This chapter presents an introduction to this study and identifies the purpose and goals of this study in the following sections:

- Introduction
- Purpose and Goals

## 1.1 INTRODUCTION

Eight people have drowned in the Walnut Creek Flood Control Channel System (WCFCCS), which includes Drop Structure 2 (shown in Figure 1-1) since the WCFCCS was constructed in the 1960s. Additionally, one fire fighter was injured while rescuing a victim from the channel.

Figure 1-1. Drop Structure 2 at a Relatively Low Flow

At Drop Structure 2, just downstream of Bancroft Road, the water flows from the upstream concrete channel over a 20 foot drop, flows through a stilling basin (to slow the water down) and then up-wells by 8 feet into the downstream earthen lined channel. This results in an overall drop of 12 feet (also see the front cover of this report).

At the design flow rate of 18,000 cfs, the maximum water velocity in the concrete lined channel is up to 31 feet per second (about 21 miles per hour). The water right at the top of the drop structure is flowing even faster. Figure 1-2 shows the water flowing over the drop structure on December 13, 2009, when the flow was 1,500 cfs. In the stilling well, the water is very turbulent, and swirls around in a vertical loop and eventually leaves the stilling well and enters the downstream channel. In the downstream earthen channel, the water velocity has slowed to 13 feet per second (still almost 9 miles per hour). The swirling of the water in the stilling well is called a hydraulic jump or a hydraulic. The water flowing through this hydraulic can flow through the vertical loop several times before it is pushed out of the stilling well and flows downstream. This vertical flow loop can also carry a person around the vertical loop, and hold them underwater for a dangerously long time.

Design Flow
"Design Flow" is the rate of water flow (usually in cubic feet per second, cfs) that a channel or structure is sized (or designed) to convey. Flood control channels are designed to convey the design flow rate with a certain amount of freeboard. "Freeboard" means the distance (vertically) from the water surface to the top of the channel bank. The design flow is the flow rate from a "Design Storm," which is often described based on a return frequency, such as a 100-year storm or a 10-year storm. A 100-year storm means that on the average, a storm of this size or larger is expected to occur once every 100 years. Phrased another way, there is a 1 percent chance that the 100-year storm will occur in any given year.

This swirling water loop and the associated turbulence dissipates a tremendous amount of the energy from the upstream water. At the flow rate of 18,000 cfs, dropping 12 feet, this dissipation of energy is equivalent to 24,400 horsepower, which is equivalent to the power of about eight fully loaded train locomotives going at full speed.

The WCFCCS conveys the 100-year peak flow from the watershed quickly and efficiently. This system of channels has greatly reduced the potential for flooding within the Walnut Creek watershed. Prior to the construction of the WCFCCS in the 1960s, flooding was relatively common, with major floods occurring in 1938, 1952, 1955, 1958, 1962, and 1963. Several historical photographs of flooding are presented in Figures 1-3 through Figure 1-6. Also, severe erosion of the earthen channel banks was occurring, as shown in Figure 1-7. These photographs were provided by the Walnut Creek Historical Society [WCHS 2012].

Additionally, since the WCFCCS was constructed the population in Contra Costa County has increased from about 409,000 in 1960 to 1,049,000 in 2010 [ABAG 2012]. This level of increased development means that:

- The peak runoff rates and volumes have dramatically increased since the 1960s, and without the flood control channel system, flooding would be even worse than it was in the period of 1938 to 1963.

Figure 1-2. Drop Structure 2 at a Flow Rate of about 1,500 cfs on December 13, 2009

- There are more houses and businesses that could be flooded and damaged if the flood control channel system was not present.

Unfortunately, these conditions may have contributed to the drowning of several people at Drop Structure 2 since it was constructed, including:

- January 1973, two boys lost their football over the fence and went in the channel after it and drowned.
- In February 1973, three adults ages 29-34 rafted down the Channel were ejected from the raft when going over Drop Structure 2. One was knocked unconscious and drowned. Fortunately, CCCFCWCD maintenance crews were working at the structure and were able to throw ropes to and save the other two rafters.
- In 1991 a boy fell into the channel while looking for a ball.
- In April 2010 a car crashed through a fence and into the channel and a father and son were drowned. The wife was almost drowned, and a firefighter was badly injured rescuing her.

- A pair of high-school aged boys who tried to raft the channel in February 2011.

Although Drop Structure 2 is dangerous, the WCFCCS has provided a meaningful reduction of flooding that used to impact the cities of Danville, Alamo, Lafayette, Walnut Creek, Pleasant Hill, Concord, Moraga, Martinez, and areas of Contra Costa County.

## 1.2 PURPOSE AND GOALS OF THIS STUDY

The overall purpose for preparing this study is to help identify how Drop Structure 2 could potentially be made safer, while still achieving its flood control requirements and benefits. This study was commissioned by the CCCFCWCD to provide information regarding improving the safety of the WCFCCS and Drop Structure 2 to guide future management decisions.

This study achieves the following goals that in turn help achieve the overall purpose.

- Summarize the concerns and comments from the public related to the previous drownings at Drop Structure 2. Also summarize the public's ideas for improving the safety of Drop Structure 2.
- Summarize the planning, design, and flood control benefits provided by the WCFCCS.
- Identify a wide range of possible safety barriers and devices that could be used at or upstream of Drop Structure 2.
- Identify a wide range of possible channel and drop structure modifications that could be used at or upstream of Drop Structure 2.
- Identify the requirements of the United States Army Corps of Engineers (USACE) for modification of the Drop Structure 2. The USACE designed and constructed the WCFCCS, and their approval is necessary for any modification of the channels and drop structures.
- Compare the most promising safety barriers and devices and the most promising channel and drop structure modifications.
- Estimate the level of safety improvement, potential increase or decrease in flood protection, flood period maintenance requirements, routine (non-flood period) operational and maintenance requirements, land requirements, construction/capital costs (including land costs), and potential environmental impacts/benefits (e.g. enhanced fish passage) that would occur from the most promising safety barriers and devices and from the most promising channel, and drop structure modifications.
- Identify a set of safety barriers and devices and channel and drop structure modifications that warrant additional evaluation.
- Summarize the additional evaluations that would be needed to implement the identified safety barriers and devices and channel and drop structure modifications.

These goals are accomplished in the following chapters.


**Figure 1-3**

**CCCFCWCD**

Flooding of the old Broadway Plaza and associated shops. Broadway Plaza was a short street connecting Broadway and Main Streets that was replaced with the Broadway Plaza Shopping Center.

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**Figure 1-4**

**CCCFCWCD**

Main Street looking north.

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**Figure 1-5**

**CCCFCWCD**

Main Street looking south.

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FLOODING OF DOWNTOWN WALNUT CREEK
3:30 P.M. WEDNESDAY, APRIL 2, 1958

**Figure 1-6**

**CCCFCWCD**

Parking lot behind the old Lucky Market on April 9 1958 at 3:30 PM. The Lucky Market was at the east end of the old Broadway Plaza

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**Figure 1-7**

**CCCFCWCD**

Walnut Creek from the old railroad bridge in Civic Park, looking south. Walnut Creek was severely eroding its channel banks, leading to risk of undermining an existing apartment building

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