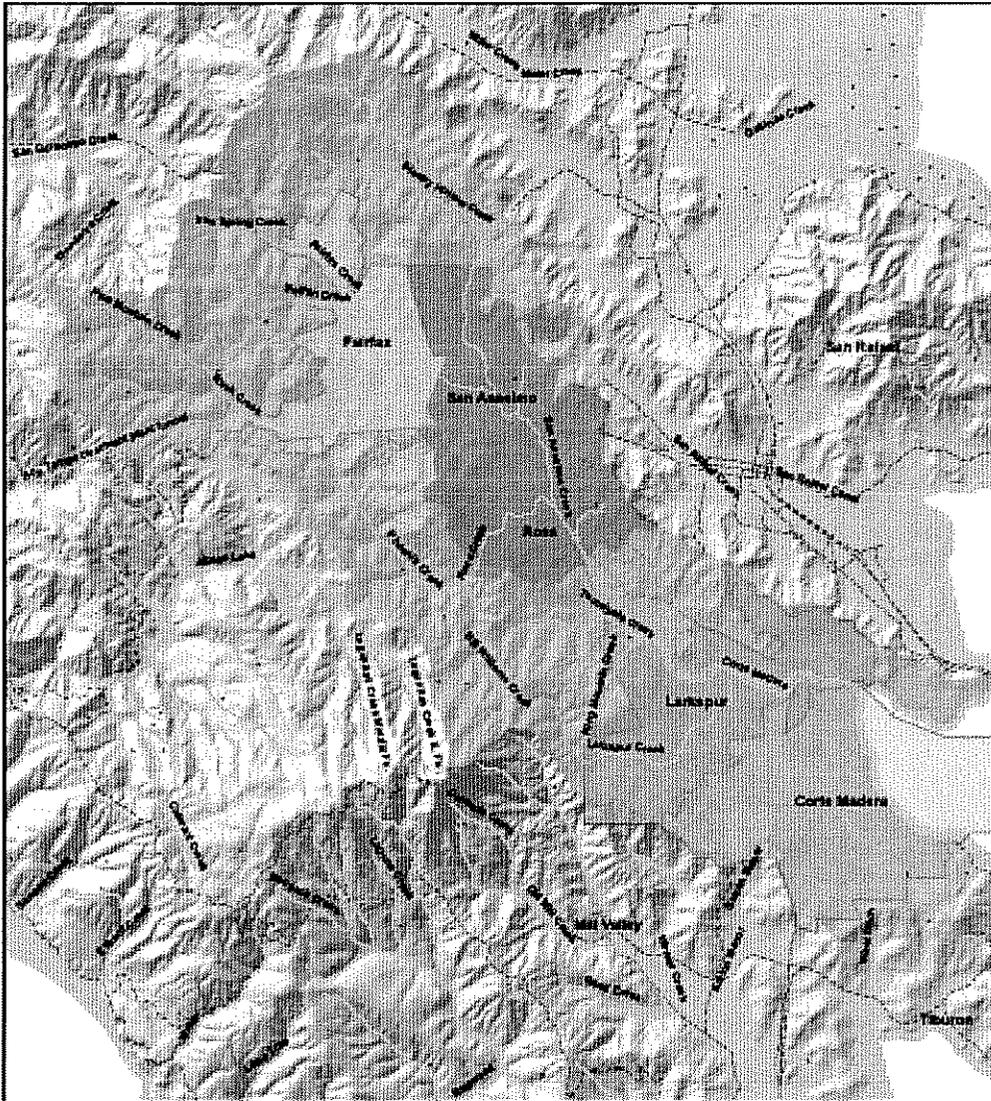
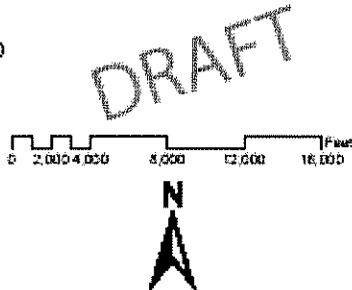


# TOWN OF FAIRFAX ROSS VALLEY WATERSHED



-  ROSS VALLEY WATERSHED
- City Name**
-  Corte Madera
-  Fairfax
-  Larkspur
-  Ross
-  San Anselmo

SOURCE: Marin County Marin Map/GIS Data - 2007



### Base Map

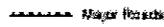
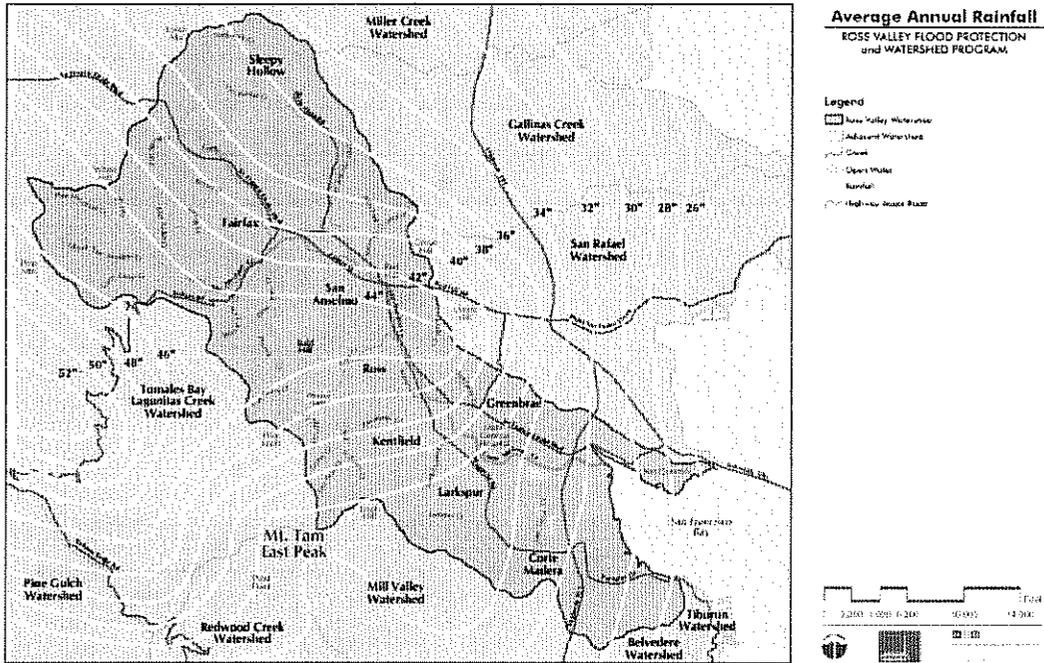
-  Stream
-  Major Roads

FIGURE 3-1

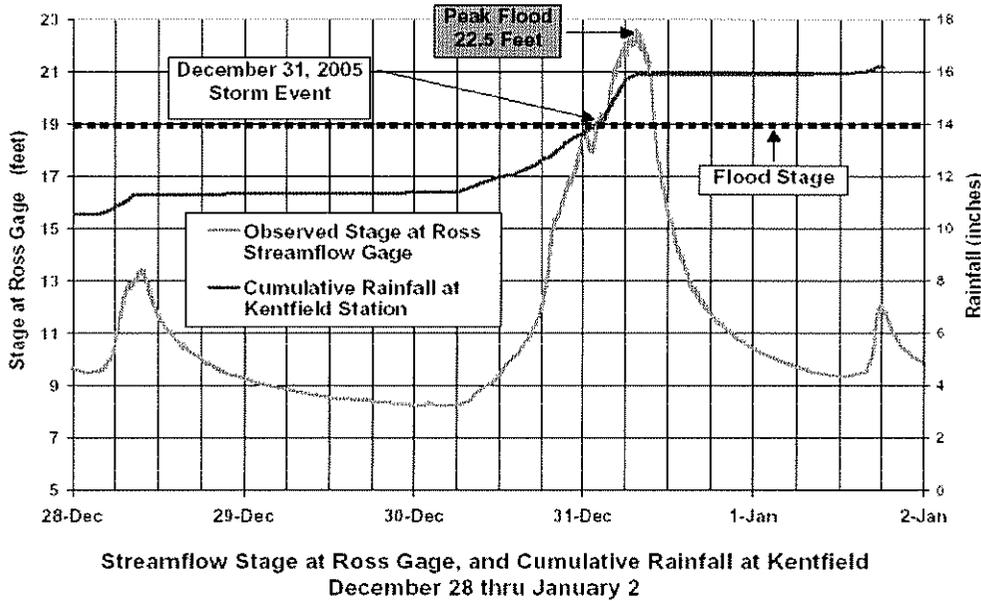
Rainfall in the Marin County Coastal Range area averages from thirty to sixty inches per year, most of which falls during the winter months between November and April. The figure below, developed for the Ross Valley Flood Protection and Watershed Program, indicates the Fairfax area receives between thirty-eight and forty-four inches annually.

**Figure 3-2 Average Annual Rainfall** (Source: Ross Valley Watershed Project )



Records kept by Crocker Citizens National Bank and its predecessors, Bank of Marin and First National Bank of San Rafael, run back to 1875-76. Over a period of about a century, the greatest rainfall was produced during the rainy seasons of 1889-90, 1913-14, 1914-15, 1940-41, 1957-58, and 1966-67. However, in 1969, rainfall totals by the end of February had exceeded any year on record to that time. The 24-hour rainfall total in Fairfax on February 15 that year was recorded at 2.74 inches. In April of 1982, the City of San Rafael in southern Marin County had passed the sixty-inch rainfall mark for only the sixth time in recorded history. Rainfall totals for the December 31, 2005 storms are shown in Figure 3.3 below, which clearly demonstrates the relationship between periods of intensive rainfall and the rapid rise of creek levels to flood stage. Seven inches of rain fell in the Ross Valley Watershed in the two weeks prior to the December 31, 2005 flood.

**Figure 3-3 Rainfall and Creek Level Rise** (Source: Ross Valley Watershed Project)



Several hydrologic and historical descriptions of the flood hazard in Fairfax provide useful information in defining the flood hazard. The hydraulic study prepared by Wallace, McHarg, Roberts and Todd (WMRT) laid the foundation for the Town's first Environmental Safety Element adopted in 1976. It concluded that the primary flood prone areas within Fairfax are limited to the floodplain adjacent to the confluence of San Anselmo and Fairfax Creeks, which has a one percent chance, on average, of being inundated in any given year. The first Flood Insurance Study (FIS) for the Town of Fairfax, issued by the Federal Insurance Administration in March 1977, confirmed and expanded the flood hazard area to include San Anselmo Creek and its tributaries, Deer Park Creek and Wood Lane Drainage, as well as Fairfax Creek and its tributary, Bothin Creek. Stream profiles were prepared, and hydrologic analyses were carried out to establish peak flow discharge-frequency relationships for each stream as shown in Table 3-1 below.

A Preliminary Draft of the *Revised Flood Insurance Study for Marin County, California and its Incorporated Cities* was released by the Federal Emergency Management Agency (FEMA) in September 2007. The main purpose of the updated FIS is to provide the information in a digital format and to convert existing FIS data from the National Geodetic Vertical Datum of 1929 (NGVD29) to the North American Vertical Datum of 1988 (NAVD88). There appear to be no significant differences in the data contained in the existing (1977) and the updated (2007) FIS documents. The FIS identifies the floodplain boundaries for the subject creeks, which in turn establishes flood insurance

requirements and guides local floodplain management policies and programs. According to the FIS:

*“Along Fairfax Creek, the boundaries of the 1- and 0.2-percent annual chance of flooding have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at scales of 1:24,000 and 1:3,600 with a contour interval of 10 feet.*

*San Anselmo Creek produces no flooding in Fairfax; the flows considered in this study are contained within the channel.*

*In Deer Park Creek and Wood Lane Drainage, the flood (sheetflow) boundaries were delineated using information supplied by local residents, available topographic information, and field-surveyed data, including cross sections.*

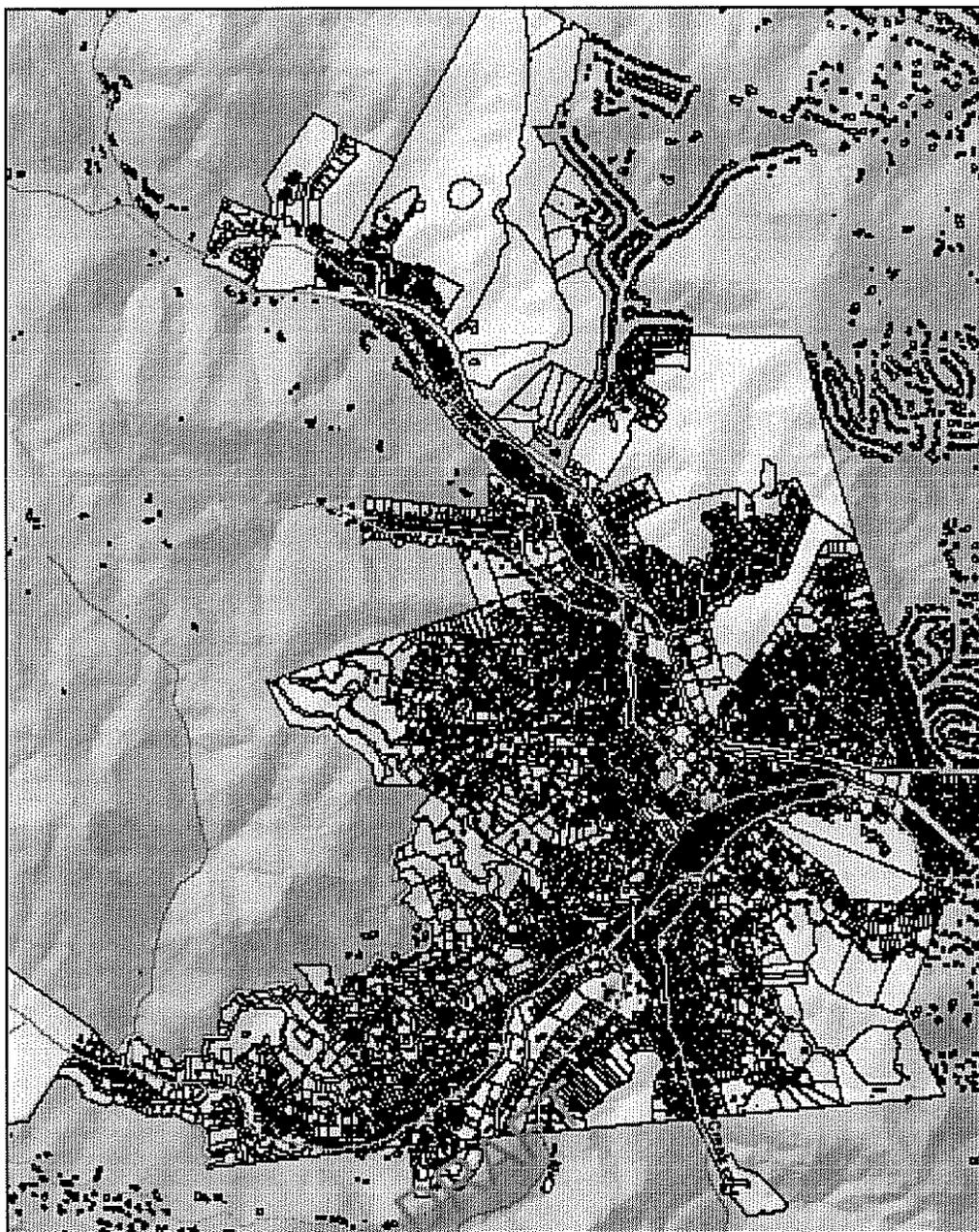
*For Bothin Creek, the estimated boundary of the 1-percent annual chance flood was determined in this study by using estimates of 1-percent annual chance discharges, culvert computations, and available topographic data augmented where necessary with field-survey data. Information provided by local residents was also used. Bothin Creek overflow is initiated outside the corporate limits of Fairfax. Flow is diverted to Bothin Road, Rockridge Road, and finally Fairfax Creek. Field data obtained for flood boundary delineation indicated shallow flow.”*

The peak flow discharge-frequency relationships shown in the table below are calculated based on three factors: observed peak flows (historic); mean annual precipitation; and drainage area/topography. The frequency is expressed as a probability of occurrence. For example, a flood with a projected peak discharge of 3500 cfs at the Mouth of Fairfax Creek has a 1 percent chance on average of occurring each year. A more commonly accepted way of describing that probability has been in terms of how often one would expect to experience that level of flood. In the case of the 1 percent probability, it translates to a 100 year flood. However, using this terminology has led to confusion and misinterpretation, in that the actual occurrence of flooding experienced in the past 100 years has in many cases exceeded the probable events. Therefore, in the updated FIS, FEMA now uses the more accurate designation of percentage rather than year for calculating probability of occurrence. The Flood Insurance Rate Maps (FIRMS) produced by FEMA for purposes of flood insurance, which in the past showed 100 year and 500 year floodplains, now show those areas in terms of the 1 percent and .02 percent floodplains. See Figure 3-4.

**Table 3-1 Creek Drainage Areas (Source: FEMA 1977 FIS)**

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharge (Cubic Feet per Second)			
		10 Percent (10 Year)	2 Percent (50 Year)	1 Percent (100 Year)	0.2 Percent (500 Year)
<i>Fairfax Creek</i>					
Confluence with San Anselmo Creek	4.10	850	1450	1720	2400
Mouth of Bothin Creek	3.40	690	1200	1450	2000
White Hall School (Near Corporate Limits)	1.80	450	770	960	1600
<i>San Anselmo Creek</i>					
Mouth of Fairfax Creek	9.00	1970	3100	3500	4500
Mouth of Deer Park Creek	4.96	1080	1780	2100	3000
Mouth of Wood Lane Drainage	4.19	930	1620	1900	2780
Cross Section P	3.70	800	1420	1590	2350
Corporate Limits	3.10	725	1300	1480	2100

# TOWN OF FAIRFAX FLOODPLAINS



## Fairfax and Local Creeks

-  100 Year Floodplain
-  100 - 500 Year Floodplain
-  Fairfax Town Boundary

SOURCE: Marin County Marin Map GIS Data - 2007

0 445 890 1,780 2,670 3,560 Feet



## Base Map

-  Stream
-  Major Roads

FIGURE 3-4

Existing Flood Control Structures and Drainage Systems:

The 1977 FIS identifies two flood control structures in the Town of Fairfax and notes their inadequacies as follows: “There is a small dam on Fairfax Creek along Olema Drive (upstream from Westbrae Avenue) which acts as a drop structure. Fairfax Creek is diverted to San Anselmo Creek in a 10-foot by 6-foot conduit at Bolinas Avenue. None of these structures, however, provide significant protection from flooding in these areas.”

This information is consistent with information contained in the Storm Drain Study for the Fairfax Area that was prepared in 1966 for the City of Fairfax by the Marin County Flood Control District. That report reviewed several existing drainage structures on Fairfax and San Anselmo Creeks and made recommendations to 1) enlarge the undersized culvert on Fairfax Creek and under Sherman Avenue; 2) supplement the inadequate culvert facilities on Bothin and Deer Park Creeks, over which structures and roadways have been built, with pipe located in the road right of way; and, 3) institute a creek cleaning program for all major waterways in the Fairfax Watershed.

The Fairfax culvert was also studied in July 2002 as part of the Catalog of Marin County Stream Crossings, which stated for the culvert at Bolinas Avenue-Sherman Avenue: “A retrofit is probably not feasible because the box culvert is undersized and currently the inlet overtops on less than a 10-year storm flow.” A further study conducted in 2003 by Ross Taylor and Associates entitled “Marin County Fish Passage Evaluation” called out the culvert as a RED filter culvert, which means it does not meet the criteria for passage of all species and life stages of salmon as defined by the California Department of Fish and Game. The report also concluded that the culvert could not be retrofit to meet the fish passage criteria.

A hydraulic analysis conducted as part of the Ross Valley Flood Protection and Watershed Program by Stetson Engineers, and based on the December 31, 2005 flood flows, indicates that flood was a 100-year storm event, with a flow of 1700 cubic feet per second. The study also concluded that much of the Ross Valley storm drainage system currently provides only about 5-year flood protection, meaning that it can be overwhelmed by a storm that has a 20% chance of occurring in any year.

The hydraulic model simulated rainfall, how storm water flows through creeks, and where and how much water will break creek banks and flood. Although the hydraulic model did not include the portion of San Anselmo Creek and its tributaries that flow through the Town of Fairfax, those streams were modeled using existing information from the FIS cited above. The study resulted in a series of proposed flood protection solutions based on the following conclusions: 1) removing constrictions that block creeks could quadruple flood protection—and contain floods during 20-25 year storms, and 2) adding detention basins upstream to hold water and release it slowly, could provide 100-year flood protection.

Ranking high on the priority list of infrastructure-related solutions is enlarging/replacing the Downtown Fairfax Culvert. This project, combined with construction of two detention basins upstream would provide 100-year flood protection to the Town of Fairfax. See Figures 3-5 through 3-8 below.

**Figure 3-5 Fairfax Creek Simulated Flood Flow and Reported Damage Sites**

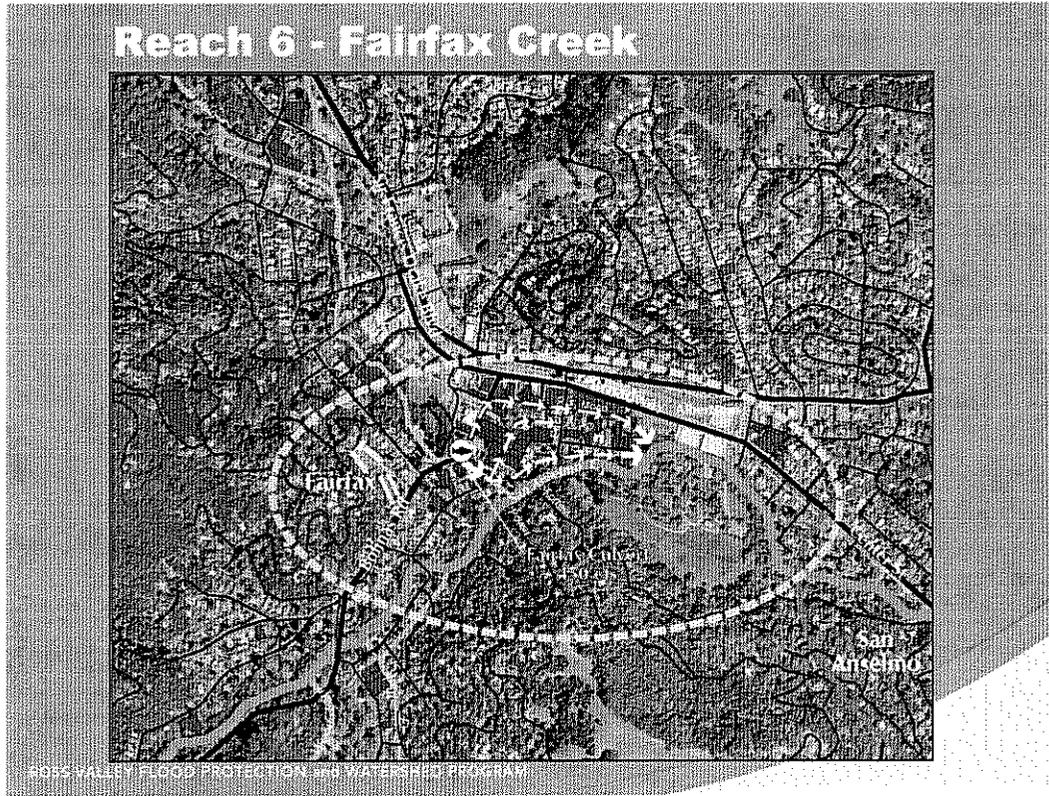


Figure 3-6 Fairfax Creek Culvert Under Sherman Avenue

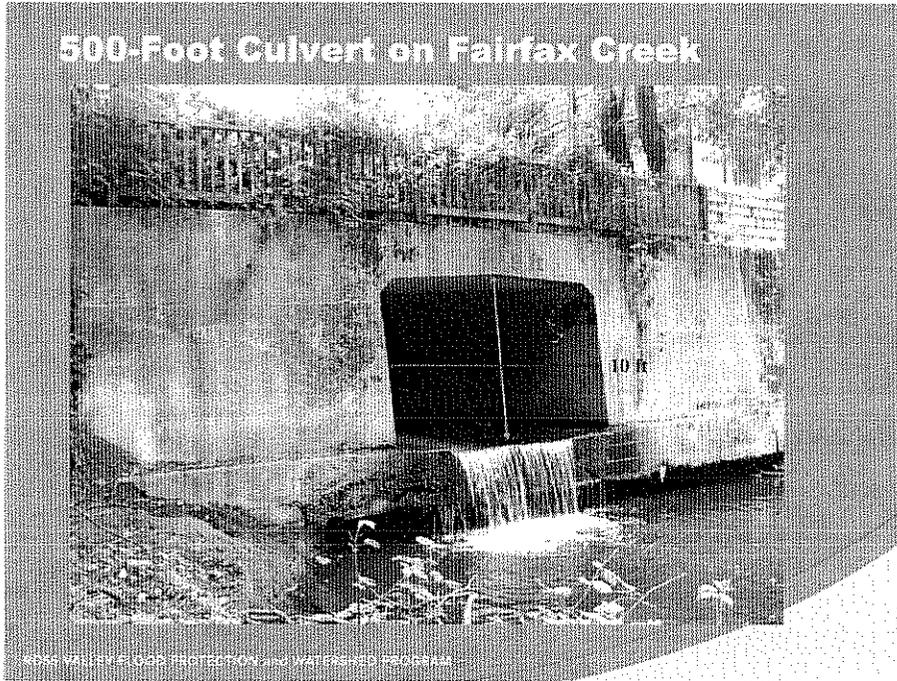
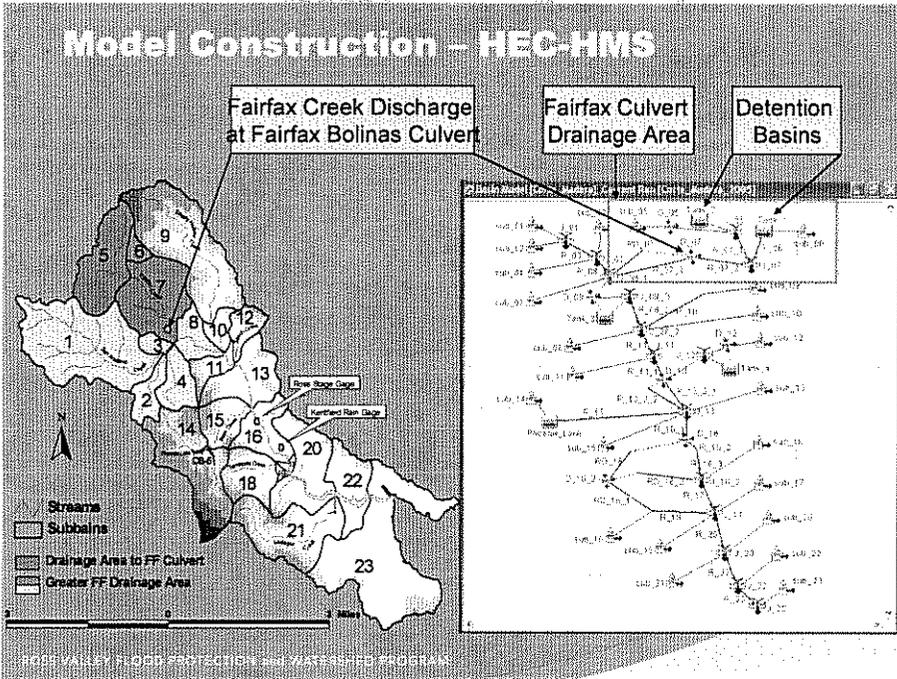
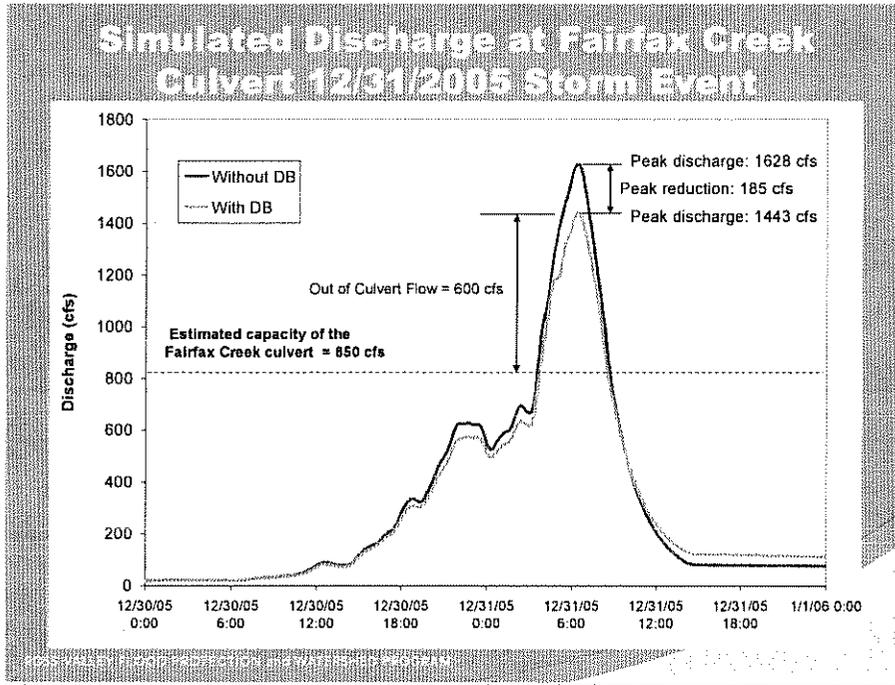


Figure 3-7 Fairfax Creek Hydraulic Model Results



**Figure 3-8 Simulated Peak Flow Reduction with Detention Basins**



A recent and comprehensive analysis and documentation of drainage culverts and natural channels was conducted by Fluvial Geomorphology Consulting (FGC) in July 2006. The main purpose of the study was to evaluate the potential of biotechnical bank stabilization and riparian and aquatic habitat protection and enhancement as part of necessary repair work at six project sites that experienced damage due to flooding on December 31, 2005. However, as part of the study, FGC also conducted the following activities:

- field measured the high water marks to estimate flood depth at each site and approximate flood return intervals;
- identified potential flood flow conveyance constrictions at existing culverts and within natural channel sections;
- inventoried potential flood management improvement projects in Fairfax.

The resulting report, *Geomorphic Assessment of Town of Fairfax Project Sites* identifies nearly 100 storm drains, their locations, design and structural condition, and provides preliminary recommendations for approximately 200 flood management improvement projects.

In reviewing the possible benefits of the recommended flood management improvement projects, it was determined that there was a symbiotic relationship between flood management and habitat restoration. Many proposed culvert improvements, streambank erosion control, and stream channel capacity solutions for flood management may also result in improvements to fish habitat and fish passage.

### **3.2 Flood History**

Historic records of flood and resultant damage are scarce, however the 1977 FIS cites that major floods occurred in Marin County in 1952, 1955, 1958, 1967, 1969, 1970, 1973, and 1975, with the storm of December 1955 generally considered to be largest of this period. However, while most streams studied have short or nonexistent gage records, it is unlikely that any storm in this period produced peak stream discharges greater than a 20- to-25 year event on the basins studied. (FIS 2007). The 1977 FIS cites information supplied by local residents of flooding occurring in the lower reaches of Fairfax Creek, Deer Park Creek, Bothin Creek and Wood Lane Drainage during major storm events. The U.S. Army Corps of Engineers estimates that major damage occurred in Fairfax during the 1942 and 1955 floods.

Other reports indicate that the 1982 flood may have been the largest on record, but agree that the 1955 and 1964 floods may have equaled or exceeded the 1982 flood levels. Newspaper reports identify each of these events as 100 year floods, along with the most recent flood of December 31, 2005. Based on this minimal record, it appears that Fairfax experiences a 100 year flood every ten or twenty years.

Lack of stream gages and written historic records has resulted in many inconsistencies and potential inaccuracies in information describing the severity of past flooding events and specific local impacts. Table 3-2 below summarizes available information of past flood event loss estimates culled from Marin County and Town of Fairfax documents as well as newspaper articles.

**Table 3-2 Estimated Losses for Past Flood Events**

<b>Date</b>	<b>Damage Description</b>	<b>Loss Estimate</b>
1/69	Marin County Wide: Public Property-Road Damage Private Property	\$ 411,000 \$ 400,000
1/82	Marin County Wide Total Damage County Roads and County Owned Property Staff Time and Emergency Repairs Town of Fairfax: Town Hall Private Sector (Homes/Apartments/Businesses)	\$150,000,000 \$ 25,000,000 \$ 750,000 \$ 30,000 \$ 1,800,000
2/86	Marin County Wide Total Damage Town of Fairfax: Road Repairs Clean-up Private Property-13 Homes Damaged	\$ 13,000,000 \$ 1,200,000 \$ 350,000 \$ 300,000 \$ 550,000
2/87	Marin County Wide Total Damage	\$ 12,153,200
12/31/05	Marin County Wide: Public Sector-Incorporated Areas & Special Districts Public Sector-Unincorporated Areas Private Sector-Incorporated Areas Private Sector-Unincorporated Areas Town of Fairfax: Town Facilities	\$ 15,291,500 \$ 16,355,000 \$ 54,595,380 \$ 8,595,000 \$ 1,400,000

**3.3 Vulnerability Assessment and Loss Estimates**

Critical to understanding the flood risk and determining cost effective risk reduction measures is identifying and quantifying community assets that are exposed to the flood hazard. This section examines the exposure of public and private sector assets, generally by identifying which of those assets are within the 100-year (1%) floodplain as defined by the FEMA Special Flood Hazard Areas (SFHA). Floods are often accompanied by landslide and debris flows, which can cause significant damage in areas that are located away from floodplains. While this hazard is related to flood risk, it is not directly addressed in this plan.

### Town Owned/Critical Facilities

Several important Town buildings and facilities are located in the Special Flood Hazard Area (1%/100-year floodplain), including the Town Hall, Police Station, and Fire Station. These facilities have suffered damage in past flood events, including the December 31, 2005 flood which resulted not only in significant repair costs, but also extended dislocation and the need for temporary relocation facilities. Location of these critical facilities in relation to the Special Flood Hazard Area is shown in Figure 3-9 below.

### Roads

Approximately five linear miles of roadways are within the SFHA.

### Commercial and Residential Properties

Commercial and residential properties exposed to the flood hazard were identified by overlaying County Assessor parcel files and the Town zoning map with the Special Flood Hazard Area map, and using current assessed value as the total dollar exposure. However, it should be noted that assessed value does not reflect either current market value or current replacement cost of structures or content.

Based on the above methodology, there are 54 commercial parcels with an assessed value of more than \$20 million located in the SFHA, with approximately 78,000 square feet of commercial space.

Using the same methodology of overlaying the Zoning map with the SFHA map, there are approximately 375 single family residential parcels exposed to the flood hazard, with an additional 20 vacant parcels available for development. Using the current median home value of approximately \$700,000 for a single family residence, the total possible exposure, assuming total loss would be in excess of \$250 million. The methodology also identified 88 parcels zoned for multifamily residential, with 9 vacant parcels available for development.

### Repetitive Loss Structures

Repetitive Loss Structures as defined by the Federal Emergency Agency's National Flood Insurance Program (NFIP) are residential buildings that have experienced one or more of the following since 1978, regardless of any changes in ownership during that period:

- Four or more paid flood losses of more than \$1,000 each
- Two paid flood losses within a 10-year period that, in the aggregate, equal or exceed the current value of the insured property
- Three or more paid losses that, in the aggregate, equal or exceed the current value of the insured property

Repetitive loss properties account for twenty-five to thirty percent of all claims paid by the NFIP, although they comprise only about one percent of insured properties. As of August 31, 2007, the Town of Fairfax has six repetitive loss properties with an assessed value of \$1.2 million. At that time there were 107 properties insured under the NFIP in Fairfax, putting it slightly below the national repetitive loss average.

Total insured losses to those six properties totals nearly \$550,000. Left unmitigated either by individual action, such as home elevation, or through community-wide flood control measures, such as enlarging the Sherman Street culvert, these properties will likely incur a similar level of damage in future flood events.

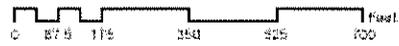
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# TOWN OF FAIRFAX FAIRFAX CRITICAL FACILITIES



- 100 Year Floodplain
- 100 - 500 Year Floodplain
- Fairfax Critical Facilities

SOURCE: MARIN COUNTY MARIN MAP GIS - 2007



### Base Map

- Major Roads
- Streets

FIGURE 3-9