IV. (340 points) Flood Protection Benefits

A. Existing and potential urban development in the floodplain (50)

1. Describe the existing and potential urban development at the site and the nature of the flood risk.

Within the 575-acre Improvement District, there is a 259-acre area which was subdivided to "ranchettes" in the 1960s (referred to hereinafter as the "subdivision"). Individual lots range from 0.2 to 5 acres, with the "typical" lot being on the order of 2.5 acres. Currently, there are 128 dwellings in the subdivision, consisting largely of manufactured (or mobile) homes. The subdivision is located within the 100-year floodplain of Kelso Creek (designated as "Zone A", a Special Flood Hazard Area, under the National Flood Insurance Program; reference Community-Panel Nos. 060075-0530-C and 060075-0540-C, dated March 2, 1994, copies included in Appendix #3). There are 50 unimproved lots within the subdivision which could be similarly developed. In addition, there is a 105-acre parcel located immediately upstream of the subdivision and adjacent to the same levee, which is currently undeveloped, but which could conceivably be developed at some time in the future (reference Figure 3 in Appendix #2).

While the primary risk of flooding is from Kelso Creek, there is also a risk of flooding from side canyons which are tributary to Kelso Creek, but discharge on the subdivision side of the levee; these include Short Canyon, Cholla Canyon, and Cane Canyon (reference Figures 2 and 3 in Appendix #2 and the cover photo). Potential damages include loss of life and property damage. Property damage could include damage to structures (homes and outbuildings), landscaping, utilities (including domestic wells and septic systems), vehicles, livestock, roads, and crops.

Kelso Creek drains an area of about 145 square miles upstream of the subdivision. Flows in the Creek in the vicinity of the subdivision only occur during periods of "significant" rainfall. The existing levee begins about one mile upstream from the subdivision (reference Figure 2 and 6 in Appendix #2). At this point, Kelso Creek is a wide alluvial wash. In recent times, most of the "lower" flows have been along the west edge of the wash and thereby on the west or channel side of the levee. However, higher flows and/or an upstream channel shift could result in significant flows on the east or subdivision side of the levee.

As noted above, the levee does not provide any protection from side canyons (totaling over 20 square miles of drainage area) which discharge on the subdivision side of the levee. The Flood Insurance Study (1990) for the unincorporated areas of Kern County states the following:

> "In addition to flooding from washes, creeks, and rivers, many areas are subject to flooding from flows on alluvial fans. Both unpredictability of flow paths on alluvial fans and typically high sediment loads compound the problem."

These statements are particularly true in this case. In 1984, there was a significant debris/mud flow from Short Canyon which deposited sediment up to eight feet deep on properties within the subdivision in the immediate vicinity of Short Canyon.

2. How often has flooding occurred historically?

Flows in Kelso Creek in the vicinity of the Project site are infrequent, occurring only during periods of intense or prolonged rainfall; accordingly,

flooding has been infrequent. However, damages have been caused to flood control improvements (i.e, the levee) or other properties during most runoff events. The record of Kelso Creek peak flows is summarized in Table IV-1 which is located at the end of this section, following the text, (See historical levee and ag land damages in Appendix #13).

As shown in the table, the annual peak flows have been segregated into two periods; a "winter" period and a "summer" period. The largest "summer" peak of record is 11,000 cfs (in September 1976) and the largest "winter" peak of record is 7,300 cfs (in March 1978). As designed and constructed, the levee will contain flows up to about 2,500 cfs; however, significant flood fighting efforts have maintained the integrity of the levee at flows up to about 4,000 cfs. Accordingly, during the two cited events, the levee suffered extensive damage which required emergency/disaster funding assistance (in both cases) to repair. In addition, there were flows on the east or subdivision side of the levee which resulted in both sedimentation and erosion within the subdivision; however, the flow depth in the subdivision was not sufficient to cause structural damage to residences. It is noted that, based on flood frequency data developed in the context of the Flood Insurance Study for the area (1990), the 100-year peak discharge is estimated at 22,700 cfs, which is considerably in excess of anything of record.

While there is no record of discharge for Short, Cholla, and Cane canyons (which discharge on the subdivision side of the levee), it is noteworthy that, in 1984, there was a significant debris/mud flow from Short Canyon which deposited sediment up to eight feet deep on properties within the subdivision in the immediate vicinity of Short Canyon (i.e., where the alluvial fan of Short Canyon meets the floodplain of Kelso Creek). See the cover photo.

3. Discuss the importance of improving the flood protection at this location. Include the number of people and structures that are affected by the flood hazard, and the flood impacts to highways and roads, railroads, airports and other infrastructure, and agriculture.

Flood protection is inadequate and potential damages include loss of life and property damage. It has been estimated (by FEMA's Flood Insurance Study contractor, Boyle Engineering Corporation) that the levee provides some measure of "protection" to the subdivision from runoff events (on Kelso Creek) with a return frequency of less than 10 years. Also, the flood protection that is afforded by the levee is a function of how much water finds its way to the channel side of the levee (which is, in turn, a function of alluvial wash dynamics at and above the upstream end of the levee) and of flood fighting efforts to preserve the integrity of this highly erodible levee (during times of flow in the main channel which encroaches on the levee). The levee doesn't provide any protection from runoff events occurring in the watersheds of Short, Cholla, and Cane canyons; in fact, depending on the given event, the levee has the potential to exacerbate flooding problems by impounding water on the subdivision side of the levee. Property damage could include damage to structures (homes and outbuildings), landscaping, utilities (including domestic wells and septic systems), vehicles, livestock, roads, and crops. There are an estimated 129 homes in the subdivision and, based on the most recent census data (from the Kern Council of Governments), there are 229 people living in the floodplain of Kelso Creek. Finally, owing to a median annual income of $19,265 (Kern Council of Governments), these residents are hard pressed to fund relatively nominal maintenance costs of the existing and inadequate flood protection, let alone make improvements in the level of protection. In fact, the Improvement District has "regularly" supplemented funds derived from landowner assessments with

"emergency" grants from agencies such as FEMA and NRCS to repair flood damages to the levee.

B. Flood damage reduction benefits of the project (100)

1. Does the proposed project provide for transitory storage of floodwaters? What is the total community need for transitory storage related to this water course and what percentage of the total need does this project satisfy? What is the volume of water and how long is it detained?

The Project does provide some transitory storage in that infiltration losses would be increased by opening up more of the floodplain to flow. By removing the levee and/or decreasing the density of homes in the floodplain, flows will have the opportunity to be absorbed into the aquifer. The 575 acres within the Improvement District could absorb more than 575 acre-feet in a day-long flow event. This absorption would also help decrease the peak flow by about 300 cubic feet per second. The duration of the storage would be indefinite, since the water is absorbed into the aquifer and subject to movement based on prevailing groundwater gradients.

The total need for transitory storage is about 25,000 acre-feet for the 100-year flood, assuming the levee can convey 2,500 cfs without failing. The 100-year volume is estimated at 30,000 acre-feet (Simons, Li and Associates, Inc., 1986). An excerpt from the Simons and Li report is included in Appendix 3, showing the expected 100-year flood hydrograph. The duration of the 100-year flood is expected to be about 35 hours. The proposed Project can provide about 2% of the total needed transitory storage.

2. Describe any structural and non-structural flood damage reduction elements of the project. (Examples of structural elements are levees, weirs, detention/retention basins, rock slope-protection, etc. Examples of non-structural elements are acquisition of property for open space,

acquisition of land for flood flow easements, transitory storage, relocation of structures and other flood prone development, elevating flood prone structures, flood proofing structures, etc.)

The Project is based on non-structural flood damage reduction elements, including acquisition of property for open space (through purchase of vacant lots within the subdivision, a large parcel immediately upstream of the subdivision, and parcels on the channel side of the levee); acquisition of land for flood flow easements (through purchase of easements from subdivision residents who do not choose to relocate); transitory storage (to the extent that the removal of some of the improvements within the subdivision allows water to spread out to cover a larger area of the floodplain); relocation of structures (through the purchase of improved properties from those residents who elect to relocate); elevating or otherwise "floodproofing" flood-prone structures (required as a part of the purchase of flood flow easements from residents who do not choose to relocate). Also, reference the Project Description found in Section II.

3. By what methods and by how much dollar value will the project decrease expected average annual flood damages?

The proposed Project is a flood damage reduction program. In particular, it includes (a) purchase of unimproved properties, both inside and outside of the subdivision, to eliminate the possibility of future development of these properties, thereby preserving the flood corridor provided by the existing channel and floodplain, (b) purchase of improved properties within the subdivision, with relocation of residents and removal of structural improvements, thereby enhancing the floodplain corridor, and (c) purchase of flowage easements from residents who choose to remain, along with floodproofing of the dwelling unit (in compliance with current Kern County Floodplain Management Ordinance requirements). It is noted that, to the extent current residents are relocated and improvements

are removed, the hydraulics of the floodplain are improved for those that remain. Since the program is voluntary, there may be some residents who choose not to sell either their property or a flowage easement.

The Agency, in their "Report of Special Benefit Assessment" (June 2002), included in Appendix 14, estimated the damages to the existing development without the protection of the levee would occur in the following amounts four times in a 30-year period. As shown below, using these cost factors, the estimated potential flood damages to the private property in the Kelso Creek floodplain could be $4.5 million for each major flood event which exceeded the capacity of the levee. Purchasing the private property and removing the improvements would eliminate this significant flood damage risk and costs.

Homes with flood protection	64ea	at	$27,000	=	$1,728,000
Homes with no flood protection	68ea	at	$40,000	=	$2,720,000
Vacant lots	69 acres	at	800/acre	=	$55,200
Estimated maximum damages to private properties.					$4,503,200

The Agency estimated that a flood with this damage capability could occur four times in 30 years; therefore, the maximum expected annual flood damage would be about $600,000. It is anticipated that about 65% of the improved properties will be acquired and removed with this program; therefore, the expected annual reduction in flood damages could be as high as $390,000 per year.

4. How does the project affect the hydrologic and hydraulic conditions at the project site and adjacent properties?

Kelso Creek, in the vicinity of the Project site, has been the subject of hydrologic and hydraulic investigations initiated by Kern County Water

Agency and FEMA over the last 30 to 40 years. A Flood Insurance Study (which included Kelso Creek) was commissioned by FEMA in the late 1970s and was completed in 1984 (and since revised in 1990 and 1994). These investigations provided the basis for some of the observations made in the responses that follow. The responses are largely qualitative inasmuch as the proposed Project is predicated on "turning the clock back" with respect to improvements in the floodplain, i.e., it is principally based on removal of improvements and does not involve design/construction of any improvements.

a) Will the project reduce the magnitude of a flood flow, which could cause property damage and/or loss of life?

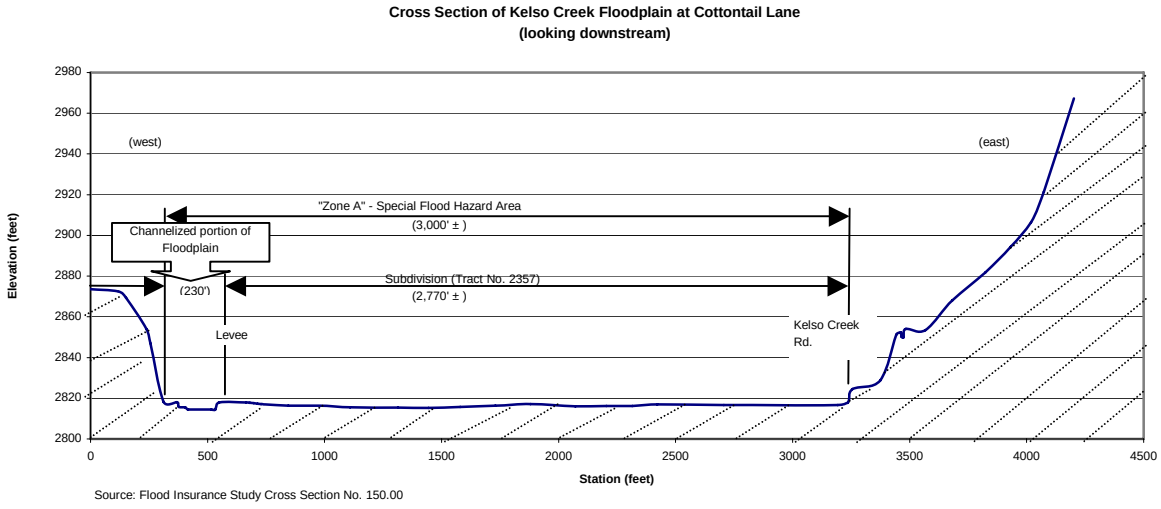
It is not likely that the Project will measurably reduce (only about 300 cfs) the magnitude (i.e., the peak discharge) of a flood flow on Kelso Creek; however, to the extent that the removal of some of the improvements within the subdivision allows water to spread out to cover a larger area of the floodplain, there is the potential, depending on the flow duration, of reducing the magnitude which is evidenced downstream by about 300 cfs (or about one tenth of a percent of the 100-yr discharge). It is also noteworthy that the purchase of currently unimproved property which could otherwise be developed in the future, will preserve naturally occurring floodplain losses which help to attenuate downstream peak flows, and removal of homes will reduce the risk of property damage and loss of life for the current residents.

b) What are the effects of the project on water surface elevations during a flood event which could cause property damage and/or loss of life?

To the extent that current residents are relocated and improvements are removed, the hydraulics of the floodplain will be improved. In

other words, fewer obstructions to flow will result in lower water surface elevations for the same discharge. Similarly, precluding future development (through the purchase of currently unimproved properties) will be beneficial. In this regard, there are 50 vacant lots within the subdivision, in addition to the large parcel located immediately upstream of the subdivision that is proposed for acquisition.

For illustrative purposes, consider a cross section of the floodplain at the upstream end of the subdivision (near Cottontail Lane).



Source: Flood Insurance Study Cross Section No. 150.00

Currently, there are ten parcels within the subdivision and the floodplain at this location. Each of these ten parcels could support one 60-foot long manufactured home. Assuming they are oriented with the long side perpendicular to the direction of flow, they would obstruct about 20 percent of the floodplain. This percentage would decrease if some of the homes were oriented differently, and could increase if some of these lots were further subdivided.

c) How are flow velocities impacted by the project during a flood flow which could cause property damage and/or loss of life?

The Kelso Creek floodplain in the vicinity of the Project is hydraulically steep (on the order of one percent); accordingly, velocities are relatively high, with mean "floodway" velocities ranging from six to nine feet per second (based on FEMA's Flood Insurance Study, 1990). The Flood Insurance Study includes the following statement:

> "Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment."

To the extent that improved properties are purchased and structural improvements (or encroachments) removed, the opposite will occur, i.e., a decrease in velocities would be realized. Also, to the extent that currently unimproved properties are purchased and future development is precluded, possible future encroachments are precluded which would otherwise have an adverse effect on velocities.

At such time as the levee is abandoned (i.e., breached), velocities on the west or channel side of the levee would be reduced as the water was permitted to spread to the east of the levee.

C. Restoration of natural processes (60)

1. Describe how any natural channel processes will be restored (for example: for channel meander, sediment transport, inundation of historic floodplain, etc.) and describe how these natural processes will affect flood management and adjacent properties.

As noted under B-4 (above), the proposed Project is predicated on "turning the clock back" with respect to improvements in the floodplain,

i.e., it is principally based on removal of improvements and does not involve design/construction of any improvements. Accordingly, the braided flow characteristics of the natural channel processes will be restored to the extent that the removal of improvements is effected. It is noted that, in the vicinity of the Project site, Kelso Creek can be characterized as a relatively wide alluvial wash ($\frac{1}{4}$ to $\frac{1}{2}$ mile wide), which results in meandering, braided flow. Further, the purchase of currently unimproved properties and precluding future development, will preclude natural channel processes from being adversely affected in the future. In 1986, Simons, Li & Associates prepared a sediment transport evaluation which concluded that the sediment transport capacity of Kelso Creek would be decreased with removal of the levee and, in general, sediment transport capacity would decrease in the downstream direction.

Regarding adjacent properties, to the extent that residents in the subdivision relocate and the associated improvements are removed, the remaining residents will benefit from having fewer encroachments/obstructions in the floodplain, i.e., water will occupy more of the floodplain, which will result in lower water levels and decreased velocities (which translates to a reduction in flood damages). At such time as the levee is abandoned, flows that would otherwise be contained by the levee, would spread out to occupy more of the floodplain, which would have the effect of reducing velocities evidenced by downstream properties. In addition, the risk of catastrophic levee failure with flow depths nearly five feet deep would be eliminated. The Project addresses the properties in the floodplain and would not affect adjacent properties which are outside of the floodplain.

2. Describe any upstream or downstream hydraulic or other effects (such as bank erosion or scour, sediment transport, growth inducement, etc.).

Downstream -- To the extent that residents in the subdivision relocate and the associated improvements are removed, there will be fewer encroachments/obstructions in the floodplain, i.e., water will occupy more of the floodplain, which will result in lower water levels and decreased velocities, thereby reducing scour and sediment transport. Similarly, at such time as the levee is abandoned, flows that would otherwise be contained by the levee, would spread out to occupy more of the floodplain, which would have the effect of reducing velocities evidenced by downstream properties. Finally, restoring natural floodplain processes in the Project area will not encourage growth downstream.

Upstream -- The Project includes the purchase of currently unimproved property located immediately upstream of the subdivision. This action will preclude future improvements on the purchased properties, which will preserve natural floodplain processes. Further, at such time as the levee is abandoned in this same area (i.e., upstream of the subdivision), natural floodplain processes will be enhanced. The Project will not affect hydraulics upstream of the existing levee, nor will it be growth inducing.

3. If the project includes channel modification or bank protection work, will riprap or dredging be part of the design? If so, provide an analysis of potential benefits and impacts.

Not Applicable.

D. Project effects on the local community (60)

1. How will the project impact future flooding on and off this site?

At "low" flows, there would be decreased volume and peak once the Project is complete, since more water can be absorbed through enhanced floodplain losses. At higher flows (i.e., with flow on the subdivision side of the levee), to the extent that current residents are relocated and improvements are removed, the hydraulics of the floodplain will be improved. In other words, fewer obstructions to flow will result in lower water surface elevations for the same discharge. Accordingly, this will benefit those who choose to remain in the floodplain. If the Project has any off-site effect, it would be downstream and would be related to sedimentation. In particular, to the extent that flow velocities are reduced by "opening up" the floodplain (i.e., through reduction in the number of obstructions to flow), the sediment-carrying capacity of the flow would be reduced, which would have the effect of reducing the sediment which is transported and deposited downstream. At such time as the levee is abandoned, it would have a similar effect at flows which would otherwise be contained by the levee.

2. How will the project affect emergency evacuation routes or emergency services and demands for emergency services?

The Project should have little effect on emergency evacuation routes; however, the Project will reduce the demand for emergency services to the extent that people and structures are removed from the floodplain and to the extent that "floodproofing" is implemented.

3. Explain how the project will comply with the local community floodplain management ordinance and the floodplain management criteria specified in the Federal Emergency Management Agency's National Flood Insurance Program (FEMA's NFIP).

The Project is located within the County of Kern which has a Floodplain Management Ordinance (copy included as Appendix #4) which is

consistent with the floodplain management criteria specified in FEMA's National Flood Insurance Program. The Ordinance, at Section 17.48.050 of the Kern County Ordinance Code, lists methods for reducing flood losses. Each of the listed methods is reproduced following, along with relevant comments respecting the proposed Project. As shown below, the proposed Project is in furtherance of the purposes of the Floodplain Management Ordinance.

- "Restricting or prohibiting uses which are dangerous to health, safety, and property loss due to water or erosion hazards, or which result in damaging increases in erosion or in flood heights or velocities."

  Unimproved properties in the Kelso Creek floodplain will be acquired under the Project and future development of these properties will not be allowed. Regarding (existing) improved properties, the Project includes options for relocating to an area outside of the floodplain and for "floodproofing".

- "Requiring that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction."

  The Kern County Floodplain Management Ordinance includes requirements for flood hazard reduction which are applicable to new construction (reference Article III of the Ordinance). Respecting existing improvements which are not in compliance with these requirements, the Project includes, as an option, the purchase of flowage easements, with the condition that

"floodproofing", consistent with current standards for new construction, be implemented.

- "Controlling the alteration of natural floodplains, stream channels, and natural protective barriers, which help accommodate or channel flood waters."

  In this regard, the Project includes the purchase of unimproved properties in the Kelso Creek floodplain as well as areas of the main channel of Kelso Creek, and future development of these properties will not be allowed.

- "Controlling filling, grading, dredging, and other development which may increase flood damage."

  As noted above, unimproved properties in the Kelso Creek floodplain will be acquired under the Project and future development of these properties will not be allowed.

- "Preventing or regulating the construction of flood barriers which will unnaturally divert flood waters or which may increase flood hazards in other areas."

  The Project includes the removal of some existing obstructions to flow to the extent that (existing) improved properties are purchased and the improvements are removed.

E. **Value of improvements protected** (70)

1. What is the assessed value of structural improvements that will be protected by the project?

The total assessed value of all the improvements on the private properties which make up ID3, after adjusting for the homeowner exemption, is $2,663,358. It is intended to protect all of these improvements from flood damage by purchasing them and thereby relocating the residents and their assets or by flood proofing the remainder. As described in Section II, the flood damage from one large flood event could be as high as $4.5 million. By implementing this Project, that risk of loss and the reoccurring flood fighting costs would be eliminated.

2. What is the estimated replacement value of any flood control facilities or structures protected by the project?

An estimated replacement value of the improvements on the private properties within ID3 (132 residences) was calculated at almost $4.9 million. This was determined by using the Agency Benefit Assessment data to calculate the replacement cost of the typical mobile/manufactured home residence. Compared to the average assessed value, an average of an additional $16,810 per residence would be needed to replace it.

The flood control levee is approximately 13,000 feet long, averages five feet high, and has a 14-foot top width with 3:1 side slopes. The costs to construct it in 1970, repair, and improve it total $1,233,413, adjusted to February 2003 price levels. The levee is made of the native sandy sediment materials and is inadequate for anything over a 10-year flood. The Agency previously estimated the costs to raise the levee four feet and fortify it for 2,300 feet, and armor another 2,000 feet length of it, at $3,238,300. To construct the levee as it is now, is estimated at $2,366,000. An additional 1,800 feet of levee would be needed to

prevent the high flood flows from going behind it and would cost an additional $330,000 to match the existing levee.

To design and construct a 14,800 foot levee (13,000 feet plus 1,800 feet) of sufficient height and durability to withstand a 100-year flood, and not erode away during intervening flood flows, would be an expensive project, estimated to cost at least $7.8 million. There would still be the risk of a higher than designed extreme flash flood event and a catastrophic failure, resulting in extensive loss of property and possibly lives. In addition downstream flooding would be aggravated due to the concentrated flows. Further, this would not address runoff from the side canyons to the east of the subdivision. The cost to address downstream conditions would add costs greater than $10 million. Also due to the high volume of sediment transported through the system, maintenance costs would be prohibitive.

Table IV-1
Summary of Seasonal and Annual Peak Discharge
for Kelso Creek
(1960 - 2002)

Water Year	Winter Peak (November - May)		Summer Peak (June - October)		Annual Peak	
	Date	Discharge (cfs)	Date	Discharge (cfs)	Date	Discharge (cfs)
1960	5/22/60	7		0	5/22/60	7
1961		0	8/23/61	1,180	8/23/61	1,180
1962	2/11/61	108		0	2/11/61	108
1963	5/31/63	18	10/7/63	32	10/7/63	32
1964		0		0		0
1965		0	8/15/65	1,340	8/15/65	1,340
1966	12/30/65	14		0	12/30/65	14
1967	12/6/66	5,800		0	12/6/66	5,800
1968						
1969	2/1/69	1,900			2/1/69	1,900
1970						
1971						
1972						
1973						
1974						
1975						
1976		0	9/29/75	11,000	9/29/75	11,000
1977		0		0		0
1978	3/3/78	7,300		0	3/3/78	7,300
1979						
1980						
1981						
1982	3/17/82	130		0		130
1983	3/1/83	1,200	8/19/83	350	3/1/83	1,200
1984	1/17/84	95	7/30/84	910	7/30/84	910
1985		0		0		0
1986		0	7/28/86	13	7/28/86	13
1987	2/17/87	130	11/5/87	30	2/17/87	130
1988		0	7/23/88	4	7/23/88	4
1989	3/2/89	5		0	3/2/89	5
1990		0		0		0
1991	3/1/91	63		0	3/1/91	63
1992		0		0		0
1993	12/7/92	4		0	12/7/92	4
1994		0		0		0
1995	3/10/95	1,600		0	3/10/95	1,600
1996	2/20/96	5		0	2/20/96	5
1997	12/10/96	137		0	12/10/96	137
1998	2/24/98	1,300		0	2/24/98	1,300
1999		0		0		0
2000		0	8/29/00	6	8/29/00	6
2001		0		0		0
2002		0		0		0

Sources:
(1960 - 1967) - "Cooperative Stream Gaging Program - A compilation of Peak Discharge Data on Selected Streams - Kern County, California," Kern County Water Agency (Jan 1976).

(1969) Kern County Water Agency

(1976 - 2002) - County of Kern, Engineering and Survey Services (fax from Richard Lloyd, February 2003).

Notes:
(1) For 1959 – 67, reported data based on a water stage recorder located about stage recorder located about seven miles southeast of Weldon with a drainage area of about 101 square miles (which is about two-thirds of the drainage area at the subdivision).

(2) For 1976 – 2002, reported data based on a crest-stage gage located about 2.9 miles southeast of Weldon with a drainage area of about 163 square miles.

(3) Where no values are shown, there is no available record.