# 3.0 FLOOD HISTORY AND PREVIOUS STUDIES

## 3.1 FLOOD HISTORY IN HUNTINGTON

Flooding has been a concern in Huntington for decades. As early as 1966, the Fairfax County Board of Supervisors adopted an ordinance for a regulated 100-year floodplain for Cameron Run. Previous studies and historical information confirm that the most significant type of flood event that would affect Huntington is riverine flooding from Cameron Run. Although the area is susceptible to storm surges from the Potomac River resulting from tropical systems, such as Hurricane Isabel in 2003, flood levels tend to reach higher elevations during riverine events. However, there were some complaints of houses flooding during Hurricane Isabel, however, the number is unknown. During Hurricane Isabel, 2 to 3 inches of rainfall fell in the area, and riverine flows along Cameron Run were minimal. In contrast, past riverine events along Cameron Run have produced much higher flood levels in Huntington.

The majority of the residential structures in Huntington were built in the late 1940s and early 1950's. Since that time, and prior to the June 2006 flood event, there have been two significant storm events that have created the potential for riverine flooding in Huntington: Tropical Storms (or remnants thereof) Agnes (1972) and Eloise (1975).

***Tropical Storm Agnes***

For many years, Tropical Storm Agnes has been the storm of record in the Cameron Run watershed, as well as other watersheds in the mid-Atlantic and Northeast regions of the United States. Tropical Storm Agnes occurred between June 20 and June 25, 1972. Flood damages were recorded throughout the central part of Virginia, but were particularly heavy in the northern part, where Fairfax County reported damages estimated at $25 million (1972 dollars). In the Four Mile Run watershed, damage was estimated at $14 million (USGS, 1975); however, no exact record of the amount of damages in the Cameron Run watershed could be found.

A rainfall gage at Washington National Airport recorded a total of 8.24 inches of rainfall over that 5-day period, with the heaviest rainfall occurring between June 21 and June 22, 1972. During that period, rainfall intensities of just over 1 inch per hour were recorded. This rainfall created a record flow of 19,900 cubic feet per second (cfs) at a USGS stream flow gage (01653000) along Cameron Run (see Figure 1.1).

This flow created flooding in Huntington, but the extent and cause is not well documented. No records of homes damaged during this event are on record with Fairfax County, FEMA, USACE, or any other entity. In a letter from a homeowner to the Fairfax County government, it is stated that "*Every home in the immediate neighborhood was flooded. Yards and streets were flooded and some homes received structural damage to their basements. One thing that did not become apparent until after the storm was the fact that not one of the homes was flooded by surface water. All flooding incidents were caused by either raw sewage backing into the basements or structural damage caused by severe water pressure upon the basements.*"

It is evident that Tropical Storm Agnes caused damages to Huntington, but the extent of flooding via overland flood flow is not apparent. It appears that the flood levels during Tropical Storm Agnes were lower than the June 2006 flood levels; however, peak flows of 19,900 cfs were recorded at the USGS stream flow gage during Tropical Storm Agnes, and the June 2006 flood event produced peak flows of 16,500 cfs at the same gage.

***Tropical Storm Eloise***

Rainfall associated with Tropical Storm Eloise occurred in the mid-Atlantic region between September 23 and September 27, 1975. The most significant damages as a result of Tropical Storm Eloise occurred on the tributaries to the Potomac River in and around Washington, D.C. (USACE, 1975), where nearly 400 people were evacuated along Four Mile Run. Rainfall totals of between 8 and 9 inches fell near the Cameron Run watershed. The USGS stream flow gage along Cameron Run recorded a peak flow of 14,400 cfs during the event, the third largest to date behind Tropical Storm Agnes (19,900 cfs) and the June 2006 flood event (16,500 cfs).

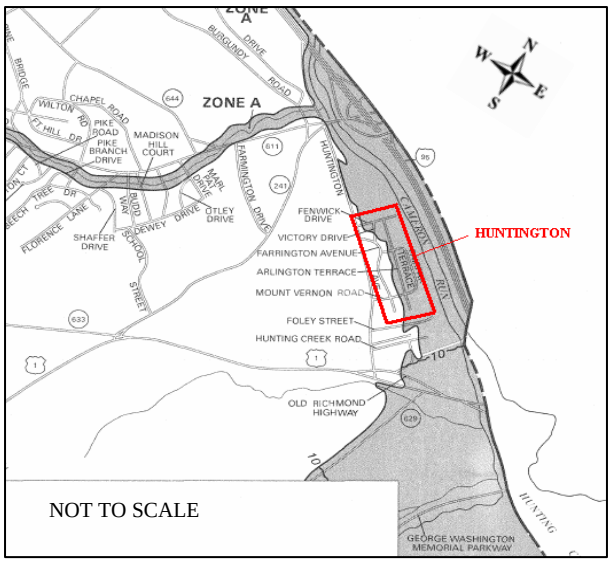
As with Tropical Storm Agnes, there is a lack of documentation of the extent of flooding in Huntington. Internal Fairfax County memos indicate that the County as a whole was hit hard by Tropical Storm Eloise, including: damage along Pike Branch; sanitary sewer line problems near Telegraph Road; outfall issues resulting in the flooding of five homes near Kathmoor Street; and storm sewer issues that resulted in homes flooding along Thornwood Drive.

Articles in local newspapers and letters from homeowners to the County verify that flooding was an issue in Huntington during Tropical Storm Eloise, especially in basements, although interviews with residents of Huntington did not confirm this. However, as with Tropical Storm Agnes, it is not apparent that the flooding of these homes was directly from overland flow from Cameron Run, or if it may have been from backed up sanitary sewer lines.

## 3.2 PREVIOUS STUDIES

Traditionally, the primary source for floodplain information is FEMA. FEMA publishes FIRMs and Flood Insurance Studies (FIS) that are used by local entities for floodplain management purposes. The floodplains for Cameron Run in Fairfax County are delineated as Zone A. Zone A means no detailed hydrologic and hydraulic analyses have been completed, so no exact 100-year floodplain elevations are shown for Huntington on the FEMA Fairfax County maps and study, which are dated March 5, 1990 (Figure 3.1). However, Zone A does mean that the area is in the 100-year floodplain. FEMA and Fairfax County are currently working to digitize the FIRMs and revise the FIS for Fairfax County. As part of this process, the County is in discussions with FEMA to correct the FIRMs where known inaccuracies exist.

**Figure 3.1. Effective FEMA FIRM for Fairfax County, Virginia (dated March 5, 1990)**

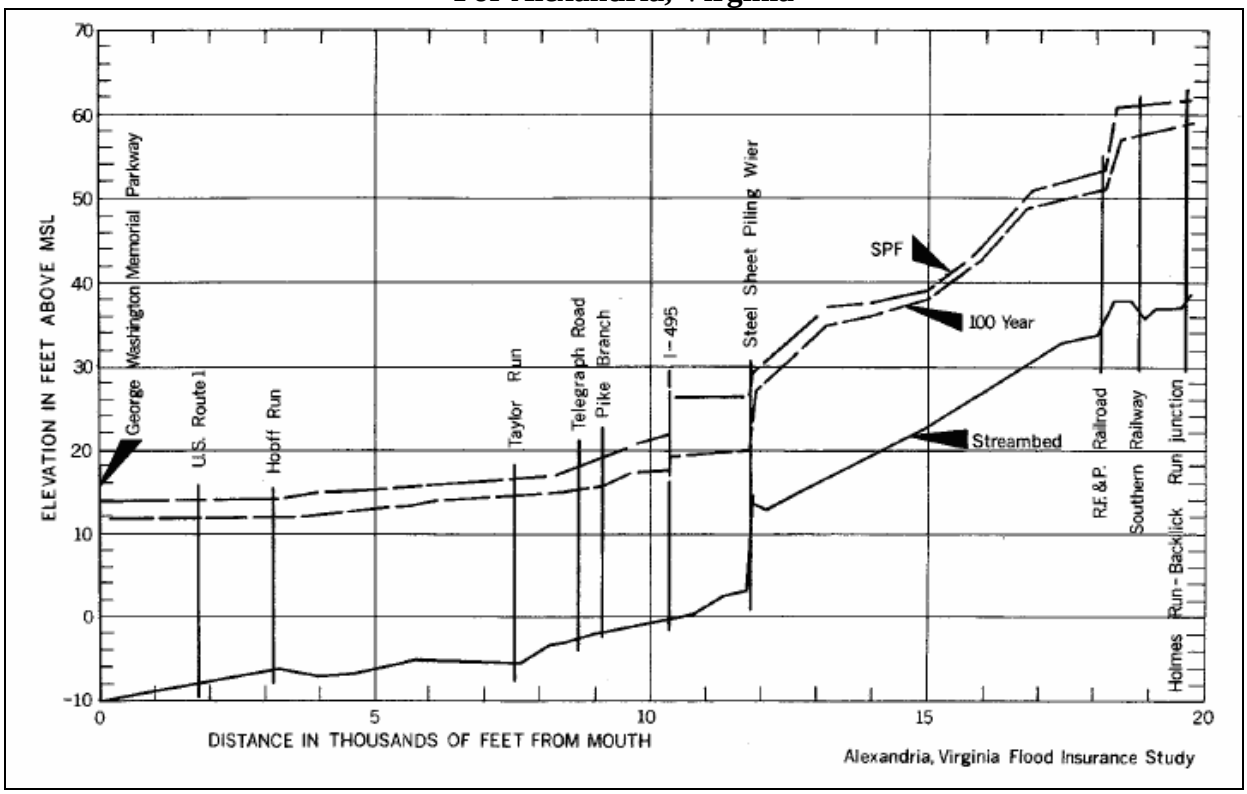


The flooding in Huntington from Cameron Run has, however, been studied in the past. The earliest documented investigation was dated December 1970, with the most recent being in February 2002. A summary of previous investigations along Cameron Run that directly impact Huntington are listed below. There have been other studies related to flooding within the Cameron Run watershed; however, the results of those investigations do not directly impact Huntington.

***December 1970: Alexandria, Virginia, Flood Insurance Study, completed by the U.S. Army Corps of Engineers, Baltimore District***

The purpose of this investigation was to analyze the flood potential and the damages related thereto in the City of Alexandria, Virginia. The study involved hydrologic and hydraulic studies to create elevation-frequency curves and tables, flood profiles, and floodplain maps along Cameron Run to assist in establishing flood insurance rates within the City of Alexandria. The Immediate Regional Flood elevations, which are equivalent to the 100-year flood elevations, ranged from 12.0 feet mean sea level (msl) at the confluence of Hoofs Run (just downstream of the downstream end of Huntington) to 15.0 feet msl at Telegraph Road (upstream of Huntington) as shown in Figure 3.2. It is assumed, due to the date of this study, that msl is equal to NGVD29.

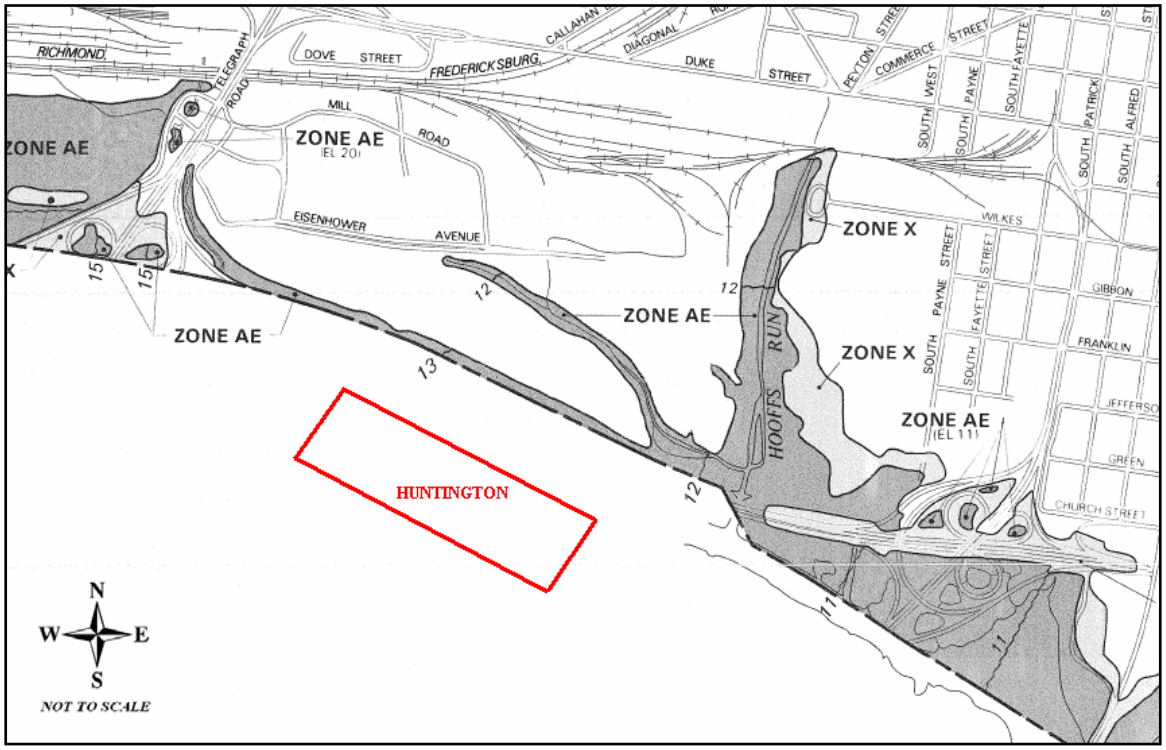
**Figure 3.2. Flood Profile from December 1970 Flood Insurance Study For Alexandria, Virginia**




No modeling is available from the December 1970 study. It is assumed that the results of this study were used to create the effective flood insurance rate maps for the City of Alexandria, dated May 15, 1991 (Figure 3.3). No FEMA flood insurance study is published for Alexandria;

however, floodplain elevations and flood limits on the FIRM are consistent with the results of this Corps study. Note that the FIRM maps for the City of Alexandria are currently being revised to reflect better topographic data provided by the City.

**Figure 3.3. Effective FEMA FIRM for Alexandria, Virginia (dated May 15, 1991)**




***March 1971: Cameron Run, City of Alexandria and Fairfax County, Virginia, Review Report on Flood Control, completed by the U.S. Army Corps of Engineers, Baltimore District***

The purpose of this report was to determine the feasibility of providing a project for flood damage reduction along streams that flow through the City of Alexandria, Virginia, with particular reference to Cameron Run and its tributaries. The tasks for this study included: soil surveys; elevation surveys; damage surveys to determine the extent and magnitude of damages caused by flooding; real estate investigations; economic evaluation; hydraulic studies; and analysis of flood protection measures to alleviate flood damages.

Huntington is located in Reach CA-1 in this investigation. The flood of record prior to this investigation was flash flooding that occurred September 14, 1966, which caused a peak flow of 9,300 cfs at the USGS stream gage. Based upon calculations in the investigation, only five residential structures and one commercial structure in Huntington would have been inundated by this 1966 flood, causing minimal damages. The result of this study was the recommendation of a Federal flood damage reduction project along Cameron Run to address flooding issues. However, no flood improvements were made in the Huntington area. In a USACE memo dated September 1977, Survey Report, Potomac River Streams Draining Alexandria Area, Virginia, the reason is explained:

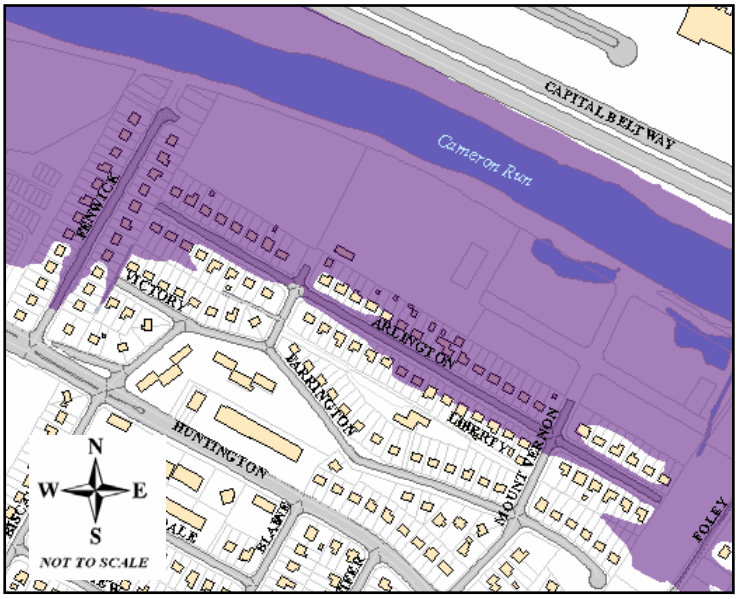
*"A report on Cameron Run was prepared… which represents a positive recommendation for a Federal flood control project along Cameron, Holmes, and Backlick Runs. Because of the inability to obtain required assurances of local cooperation, the report was not processed further. In 1969, Cameron Run formed part of the boundary between Fairfax County and the City of Alexandria; thus, both jurisdictions were required to provide the local assurances. However, nearly all of the benefits of the proposed project would accrue to the City of Alexandria and, for this reason, Fairfax County would not provide their assurances. In order to overcome this problem, a land transfer was agreed to by the local jurisdictions and became effective 1 January 1973. This land transfer and boundary change placed the entire project area within the City of Alexandria limits."*

Subsequently, to expedite the construction of the project, the City of Alexandria decided to implement the plan of protection recommended in this report at their own initiative and cost. The recommended plan was to channelize a portion of Cameron Run. Thus, Cameron Run is now channelized upstream of the Capital Beltway; however, it is not a Federal project.

### *1976: Flood-Plain Delineation for the Cameron Run Basin, Fairfax County-Alexandria City, Virginia, Open File Report 76-443, completed by USGS*

The results of this investigation are currently being used by Fairfax County for the management of floodplains along Cameron Run. Floodplain mapping produced in this investigation were adopted by the County Commissioners and are still used today for floodplain information (Figure 3.4). The purpose of this investigation was to establish floodplain mapping for Cameron Run and its tributaries. It is noted, however, that although this study is dated 1976, the report documents that the field survey in the basin was done in 1961, with supplemental surveys made in 1965. The 100-year peak flows, using the Anderson method for ultimate built-out conditions, were estimated at 21,800 cfs for the Huntington area. The 100-year flood elevations ranged from 10.3 feet (NGVD29 datum) just upstream of U.S. Route 1, to 13.2 feet just downstream of Telegraph Road.

**Figure 3.4. 100-year Floodplain Limits for Huntington from 1976 USGS Study**



***April 1977: Huntington Drainage Study (Huntington Conservation District), completed by William H. Gordon Associates***

The purpose of this study was to develop an updated storm drainage master plan for the Huntington area based upon current design standards and criteria. Although this study dealt more with stormwater infrastructure rather than riverine flooding, the report contains useful information on the history of flooding in Huntington. The report notes that "The houses along Arlington Terrace and closest to Cameron Run have evidently never experienced flooding due to an overflow of the creek's banks. Any flooding of the dwellings has occurred as a direct result of the storm sewer backup or the sanitary sewer backup." Recommendations as a result of this investigation included improving the storm sewer infrastructure and installing subsurface interceptors, among others. It is unknown if any of the recommended improvements were implemented.

***December 1977: Proposed Drainage Plan, Cameron Run Watershed, Task Order 3.2 Immediate Action Plan, completed by Parsons, Brinckerhoff, Quade and Douglas***

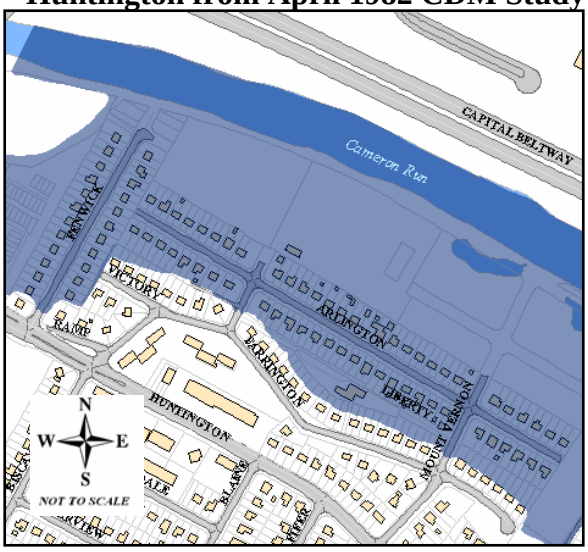
The purpose of the Immediate Action Plan (IAP) was to recommend projects to enable the drainageways in the Cameron Run Watershed to safely carry stormwater to the Potomac River with minimal disruption to areas adjacent to the streams. A total of 40 projects were recommended throughout the watershed. The study recommended the construction of an earth berm along Cameron Run to alleviate the flooding of homes and structures along Fenwick Drive and Arlington Terrace in the Huntington community. The Huntington portion of the study was never implemented.

***April 1982: Arlington Terrace Storm Drainage Study, Fairfax County, Virginia, completed by Camp Dresser & McKee (CDM)***

The purpose of this study was to perform a comprehensive flood drainage feasibility study for the Huntington community. It includes a detailed definition of the flooding problem in the Huntington community caused by Cameron Run flood flows and Potomac River high tides, and the development of alternate flood control solutions with cost estimates to resolve the flooding problems in the Huntington area. Initial analysis during the investigation concluded that although tidal surge was a flood risk in Huntington, the type of flooding that would cause the most significant damage was riverine flooding from the Cameron Run watershed.

The hydrology for the project was completed using the MIT Catchment Computer Model (MITCAT) and "other well-supported methodology," with peak flows for a 100-year flood event estimated to be 37,785 cfs. The hydraulic analysis was completed using the USACE HEC-2 program, with the following computed flood elevations for the Huntington community: 10-year flood elevation of 8.63 feet; 25-year elevation of 10.38 feet; 50-year elevation of 11.86 feet; and 100-year elevation of 14.34 feet (all elevations are NGVD29 datum). The study concluded that a 100-year flood event at elevation 14.34 feet would inundate approximately 167 homes in Huntington (Figure 3.5).

**Figure 3.5. 100-year Floodplain Limits for Huntington from April 1982 CDM Study**




The 1982 CDM study provides a great deal of flood information for Huntington, and outlined potential flood damage reduction measures such as channelization, levees, floodwalls, floodproofing, dredging, and constriction relief. The following is a list of the recommendations made in this investigation:

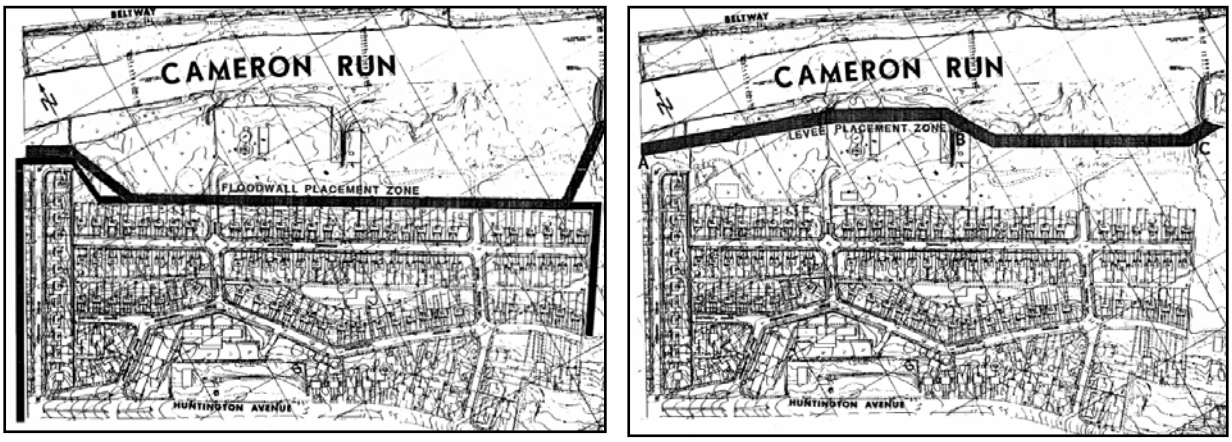
- No protection is required for a 10-year flood, and a levee would provide complete protection from a 25-year event at a lower cost than other alternatives.

- For a 50-year flood, a levee provides complete protection at a lower cost than other alternatives.

- A floodwall is the only single flood control measure that performs satisfactorily during a 100-year flood, at a 1982 cost of $3,537,000. However, other viable options would be a floodwall and dredging the reach to a width of 100 feet, at a 1982 cost of $3,987,000, and a levee plus dredging to a 200 foot width, at a 1982 cost of $3,206,000 (Figure 3.6).

- Under any plans a channel maintanence program must be established to clear sediment from Cameron Run.

**Figure 3.6. Potential Floodwall and Levee Placement Zones from April 1982 CDM Study**




Although options for flood damage mitigation were presented in this report, none were implemented. The reason they were not implemented is uncertain. Regardless of the baseline analysis and calculated flows, the types of alternatives recommended in this report may be viable and should be evaluated in further detail.

***February 2002: Hydrologic and Hydraulic Analysis of Cameron Run, completed by Potomac River Consultants (PCC) for Virginia Department of Transportation***

The purpose of this study was to examine the impact that the proposed improvements associated with the Woodrow Wilson Bridge replacement project would have on the existing flood stages and profiles, and to provide necessary hydraulic data for scour computations at proposed bridges and crossings. The study was a compilation of results presented in the following reports: *I-95/Route 1 Interchange Improvement Project, Cameron Run Hydraulic Study Report*, prepared by HNTB in November 2001; and *Interstate 95/495/Telegraph Road Interchange, County of Fairfax/City of Alexandria, Project #0095-96A-105, Hydrologic and Hydraulic Analysis of Cameron Run*, prepared by Dewberry & Davis, LLC, in December 2001.

The report outlines results of a one-dimensional HEC-RAS hydraulic model that starts at the confluence of Cameron Run at the Potomac River and extends upstream to approximately 400 feet west of the Capital Beltway bridge over Cameron Run. All field-surveyed cross-sections for the study were completed in 1999.

The study completed two separate HEC-RAS models. The existing-conditions model reflects the conditions of Cameron Run in 1999, before any improvements to U.S. Route 1, Telegraph Road, or the Woodrow Wilson Bridge were made (Figure 3.7). The proposed-conditions model reflects the conditions of Cameron Run once the entire project is completed.

The hydrology for this study was based on the Anderson method, per FEMA guidance. The Anderson method computed a 100-year peak flow of 25,525 cfs at the U.S. Route 1 Interchange; 23,845 cfs at Telegraph Road; and 22,625 cfs at the Capital Beltway bridge. The hydraulic model was developed using HEC-RAS version 2.2, and the results were verified by other agencies using two-dimensional and three-dimensional modeling.

**Figure 3.7. Existing-Conditions 100-year Floodplain Limits for Huntington from 2002 VDOT Study**

The results of the modeling showed 100-year flood elevations ranging from 10.8 feet (NGVD29) just upstream of U.S. Route 1 to 18.4 feet just downstream of Telegraph Road; however, the results for Huntington in this study showed much higher 100-year elevations for Huntington than the 1976 USGS investigation. The 1976 USGS investigation computed 100-year flood elevations ranging from 10.8 feet (NGVD29) at the downstream end to 11.7 feet at the upstream end. The VDOT existing-conditions model computed 100-year flood elevations of 13.7 feet at the downstream end to 14.6 feet at the upstream end. This is an increase of nearly 3 feet. It is noted that the USGS investigation used a 100-year peak discharge of 21,800 cfs, where the VDOT study used a peak discharge of 23,845 cfs.

Based upon the proposed design and construction, the maximum increase in the 100-year flood elevation as a result of the construction of the new U.S. Route 1 bridges is 0.8 feet approximately 300 feet west of the confluence of Hoofs Run. On average, the project will increase flood elevations by roughly 0.5 feet throughout this reach of Cameron Run and within Huntington. VDOT will re-analyze the impacts of the project when construction is complete to account for any design changes during construction.

The February 2002 study and associated modeling are considered the best available data that represents existing-conditions for Cameron Run (pre-Woodrow Wilson Bridge activity). Copies of this report and modeling were not sent to Fairfax County. However, through written correspondence, it is evident that VDOT initiated tremendous coordination efforts with the Federal Highway Administration (FHWA), FEMA, and the City of Alexandria through the process. VDOT submitted their final model results to FEMA in December 2001. USACE and USGS were also contacted throughout the process for data coordination efforts.

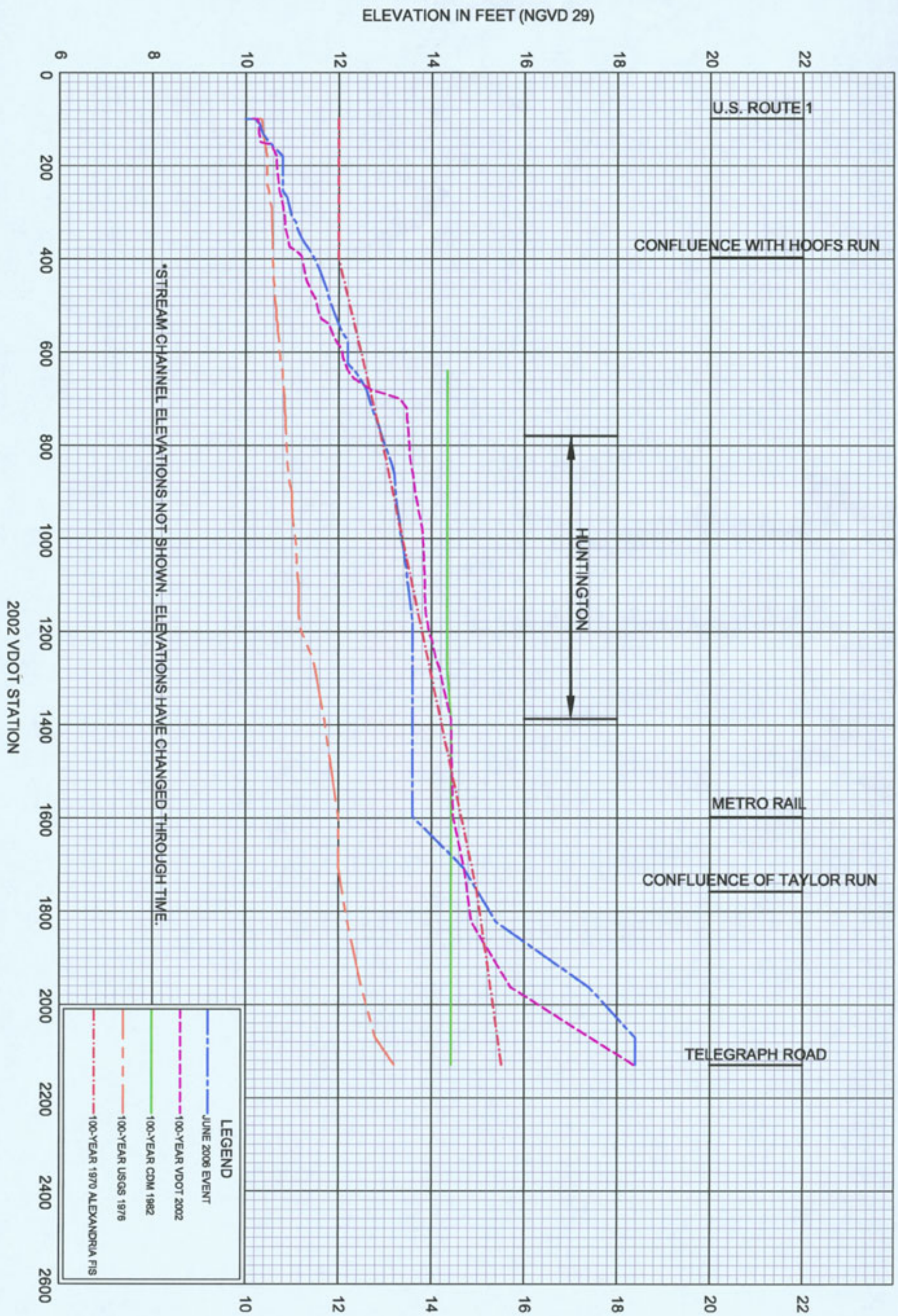
***September 2006: Woodrow Wilson Bridge Project Report on Impacts on Cameron Run Flood Event of June 25, 2006, prepared by Potomac Crossing Consultants (PCC) for Virginia Department of Transportation***

Concurrent with this investigation, the PCC conducted an examination of the severe flooding experienced June 25, 2006 in the Huntington/Arlington Terrace area of Fairfax County. The purpose of the report was to investigate the possibility that the construction activities associated with the Woodrow Wilson Bridge (WWB) Project caused the flooding conditions on June 25 and 26, 2006 in the Huntington area. The study determined that the total impact of the WWB construction attributed to a 5 to 10 inch increase in peak flow elevation in Huntington.

## 3.3 COMPARISON OF PREVIOUS STUDIES

Based upon the amount of previous hydrologic and hydraulic investigations along Cameron Run, flooding was an issue in the past and continues to be an issue today. There have been various peak flow calculations completed by various entities throughout the years, using a variety of techniques, and these results have been compared and disputed in past investigations. What is evident from compiling and comparing these previous studies is that calculated floodplain elevations, using hydraulic calculations and modeling, have increased over time and the floodplain limits have expanded in Huntington.

Figure 3.8 shows a comparison of floodplain profiles for the studies listed in this section. Figure 3.9 shows the difference in delineated 100-year floodplain limits for the various investigations.




U.S. ARMY CORPS OF ENGINEERS

BALTIMORE DISTRICT

FIGURE 3.8

CAMERON RUN

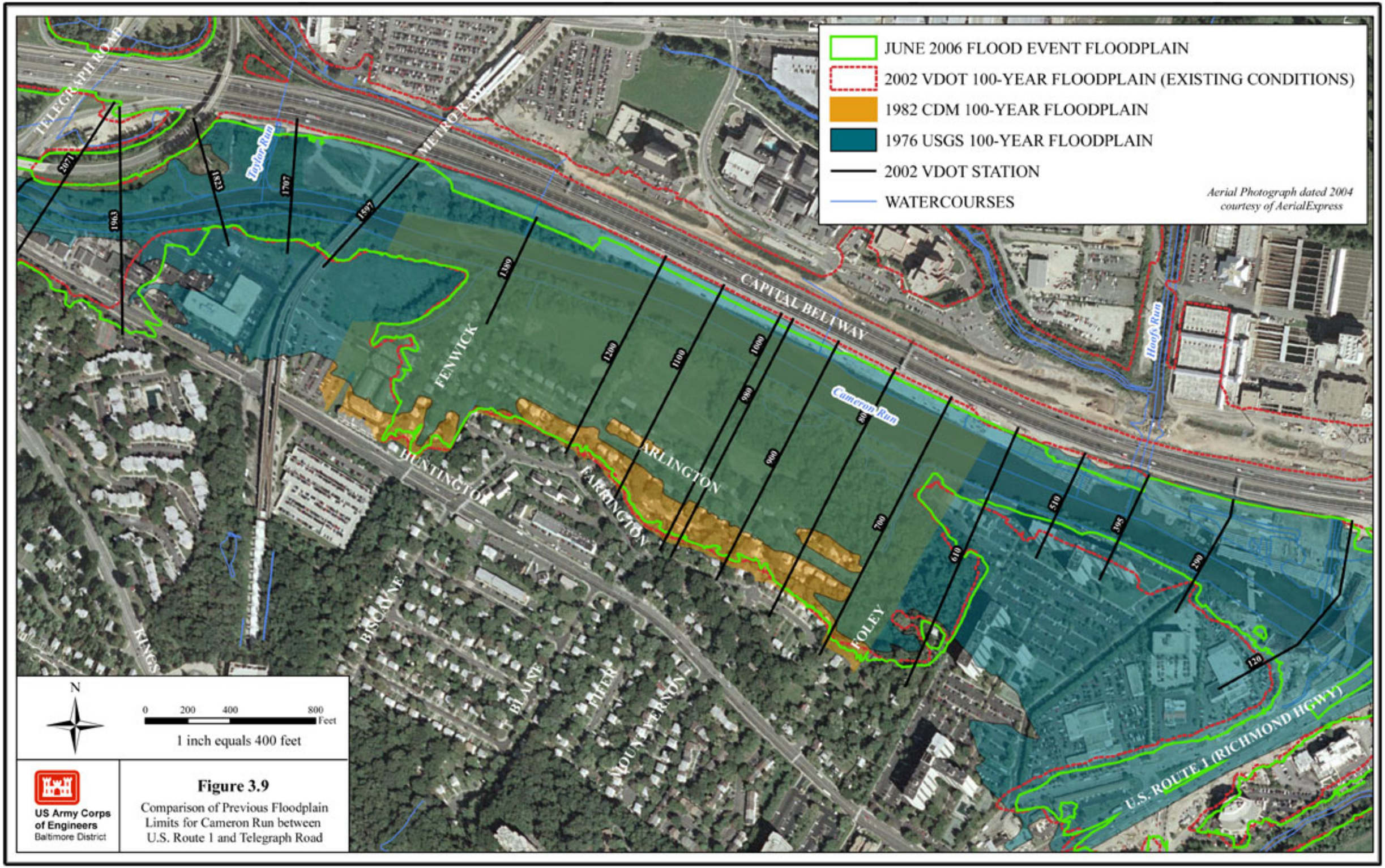



**Figure 3.9**

Comparison of Previous Floodplain Limits for Cameron Run between U.S. Route 1 and Telegraph Road