did not accurately reflect the 2021 conditions, additional mapping was created from processed 2018 LiDAR data and 2020 field surveys. The additional mapping data was used to supplement areas where tracts or channels were built after the original mapping date. 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 B. Some of the DTMs, while being up to date, still did not give accurate depictions of the channel bottoms in areas where there were conservation easements or extremely high vegetation. In these areas, the inverts and sideslopes have been updated using as-built conditions of the improved areas of the channel. This was done with the help of as-built drawings of multiple stages of the French Valley Channel as well as bridge/culvert as-builts and field visits of the area. The elevations of many of these as-built drawings are in the NGVD29 vertical elevation datum. The datum of the DTM points are in NAVD88. The elevations from some of these drawings were converted from NGVD 29 using the National Geodetic Survey 'VERTCON' to match the NAVD88 datum (2.4' conversion). Due to these edits, some cross sections may slightly deviate from the elevations given by the DTM, however, they more accurately represent the terrain.

Table 8 indicates the various drawing plans that were considered when building the hydraulic model. This table also includes plans that were used to model structures such as culverts along Washington Street, Pourroy Road, and Abelia Street. All drawings, as-builts, and 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 planset were checked prior to modeling. Model cross section descriptions will also note if plans were used in any part of it.

Table 8: Plans Used in Hydraulic Model

DWG No.	As-built	Title	Reach	Sections Affected
7-0352	As-built 10/20/05,	Warm Springs Valley – French Valley Channel Plan and Profile	Mainline	STA 24735 to STA 21230 and Abelia Street Crossing
7-0369	As-built 02/14/06	Warm Springs Valley French Valley Channel Stage 2	Mainline	STA 20016 to STA 18102 and Pourroy Road and Park Culvert
928-T	As-built 08/31/07	TR 29017-1 Street Improvement Plans	Mainline	Abelia Street
7-0467	As-built 10/17/07	Warm Springs Valley French Valley Channel Stage 3 Slope Protection Plan	Mainline	STA 13347 & 13507 and downstream known water surface
937-C	Not As-Built	TR 28297 Line 4 Storm Drain Plan	Mainline	STA 13507, Google earth and Bing imagery confirm the construction at this station
1-4	As-Built/Survey 08/05/20	Warm Springs Tributary B Street Crossing Survey	Mainline/West Tributary	Washington Street, Prairie Sun Way, and Baxter Road Crossings
7-0490	As-Built 01-30-13	Warm Springs Valley Briggs Road Storm Drain Evening Glow Drive Stage 1	West Tributary	Briggs Road Crossing
941-QQ	As-Built 01-03-12	County of Riverside TR 29848 Schedule A Street Improvement Plans	West Tributary	Downstream known water surface

The North Lateral confluences with the Mainline at a spillway into the Mainline just upstream of Abelia Street. It was decided not to place a junction structure there and instead use a known water surface from the Mainline. Additionally, the confluence area contains a levee condition on the north side of the Mainline channel (STA 22322 to STA 21970) that needed to be addressed. In order to avoid the levee condition all together, it was decided to do a natural valley run where everything landward of the levee would be considered ineffective. This was acceptable because the area downstream of the levee has a major spillway that would cause backwater from the mainline to pool up behind the levee. Only the water near the spillway would actually flow toward the Abelia Street culvert opening. Downstream cross sections for the North Lateral closely match Mainline XS21970, XS22170, and XS22322.

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 high vegetation. Through the improved channels of French Valley Channel, there were areas designated as a conservation easement. These areas will have a set invert and the vegetation will not be maintained. A very conservative n value of 0.1 was used in the conservation easement since the vegetation is unmaintained and the density of vegetation is either high or unknown. In areas where there is no set conservation easement with high vegetation, the n value is chosen to be 0.04 to 0.07 depending on visual estimation of vegetation depth and width. Concrete sideslopes are given a 0.02 n value since they are significantly less rough and contain no vegetation.

Table 9 shows the typical n values for all reaches.

Table 9: Typical n Values

Cover	n Value
Conservation Easement	0.1
Riprap	0.035
Sideslopes	0.03 – 0.04
Concrete Lined	0.02
Main Channel Vegetation	0.04 – 0.07

3.3.4 Structures

There are multiple structures that were modeled in throughout the reaches. The Mainline has four bridge crossings: Washington Street, Abelia Street, Park Culvert, and Pourroy Road. Washington Street is modeled as per survey as-builts and accounts for the four 14'x7' culvert barrels. The survey information noted that each barrel had a slightly different invert elevation, and this is reflected in the model. Abelia Street is as per 928-T and incorporates the four 8.5' tall hydroarch barrels described in the as-builts. Park Culvert is as per the French Valley, Stage 2 as-builts and incorporates both 6' diameters CMP culverts. Pourroy Road is based on French Valley, Stage 2 as-builts and reflects all 8' tall hydroarchs. Park Culvert is the only crossing unable to contain the flows in its culvert barrel. The walking bridge overtops and flow reconvenes back into the channel directly downstream of Park Culvert crossing.

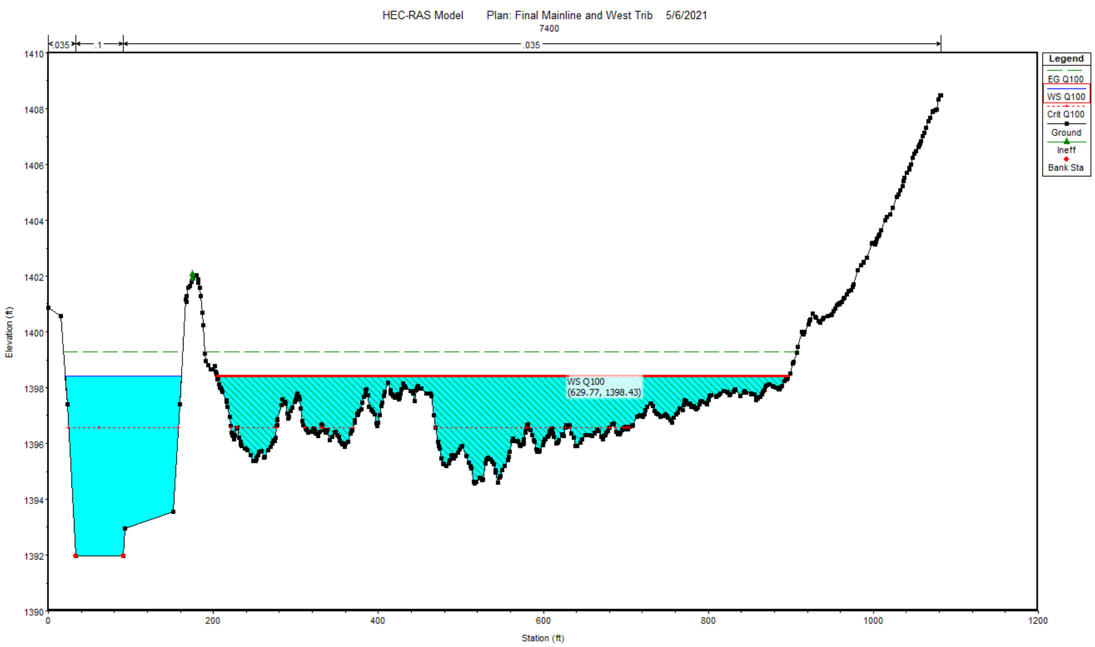
In the West Tributary, three crossing structures are modeled: Baxter Road, Briggs Road, and Prairie Sun Way. Baxter Road crossing is as per the District Survey as-builts and is a 7' rise hydroarch. Prairie Sun Way crossing is also as per the District Survey as-builts and is an 8' rise hydroarch. These two bridges had to be surveyed because as-built plans could not be produced. Briggs Road crossing is based on Evening Glow Drive, Stage 1 as-builts and is a 6' tall hydroarch. All three culverts seal on the upstream end and pond against the roadway crossing but are still contained within the channel.

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. Additionally, all downstream boundary conditions for all reaches are known water surfaces from as-builts or from the model itself. The downstream boundary condition for the mainline is a known WSE of 1354.73' based on DWG 7-0467. The downstream boundary condition of the West Tributary is 1339.12' based on as-built DWG 941-QQ.

The downstream boundary condition for the North Lateral is based on the water surfaces in the mainline hydraulic model. Mainline STA 21970 is used to generate the downstream water surface. Since the area is split by the French Valley Channel, a natural valley run was used on the Mainline to circumvent addressing a levee condition. This resulted in the area outside of the channel in the Mainline hydraulic model to be labeled ineffective because in reality the flow would not go that far. The use of the ineffective area creates a conservative starting water surface for the North Lateral hydraulic model. The North Lateral STA 1000 cross section was then placed so it exactly matches the right overbank of Mainline STA 21970. Additionally, STA 21970 is where the flow changes to match the confluence flow rate. Figure 9 shows STA 21970 and the ineffective flow area.

Figure 9: STA 21970 and the Ineffective Flow Area



Along Warm Springs and its tributaries, flow changes are implemented to ensure that the discharge the channel experiences is accurate. Table 10 below summarizes all the flow rates and the reach and station they start. All flow rates reference Appendix B Hydrology.

Table 10: Summary of Flow Rate Changes

Station (ft)	Reach	Flow Rate (cfs)
39856	Mainline	2,752
21970	Mainline	4,632
19606	Mainline	4,727
8080	West Tributary	716
6528	West Tributary	838
3382	West Tributary	1,018
4132	North Lateral	2,054

Table 11 below summarizes the model parameters associated with Warm Springs Tributary B.

Table 11: Model Parameters

Warm Springs Tributary B	Mainline
Geometry Name	Final Mainline West
Flow Name	Trib B Final Q100 Existing
Plan	Final Mainline and West Trib
D/S Boundary Cond.	Known Water Surface
Flow Regime	Subcritical
D/S Limits	STA 13447
U/S Limits	STA 39856
Warm Springs Tributary B	**West Tributary**
Geometry Name	Final Mainline West
Flow Name	Trib B Final Q100 Existing
Plan	Final Mainline and West Trib
D/S Boundary Cond.	Known Water Surface
Flow Regime	Subcritical
D/S Limits	STA 2054
U/S Limits	STA 8080
Warm Springs Tributary B	**North Lateral**
Geometry Name	North Lateral Final
Flow Name	North Lateral Final
Plan	North Lateral Final
D/S Boundary Cond.	Known Water Surface from Mainline
Flow Regime	Subcritical
D/S Limits	STA 1000
U/S Limits	STA 4132

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 called "HEC-RAS Results WSE" located in Appendix C. The mapped floodplain will stay within the improved channels along the Mainline and in the West Tributary. The North Tributary follows its natural flow path. No reach has impacts to residential or commercial structures.

The resulting floodplain will be mapped as a FEMA Zone AE. A floodway will not be designated in this study. The majority of the Mainline and West Tributary is improved and already designated for flood control purposes and conservation. The mapping as a part of this LOMR confirms this. The study will also delineate a new FEMA Zone D boundary just outside of the watershed limits of Warm Springs Tributary B. The FEMA Zone AE will be located within the watershed boundaries. The final impact is an addition of 224.6 acres FEMA Zone AE and removal of 3328 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).

As stated in this report, the Warm Springs area is currently mapped as a FEMA Zone D, the area was never studied by FEMA, and FIRM Panels 06065C2090G, 06065C2095G, 06065C2710G, 06065C2730G, 06065C2735G were never printed. The District is currently working with FEMA on 316-PMR for the Warm Springs area which will tentatively become effective sometime in 2023. As a result, as this time, Annotated FIRM Panels cannot be created as these five FIRM Panels have never been printed. This revision will operate under the assumption that once Warm Springs Tributary C PMR (316-PMR) becomes effective in the future and the five FIRM Panels are printed, this floodplain will be displayed on these panels. Therefore, Annotated Workmaps for these five panels will not be submitted with this revision, and the delineation of the proposed FEMA Zone D and FEMA Zone AE will only be displayed on the topographic workmap and via shapefiles. Figure 10 shows the proposed conditions floodplains.

Figure 10: Proposed Conditions Exhibit