6. Hydrology

Setting

This chapter consists of two basic sections dealing with stormwater runoff and water quality. Both sections are based on analysis and reports by James M. Montgomery, Consulting Engineers. The full reports are in the separately bound Appendix. Groundwater is also described based on text by the Resource Conservation District.

Stormwater Runoff

Introduction. Flooding occurs when heavy rains cause streams to overflow their banks, inundating property and structures located adjacent to the stream. Streams also back up at culverts and bridges, blocking roads or making them unsafe; emergency services can be restricted by the flooded roads. In addition, there are numerous open canals in the study area which can intercept sheet runoff from one part of the study area and spill it into another, increasing the potential for downstream flooding in that area. The following paragraphs describe the various watersheds containing the Auburn/Bowman Area and the current flooding problems in those watersheds.

Watershed Descriptions. The Auburn/Bowman area covers approximately 41.5 square miles and is contained in portions of six different drainage basins; Bear River, Orr Creek, Dry Creek (including Rock Creek), Auburn Ravine (including North Ravine), Mormon Ravine,Dutch Ravine and the American River (North Fork). Each watershed and the respective areas that are in the study area (or that contribute flows to the study area) are listed in Table 31.

A map of the study area and watersheds is presented in Figure 17. Over 85% of the study area is drained by the Orr Creek, Dry Creek and Auburn Ravine watersheds whereas the Bear River, American River, Mormon Ravine and Dutch Ravine watersheds together make up less than 15% of the total study area.

Table 31
WATERSHEDS IN AUBURN/BOWMAN COMMUNITY

Watershed	Area (Square Miles)
Bear River	2.1
Orr Creek	9.3
Dry Creek (Rock Cr)	15.5
Rock Creek	4.3
Auburn Ravine (North Ravine)	10.8
North Ravine	4.6
Mormon Ravine	1.4
Dutch Ravine	1.0
American River	9.8
Deadman's Canyon	1.0

SOURCE: Montgomery, 1992.

The Orr Creek watershed is located in the northern portion of the study area and drains water from east to west across the study area. A small portion of the watershed (approximately one square mile) is located northeast outside the study area. The Dry Creek watershed is located south of the Orr Creek watershed and also drains water from east to west across the study area. Approximately 1.7 square miles of the Dry Creek watershed is located outside the study area to the north and east. Rock Creek, a major tributary to Dry Creek, drains approximately 4.3 square miles in the southern portion of the watershed. Dry Creek and Orr Creek meet approximately 2000 feet outside the western boundary of the study area to from Coon Creek.

Auburn Ravine is located in the southern portion of the study area with the head waters primarily located within the City of Auburn. The upper portion of Auburn Ravine drains most of Auburn with a flow pattern to the south and west. North Ravine is a primary tributary to Auburn Ravine and drains the western portion of the Auburn Ravine watershed that is located in the study area. North Ravine generally drains water from north to south and the confluence with Auburn Ravine is located outside the study area approximately one mile from the western boundary.

The very northern portion of the study area is drained by a portion of the Bear River watershed. This area consists primarily of small unnamed tributaries that drain water north directly into the Bear River. The very eastern portion of the study area is drained by the American River watershed. As with the Bear River, this portion of the study area consists primarily of small, short drainages which flow directly into the North Fork of the American River. The exception to this is Clipper Creek which drains approximately five square miles outside the study area and then drains into the North Fork within the study Area boundaries.

Headwaters of Mormon Ravine and Dutch Ravine watersheds are located in the very southern portion of the study area. The general drainage pattern is to the south for Mormon Ravine and to the west for Dutch Ravine. In addition, the headwaters for Deadman's Canyon are also located within the western portion of the study area adjacent to the Dry Creek and Auburn Ravine watersheds. Deadman's Canyon flows into Coon Creek approximately two miles outside the study area boundary.

The segments of these eight watersheds within the Plan area have been divided into 105 sub-basins for detailed hydrologic study. These sub-basins are shown in Table 37 and discussed in detail in subsequent pages.

Topography. The entire Plan area is located in the foothills of the Sierra Nevada Mountains and the watersheds in the study area are characterized by relatively steep slopes and moderate relief. Elevations in the study area range from approximately 800 feet (msl) in the southern portion of the study area to over 2000 feet (msl) in upper Dry Creek and Orr Creek watersheds. Overall, most of the study area has elevations ranging from 1000 to 1500 feet (msl).

Soils. Soils in the study area have been given hydrologic classifications by the Soil Conservation Service (SCS) in the Placer County Soil Survey (1978). These classifications divide the soils based on infiltration rates and runoff potential and are:

- Group 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.
- Group B - Moderately low runoff potential. Soils having moderate infiltration rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well-drained soils with fine to moderately coarse textures. These soils have a moderate rate of water transmission.
- Group C - Moderately high runoff potential. 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.
- Group 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.

The soils within the study area are predominantly Group D - high runoff potential. Only in the northeastern portion of the study area do any significant amounts of Group B or Group C type soils occur. The "Hydrologic Soil Types" maps (A-C) of the Hydrology Study illustrate the distribution of the various hydrologic soil types occurring throughout the study area.

Land Use The types of land use that occur in a watershed are very significant in determining the amount of runoff that results from a given amount of rainfall. Much of the difference in runoff from different land uses can be attributed to the difference in the percentage of the land that is impervious (paved or covered by buildings) for each land use type. Another important factor that is determined by the type of land use is the condition, or hydraulic efficiency, of the smaller tributaries and streams in an area. For example, an area that is mostly rural residential will have streams that are largely in their natural state, with relatively inefficient hydraulic properties. This results in a slower and less intense concentration of runoff from the area. In comparison, the small tributary streams in a commercial area will most likely be improved. This improvement in the efficiency of the hydraulic properties causes the runoff in those tributary streams to reach the main streams and combine together more quickly, producing a faster and more intense concentration of runoff from the area.

Existing land use maps were obtained from the Placer County Planning Department which had performed a field survey of the land use of the entire study area (including Auburn) in 1990. The land use in the study area varies widely, from agricultural, to residential, to commercial. Most of the commercial land use is located in the City of Auburn and along the Highway 49 corridor south of Dry Creek. The areas outside of the city limits and the Highway 49 corridor are predominantly rural, agriculture and open space. Table 32 contains a listing of the land use categories used in this study. The Hydrology Study's "General Plan Land Use" maps (A-C) show the pattern of existing land uses.

Table 32
GENERALIZED LAND USE CODES

COMM	Commercial, Professional, Industrial	Self Explanatory
HDR	High Density Residential	4-10 Dwelling Units/Ac
MDR	Medium Density Residential	2-4 Dwelling Units/Ac
LDR	Low Density Residential	0.4-0.9 Acre Minimum
RLDR	Rural Low Density Residential	0.9-2.3 Acre Minimum
RR	Rural Residential	2.3-5 Acre Minimum
RE	Rural Estates	5-20 Acre Minimum
OS	Open Space (undeveloped)	Self explanatory

SOURCE: Montgomery, 1992.

Canals and Reservoirs. An extensive network of canals and reservoirs are located in study area. The canals are owned and operated by three different agencies; Placer County Water Agency (PCWA), Nevada Irrigation District (NID) and Pacific Gas and Electric Company (PG&E). The source of water for most of the canals is the Bear River and Lake Combie to the north. In general, most canals transport the water from north to south through the study area with many side diversions and spills located within the study area. Some of the canals are used solely for water supply purposes (municipal and agricultural) whereas others are also used for power generation. There are also five reservoirs in the study area ranging in surface area from less than three acres to over fifty acres. Most of these reservoirs are used primarily for storing and diverting water to canals. A listing of all canals and reservoirs are presented in Tables 33 and 34; their locations can be seen in the Hydrology Study on the "Canals and Spill Location" maps (A-C).

Table 33
CANALS IN AUBURN/BOWMAN COMMUNITY

Canal	Agency
Upper Bowman	PG&E
Wise	PG&E
Middle Fiddler Green	PG&E
Lower Fiddler Green, lower 1/2	PG&E
South Canal	PG&E
Shockley	PCWA
Lower Bowman	PCWA
Boardman	PCWA
Fiddler Green Boardman Dvrsn	PCWA
Shirland and Shirland Stub	PCWA
Upper Banvard	PCWA
Lower Fiddler Green upper 1/2	PCWA
Freeman	PCWA
Combie-Ophir	NID
Lone Star	NID
Gold Hill	NID
Pickett	NID
Kemper (East, West)	NID
Willits	NID
Oest	NID
Rock Creek	NID
Columbia (East, West)	NID
Bean Cullers	NID

Table 34
RESERVOIRS IN AUBURN/BOWMAN COMMUNITY

Reservoir	Agency	Surface Area (Acres)
Orr Creek	NID	2.8
Dry Creek	Private	11.5
Halsey Forebay	PG&E	15.1
Halsey Afterbay	PG&E	7.3
Rock Creek	PG&E	54.2
Wise Forebay	PG&E	4.1
McCrary	PCWA	0.9

Nevada Irrigation District maintains canals in the northwestern portion of the study area. The primary canals operated by NID are the Combie-Ophir, Lone Star, and Gold Hill Canals. Smaller canals include the Pickett, Rock Creek, Columbia, and Bean Cullers Canals. These canals are all used exclusively for water supply (agriculture and domestic) and are not encased except for a short portion of the Combie-Ophir Canal (approximately 900 feet in the vicinity of Bell Road). Rock Creek Canal (1,100 feet); Columbia Canal (3.800); and Bean Cullers Canal (700 feet). In addition NID operates a small reservoir on Orr Creek located approximately one mile upstream of the confluence of Orr Creek and Dry Creek. Nevada Irrigation District releases water from Combie-Ophir Canal to a tributary of Orr Creek in the very northern area of the study area and this water is later diverted to Gold Hill Canal via the small reservoir on Orr Creek.

Placer County Water Agency operates and maintains canals primarily in the eastern portion of the study area. These canals include the Boardman, Fiddler Green, Bowman, Shirland, and Freeman Canals. Boardman Canal extends from the north-eastern portion of the study area across to the southwestern corner and is the primary canal operated by PCWA in the study area. As with the NID canals, these canals are operated solely for water supply purposes, and only small portions of these canals have been encased. PCWA also operates two small reservoirs, Lake Arthur and Lake Theodore, that are used to supply water to their canal system in the event of an interruption in supply.

Pacific Gas and Electric Company operates and maintains canals in the study area primarily for the purpose of water supply and power generation. The primary canal maintained by PG&E in the study area for power generation is the Wise Canal which carries water from north to south through the study area. The Wise Canal is the largest canal in the study area (capacity over 500 cfs) and is not encased except in short segments where the water is diverted into penstocks.

The Bear River Canal releases water to Halsey Forebay located in the northeastern portion of the study area. This water is the released via a penstock to Halsey Powerhouse and Halsey Afterbay (located on upper Dry Creek). The water is then diverted from the Afterbay to Wise Canal. This segment of the canal transports the water from upper Dry Creek watershed to Rock Creek watershed and is released into Rock Creek Lake (owned by PG&E). Water is then diverted from Rock Creek Lake into a lower section of Wise Canal passing into the Auburn Ravine watershed, and ending up in the Wise Forebay. At the Wise Forebay the canal water enters

into a penstock and is carried to Wise Powerhouse located along the Auburn Ravine. From here canal water is released both to Auburn Ravine and South Canal.

The Wise Canal differs from other smaller water supply canals in the study area in that the Wise Canal has no spill points except for those into reservoirs. An emergency spill for the canal is located at the Wise Forebay and would spill to a small tributary of the North Ravine. However, this is designed to be used only in the event of penstock failure and has not been used to date.

Summary of 1986 Flooding Problems. The flood of February 1986 caused the most severe flooding damage to date in the Auburn/Bowman Community. As mentioned above, most of the flooding problems were due to inadequate bridges and culverts which resulted in overtopping of these structures. However at several locations in the study area flooding of structures did occur in the floodplains.

In order to identify the locations where flooding or overtopping has occurred, various departments were contacted within Placer County and interviews of staff members were conducted. The following is a list of departments contacted:

- Placer County Public Works Department
- Placer County Planning Department
- Placer County Office of Emergency Services

The following is a summary of the known existing problem areas due to flooding. It should be noted that this list may not be conclusive and does not include areas of local flooding not attributed to stream flow. It is also possible that more bridges and culverts were overtopped than are included in this list, but do not pose a hazard or cause damage to the structure and have not been reported to the County.

Dry Creek Watershed
Bowman Road Bridge at Dry Creek
Dry Creek Road adjacent to Dry Creek
Dry Creek Road and Haines Road at Dry Creek
Bell Road Bridge at Dry Creek
Blue Grass Road at Dry Creek
Twin Pines Trail at Dry Creek
Howe Road at Dry Creek
Hubbard Road at Dry Creek Tributary

Rock Creek Watershed
Sherwood Way at Rock Creek
Highway 49 Bridge at Rock Creek
Joeger Road at Rock Creek
Richardson Road at Rock Creek
Rock Creek Road at Rock Creek
New Airport Road at Rock Creek
New Airport Road at Rock Creek Tributary

Orr Creek Watershed
Christian Valley Road at Orr Creek
West Stanley Drive at Orr Creek
Lone Star at Orr Creek Tributary

North Ravine Watershed
Vada Ranch Road at North Ravine
Calnick Lane at North Ravine
Warren Way at North Ravine
Millertown Road at North Ravine
Mt. Vernon Road at North Ravine
Harris Road at North Ravine
Vista Road at North Ravine
Kemper Road at North Ravine
Millertown Road at North Ravine Tributary
Mt. Vernon Road at North Ravine Tributary
Bar Ranch Road at North Ravine Tributary

Auburn Ravine Watershed
Stonehouse Road and Forgotten Road at Auburn Ravine

Inventory of Stream Crossings. Many of the problems that occur as a result of flooding are related to inadequate conveyance structures (culverts or bridges) at stream crossings. Table 35 lists all the stream crossings in the watershed that were examined as part of the Hydrology Study. Also included in Table 35 are other major points of interest in the watershed. The crossing number can be used to locate the stream crossing on the "Stream Crossings and Points of Interest" maps in the Hydrology Study.

Storm Flow Estimation Techniques. The estimation of both existing and future stormflows is based upon the development and calibration of the hydrologic computer model called HEC-1 of the watersheds in the study area. This model simulates the runoff in the watersheds in response to precipitation and is a tool that is used to predict the amounts and timing of runoff from a wide variety of simulated rainfall events.

Another hydraulic model (HEC-2) was developed to model the flow characteristics (hydraulics) of larger streams within the Plan area (10-year flows exceeding 200 cfs). This hydraulic model aided in the determination of the water surface elevations associated with various streamflows within the stream channels as well as at particular structures such as bridges and culverts.

The full Hydrology Study contains a detailed description of these computer models and their application to the Plan area. The following few paragraphs discuss some of the more critical points regarding the models.

Whenever the use of a model is considered, or when the results of a model are interpreted, it is very important to understand the limitations that apply to the use of the model. Probably the most crucial limitation is that any model can only approximate the real world hydrologic and hydraulic processes. The HEC-1 model uses a number of simple mathematical and empirical methods to represent the complex physical processes that produce runoff from precipitation and route that runoff through a watershed. Although these methods are among the best currently available, they are still only mathematical or empirical simplifications of complex physical processes. The model assumptions and methods are described fully in the Hydrology Study.

The Plan area was subdivided into 105 sub-basins to provide the necessary detail for the purpose of the hydrology study. This division was made on the basis of hydrologic characteristics of the watershed with the goal of providing information at stream junctions, major bridges and crossings, problem areas, and downstream boundaries. Sub-basin hydrologic divisions were based on topography from the USGS 1:24,000 scale topographic maps. The sub-basin areas range from 0.10 square miles (64 acres) to over two square miles (1300 acres). Figure 17, at the beginning of this Chapter, shows all the study sub-basins in the study area. Table 37 presented in subsequent pages, contains most of the pertinent data and parameters for each sub-basin in the watershed for the existing conditions. The important characteristics of the sub-basins include the following:

- Size (basin area)
- Length of stream channels
- Slope of stream channels
- Rainfall loss rates due to infiltration into the soil
- Amount of impervious surfaces
- Channel and floodplain characteristics

Table 35

LIST OF STREAM CROSSINGS AND MAJOR POINTS OF INTEREST

CROSSING NUMBER	STREAM	CROSSING
1	ORR CREEK	INFLOW TO COON CR.
2		BELL RD.
3		TRIB. CONFLUENCE
4		TRIB. CONFLUENCE
5		HWY 49 (State)
6		TRIB. CONFLUENCE
7		W. STANLEY DR.
8		TRIB. CONFLUENCE
9		E. STANLEY DR.
10		COMBIE-OPHIR SIPHON
11		CHRISTIAN VALLEY RD.
12		TRIB. CONFLUENCE
13		STUDY BOUNDARY
14		TRIB. CONFLUENCE
15	ORR CK TRIB #1	LITTLE CREEK RD. (Private)
16	ORR CK TRIB #2	VIRGINIA WAY
17		KENNETH WY. (Private)
17	ORR CK TRIB #3	LONE STAR RD.
19	DRY CREEK	INFLOW TO COON CR
20		BELL RD.
21		TRIB. CONFLUENCE
22		ROCK CK. CONFLUENCE
23		HWY 49 (State)
24		TRIB. CONFLUENCE
25		BLUE GRASS RD.
26		BELOW DAM
27		INFLOW TO RES.
28		DRY CK. ROAD
29		TWIN PINES TR. (Private)
30		HAINES RD.
31		HALSEY AFTBAY OUTFLOW
32		BOWMAN RD.
33		LAKE ARTHUR RD.
34		LAKE ARTHUR RD.
35		BELOW LAKE ARTHUR
36	DRY CK TRIB #1	DRY CREEK RD.
37	DRY CK TRIB #2	DRY CREEK RD.

CROSSING NUMBER	STREAM	CROSSING
38	DRY CK TRIB #3	BLACK OAK RD.
39	DRY CK TRIB #4	DRY CREEK RD
40	DRY CK TRIB #5	JOEGER RD.
41	DRY CK TRIB #6	HOE RD. (Private)
42		HUBBARD RD. (Private)
43		JOEGER RD.
44	ROCK CREEK	INFLOW TO DRY CREEK
45		JOEGER RD.
46		SHERWOOD WY.
47		DRY CREEK RD.
48		RICHARDSON RD.
49		HWY 49 (State)
50		ROCK CREEK RD.
51		ROCK CK LAKE OUTFLOW
52		ROCK CK LAKE INFLOW
53		BELL RD.
54		NEW AIRPORT RD.
55		CRYSTAL SPRINGS RD.
56		TRIB. CONFLUENCE
57		CREEKVIEW CT.
58		RAILROAD
59	ROCK CK TRIB #1	RAILROAD
60	ROCK CK TRIB #2	NEW AIRPORT RD.
61		BELL RD.
62	ROCK CK TRIB #3	LOCKSLEY LN.
63	ROCK CK TRIB #4	ROCK CREEK RD.
64		BELL RD.
65	NORTH RAVINE	WISE RD.
66		WARREN WY. (Private)
67		CALNICK RD. (Private)
68		BELOW MILLERTOWN RD.
69		TRIB. CONFLUENCE
70		MILLERTOWN RD

CROSSING NUMBER	STREAM	CROSSING
71		MT. VERNON RD.
72		HARRIS RD. (Private)
73		VISTA ROBLE RD. (Private)
74		ATWOOD RD.
75	N.RAV. TRIB #1	KEMPER RD. (Private)
76	N.RAV. TRIB #2	HIDDEN OAKS LN. (Private)
77		RAILROAD
78		HWY 49 (State)
79		PEAR RD. (Private)
80	N.RAV. TRIB #3	MILLERTOWN RD.
81		MT. VERNON RD.
82	N.RAV. TRIB #4	MILLERTOWN RD.
83		BAR RANCH RD. (Private)
84	AUBURN RAVINE	AUBURN RAVINE OUTFLOW
85		N. RAVINE CONFLUENCE
86		WISE RD.
87		OPHIR RD.
88		OPHIR RD.
89		FORGOTTEN RD. (Abandoned)
90	AUBURN R. TRIB	I-80 (State)
91		RAILROAD
92	DUTCH RAVINE	RAILROAD
93		AUBURN-FOLSOM RD.
94	MORMON RAVINE	SHIRLAND RD.
95	MORMON R. TRIB	NO NAME RD
96		ANDREGG RD.
97	AMER.R.TRIB #1	HWY 49 (State)
98	AMER.R.TRIB #2	HWY 49 (State)
99	DEADMAN CANYON	JOEGER RD.
100		OAK CREEK CT.

Additionally, special provisions were made for canals since they have the capability of intercepting sheet runoff from areas directly upstream of the canals, as well as the potential to spill at locations located along the canals. Therefore, it may be possible for a canal to intercept storm runoff in one watershed and transport the water to another watershed where it may be spilled to a stream.

All canals with capacities greater than 10 cfs were incorporated in the HEC-1 model by utilizing the diversion options in the model. In effect, the canals were simulated by diverting water from sub-basins where canals cross through and then adding the diversion to the sub-basins where the spills are located.

The Hydrology Study (Table 2-4) lists the canals that were incorporated into the model along with the associated canal capacities and sub-basins where diversions and spills take place. Assumptions regarding the canals are described in the full Hydrology Study.

A final step preparing the computer models is called calibration. Calibration of a model is the process used to ensure that the model predicts actual system behavior as closely as possible. In model calibration, known data for a historical event is entered into the model and the resultant estimates from the model are compared with the known flood conditions. Parameters in the model are then adjusted until the model output matches historic data for the event.

The HEC-1 model of the Auburn/Bowman Community was calibrated to observed flows and high water marks for flood events occurring in February 1986. Peak flows in the February 18-19, 1986 event had recurrence intervals for most of the study area of approximately 100 years.

The precipitation used for calibration of the HEC-1 model was based on actual rain gage data collected during the calibration event (February 1986 storm).

Unfortunately, no stream gages are located within the study area and hence, very limited information was available on flows resulting from the February 1986 storm. However, through interviews with County officials, flooding problem areas were identified as described previously.

In addition PG&E did record the high water mark at the spill of Rock Creek Reservoir as a result of the storm. From this information PG&E estimated the peak spill to Rock Creek to be approximately 1100 cfs (with an additional release of 350 cfs from Rock Creek Reservoir to Wise Canal). PG&E also estimated the peak flow from Halsey Afterbay to Dry Creek to be approximately 1400 cfs. A comparison of these estimated flows to model simulated flows is presented in Table 36.

Table 36
HEC-1 MODEL CALIBRATION RESULTS

	PG&E estimated	HEC-1 Model
Rock Creek Lake Spill	1121 cfs	958 cfs
Halsey Afterbay Spill (Dry Creek)	1400 cfs	1455 cfs

Existing Condition (1990) Model. The Existing, or Base, Condition Model was developed utilizing the land use survey by Placer County Planning Department (1990) and is taken to represent the present condition of the study area. Channel and floodplain descriptions were based on the aerial photography and personal visits to each of the locations where streams cross roadways in the watershed. Tables 37 and 38 contain the hydrologic data for the Base and Future Condition Model.

The model setups described above were used to make HEC-1 model runs for the major points of interest in the watershed, such as culverts, bridges, problem areas, and tributary confluences. The 2-, 10-, 25-, and 100-year peak flows for Present and Future conditions at each of these locations are listed in Table 39 (the future conditions are described in the Impacts section). The Hydrology Study maps "Stream Crossings and Points of Interest" (A-C) indicate the locations for the peak flows listed in Table 39.

Summary of 100-year Storm Problems. The overtopping of culverts and bridges were determined using two methods.

1. Where HEC-2 model input data were available, the HEC-2 model and its associated bridge and culvert routines were used to determine the flow at which a bridge or culvert overtopped.

2. In stream reaches where the HEC-2 model was not developed, the Federal Highway Administration (FHWA) standard culvert formulas and nomographs were used to determine the capacity of the bridge or culvert. Due to the relatively steep slopes throughout the study area, the structures were analyzed as inlet control structures.

After the bridge and culvert capacities were determined, they were compared against the 2-Year, 10-Year, 25-Year and 100-year flood flows at the study locations. The capacity of the bridge or culvert was next subtracted from the flood flow and any remaining flow was entered in Table 44, which is contained in the Impacts section. (This table shows both existing and future conditions; the future conditions are described in the Impacts section). It is important to note that overtopping alone does not necessarily mean that damage will occur to the road surface or structure itself. It does mean that traffic on the roadway, and in particular emergency traffic, may be severely impeded and a serious safety hazard may exist.

The extent of the upstream floodplain that is affected by backwater from undersized culverts and bridges is hard to determine without detailed survey information indicating the elevation of the floodplain and dwellings and other buildings that may be in the floodplain. This detailed type of information was not collected as a part of the hydrology study and hence, is not possible to review in detail.

Bridges and Culverts - Overtopping and Backwater. Table 44, contained in the Impacts section, contains a listing of all bridges and culverts, with an indication next to those that have insufficient capacity to pass the design storms without going over the top of the roadway. The numbers in the table indicate the magnitude, in cfs, of the peak flow over the roadway at that location. A blank in the table indicates that the culvert or bridge has sufficient capacity to pass the flood.

Table 37
1990 BASE CONDITION SUBBASIN HYDROLOGIC DATA

BASIN ID	BASIN DESCRIPTION	Basin Area (Sq Mi)	Chan DElev (ft)	Basin UElev (ft)	Basin Length (ft)	Basin Centrd (ft)	Basin Slope (ft/mi)	Basin Type	Basin 'n'	Basin Ct	Basin Lag (hr)	Basin Cp	Imp Area (%)	1990 LAND USE CONDITIONS									Loss Rates (in/hr)	SCS Soil Classification			
														Comm 0.90	HDR 0.60	MDR 0.30	LDR 0.20 (%)	RLDR 0.15	RR 0.10	RE 0.10	Ag 0.10	Open 0.02		A:.48 A:.31	B:.25 B:.16	C:.16 C:.09	D:.12 D:.07
BR2	Bear River	0.30	940	1355	3390	2368	646	4	0.15	3.90	0.89	0.60	2.0								50	50	0.084		15		85
BR5	Bear River	0.26	1080	1380	3025	2349	524	4	0.15	3.90	0.88	0.60	2.0								40	60	0.075		5		95
BR10	Bear River	0.57	1100	1460	4446	2794	428	4	0.15	3.90	1.10	0.60	2.0								10	90	0.07		0.5		99.5
BR15	Bear River	0.31	1200	1360	1913	2348	442	4	0.15	3.90	0.78	0.60	2.0								10	90	0.07				100
BR20	Bear River	0.15	1250	1480	3000	1801	405	4	0.15	3.90	0.84	0.60	2.0								65	35	0.072		2		98
BR25	Bear River	0.33	1250	1415	3400	1662	256	3	0.15	3.90	0.92	0.60	2.0								75	25	0.072		2	0.5	97.5
BR30	Bear River	0.19	1310	1430	3000	2100	211	4	0.15	3.90	0.99	0.60	2.0								100		0.118		43	44	13
CL1	Clipper Creek	2.17	1760	1980	8100	3960	143	4	0.15	3.90	1.80	0.60	2.0									100	0.118		43	44	13
CL2	Clipper Creek	1.46	1560	1760	4270	4270	247	4	0.15	3.90	1.37	0.60	2.0									100	0.118		43	44	13
CL5	Clipper Creek	1.48	1230	1560	13400	8300	130	4	0.15	3.90	2.76	0.60	2.0									100	0.118		43	44	13
CL10	Clipper Creek	0.55	700	1230	4387	3256	638	4	0.15	3.90	1.08	0.60	2.8							10	90		0.09		20	8	72
AM5	American River	0.45	575	1570	3530	2618	1488	4	0.15	3.90	0.81	0.60	3.2						5	10		85	0.116		48	15	37
AM10	American River	0.54	600	1480	4166	2958	1115	4	0.14	3.64	0.87	0.60	8.6	5			10		5		50	30	0.094		13	18	69
AM15	American River	0.37	580	1560	4800	3400	1078	3.5	0.11	2.86	0.76	0.60	17.4	15			10		5		30	40	0.088		5		95
AM20	American River	0.14	530	1320	3800	2386	1098	4	0.15	3.90	0.85	0.60	2.9				5				30	65	0.109		40		60
AM25	American River	0.46	530	1500	6000	2850	854	3.5	0.08	2.08	0.58	0.60	13.7			5	40	5	30			20	0.114		20		80
AM30	American River	0.30	600	1380	4400	2576	936	3.5	0.09	2.34	0.56	0.60	14.9	5		15	15			20		45	0.114		25		75
AM35	American River	0.15	540	1355	2100	1325	2049	4	0.12	3.12	0.41	0.60	10.4			30					30	40	0.144		57	3	40
AM40	American River	0.15	500	1280	4000	2502	1030	4	0.08	2.08	0.47	0.60	24.4			80					20		0.123		10	1	89
AM45	American River	0.49	500	1320	3800	2049	1139	3.5	0.11	2.86	0.59	0.60	6.2			15					85		0.089		12		88
AM50	American River	0.17	560	1220	3600	2550	968	3.5	0.13	3.38	0.75	0.60	2.0									100	0.121	1	54		45
AM55	American River	0.14	500	1360	3400	2000	1336	3.5	0.13	3.38	0.65	0.60	2.0									100	0.113	1	45		54
AM60	American River	0.17	500	1120	2800	1610	1169	4	0.15	3.90	0.67	0.60	2.0									100	0.083		14		86
AM65	American River	0.24	490	1240	4095	2966	967	3.5	0.13	3.38	0.83	0.60	2.0								40	60	0.084		16		84
AM70	American River	0.32	480	1200	4400	1927	864	4	0.14	3.64	0.81	0.60	2.7					5			90	5	0.077		8		92
OC2	Bear River Canal	0.46	1695	1800	3730	3260	149	3.5	0.13	3.38	1.13	0.60	2.8							10		90	0.132		63	25	12
OC5	Irrig. Reservoir	0.37	1660	1880	4400	2600	264	3	0.11	2.86	0.85	0.60	2.8							10		90	0.097		10	90	
OC10	Sugar Pine Mtn.	0.53	1560	1660	4163	3603	127	4	0.15	3.90	1.43	0.60	2.8							10		90	0.09			100	
OC15	Halsey Forebay	0.32	1695	1765	4400	3800	84	3.5	0.13	3.38	1.37	0.60	2.8							10		90	0.115		35	65	
OC20	Christian Valley R.	0.39	1545	1680	4904	2582	145	3.5	0.11	2.86	0.97	0.60	7.6						10	60		30	0.095		7	93	
OC25	Christian Valley R	0.59	1475	1640	4200	1870	207	4	0.11	2.86	0.78	0.60	5.6						40	5		55	0.104		20	80	
OC30	Stanley Drive	0.59	1400	1475	2907	2007	136	3.5	0.11	2.86	0.76	0.60	6.4						40	15	25	20	0.096		15	60	25
OC35	Shirley Lane	0.17	1340	1400	3388	1489	94	3.5	0.11	2.86	0.77	0.60	5.2						40		25	35	0.097		30		70
OC40	Sunshine Mdw. Dr.	0.31	1495	1640	3583	2250	214	3.5	0.11	2.86	0.78	0.60	9.6							95		5	0.073			14	86
OC45	Kimo Way	0.17	1340	1495	1954	1054	419	3	0.09	2.34	0.37	0.60	9.6						10	85		5	0.07				100

Table 37 (Cont.)
1990 BASE CONDITION SUB-BASIN HYDROLOGIC DATA

BASIN ID	BASIN DESCRIPTION	Basin Area (Sq Mi)	Chan DElev (ft)	Basin UElev (ft)	Basin Length (ft)	Basin Centrd (ft)	Basin Slope (ft/mi)	Basin Type	Basin 'n'	Basin Ct	Basin Lag (hr)	Basin Cp	Imp Area (%)	1990 LAND USE CONDITIONS Comm 0.90	HDR 0.60	MDR 0.30	LDR 0.20 (%)	RLDR 0.15	RR 0.10	RE 0.10	Ag 0.10	Open 0.02	- Loss Rates (in/hr)	SCS Soil Classification A:.48 A:.31	B:.25 B:.16	C:.16 C:.09	D:.12 D:.07
OC50	Stanley Drive	0.38	1300	1340	4252	2663	50	4	0.10	2.60	1.01	0.60	9.6						80	15		5	0.106		40		60
OC55	Gold Hill Canal	0.60	1340	1435	5280	3256	95	3.5	0.13	3.38	1.36	0.60	2.4							5	95		0.094		12	68	20
OC60	Lake Valley Drive	0.49	1300	1400	5200	3600	102	3.5	0.12	3.12	1.28	0.60	3.6							20	80		0.081		5	30	65
OC62	McElroy Drive	0.44	1320	2121	4200	2800	1007	3.5	0.12	3.12	0.75	0.60	8.4							80		20	0.081		5	30	65
OC65	Hwy 49 Bridge	0.32	1285	1300	2348	1978	34	3.5	0.13	3.38	1.05	0.60	2.0								95	5	0.084		15		85
OC70	Lone Star School	0.61	1320	1410	3038	1953	156	3	0.11	2.86	0.75	0.60	2.0								75	25	0.081		12		88
OC75	Hwy 49	0.70	1285	1360	6400	4200	62	3	0.11	2.86	1.43	0.60	2.0								97	3	0.084		7	40	53
OC80	Hwy 49	1.01	1160	1285	6617	4059	100	3.5	0.13	3.38	1.56	0.60	2.2							2	90	8	0.075		5		95
OC85	Lone Star Canal	0.33	1285	1460	4800	2300	193	3.5	0.13	3.38	1.05	0.60	2.0								100		0.071		1		99
OC90	Lone Star Spill	0.15	1160	1285	2300	1295	287	3.5	0.13	3.38	0.64	0.60	2.0								100		0.07				100
OC95	Lone Star Cmty	0.38	1050	1120	4211	2074	88	4	0.15	3.90	1.27	0.60	2.0								95	5	0.07				100
DC5	Hwy 80	0.68	1740	1970	6000	3512	202	4	0.13	3.38	1.28	0.60	4.6							33	33	34	0.087		0.5	84.5	15
DC10	Hwy 80	0.98	1600	1860	7335	3966	187	3.5	0.12	3.12	1.33	0.60	4.6							33	33	34	0.087			86	14
DC15	Christian Valley R	0.48	1540	1820	4833	3469	306	4	0.14	3.64	1.20	0.60	4.4							30		70	0.096		12	75	13
DC20	Hwy 80	0.44	1540	1600	2776	2148	114	4	0.14	3.64	1.00	0.60	4.6							33	33	34	0.094		10	75	15
DC25	Dry Creek Road	0.47	1500	1600	3242	1587	163	3.5	0.13	3.38	0.84	0.60	8.2	7							30	63	0.133		60	20	20
DC30	Dry Creek Road	0.41	1420	1580	4200	2000	201	3.5	0.12	3.12	0.88	0.60	6.4	3						22		75	0.142		70	30	
DC35	Bowman Canal	0.62	1415	1700	5600	3950	269	4	0.15	3.90	1.44	0.60	3.2						8	7		85	0.135		67	25	8
DC40	Bell Road	0.57	1420	1600	5000	3800	190	4	0.14	3.64	1.35	0.60	9.4	5		2				30	25	38	0.121		45	25	30
DC45	Dry Creek Road	0.83	1335	1420	5620	3335	80	3.5	0.12	3.12	1.33	0.60	5.2							40		60	0.095		25	10	65
DC50	Gregg Way	0.27	1400	1645	3400	2138	380	3	0.10	2.60	0.63	0.60	8.4						40	40	15	5	0.139		70	30	
DC55	Black Oak Road	0.55	1335	1760	5200	2400	432	3.5	0.12	3.12	0.88	0.60	5.6							45	45	10	0.12		55		45
DC60	Dry Creek Road	0.32	1305	1490	4300	1300	227	3	0.09	2.34	0.56	0.60	8.0							75		25	0.074		4	2	94
DC65	Dry Creek Road	0.68	1260	1305	3301	1700	72	3.5	0.12	3.12	0.91	0.60	4.8							35		65	0.078		7	8	85
DC70	Dry Creek Road	0.24	1225	1470	3800	1653	340	3.5	0.11	2.86	0.67	0.60	6.8						40	20		40	0.071		1		99
DC75	Moss Rock Drive	0.28	1235	1360	3600	2188	183	3.5	0.11	2.86	0.60	0.60	10.0						5	95			0.07		0.5		99.5
DC80	Hwy 49	0.56	1200	1430	5200	950	234	3.5	0.08	2.08	0.48	0.60	14.7	5			15		30	40		10	0.08		0.5		99.5
DC85	Hwy 49	0.47	1180	1340	3600	2400	235	3.5	0.10	2.60	0.72	0.60	6.0						5	45	50		0.07				100
DC90	Joeger Road	0.69	1080	1180	6180	3472	85	3.5	0.10	2.60	1.14	0.60	5.6						5	40	50	5	0.07				100
DC95	Meadowbrook Dr.	0.29	1270	1410	5212	2777	142	3.5	0.13	3.38	1.20	0.60	2.0								100		0.07				100
DC100	Bell Road	0.94	1080	1270	5587	3365	180	3.5	0.11	2.86	1.07	0.60	7.6							70	25	5	0.07				100
DC105	Bell Road	0.44	1040	1080	3102	1618	68	3.5	0.13	3.38	0.96	0.60	2.0								100		0.084	6			94
RC5	S.P.R.R.	0.40	1500	1620	5400	2880	117	3.5	0.09	2.34	0.88	0.60	11.5	5				30		15		50	0.096		20	25	55
RC10	S.P.R.R.	0.21	1500	1600	4000	2800	132	3.5	0.11	2.86	0.95	0.60	11.9	3			7			75		15	0.115	1	39	5	55
RC15	S.P.R.R.	0.37	1450	1500	4629	2761	57	3.5	0.12	3.12	1.24	0.60	8.8	3			15	10		2		70	0.083		4	2	94
RC20	Bell Road	0.77	1450	1620	7000	2949	128	3	0.10	2.60	1.06	0.60	4.4	2						8	10	80	0.08		8	7	85

Table 37 (Cont.)
1990 BASE CONDITION SUB-BASIN HYDROLOGIC DATA

BASIN ID	BASIN DESCRIPTION	Basin Area (Sq Mi)	Chan DElev (ft)	Basin UElev (ft)	Basin Length (ft)	Basin Centrd (ft)	Basin Slope (ft/mi)	Basin Type	Basin 'n'	Basin Ct	Basin Lag (hr)	Basin Cp	Imp Area (%)	1990 LAND USE CONDITIONS Comm 0.90	HDR 0.60	MDR 0.30	LDR 0.20 (%)	RLDR 0.15	RR 0.10	RE 0.10	Ag 0.10	Open 0.02	Loss Rates (in/hr)	SCS Soil Classification A:.48 A:.31	B:.25 B:.16	C:.16 C:.09	D:.12 D:.07
RC25	Rock Creek Lake	0.47	1420	1485	3085	1360	111	2	0.07	1.82	0.45	0.60	25.2		40						5	55	0.091			5	95
RC30	Rock Creek Road	0.35	1330	1470	4550	2757	162	2	0.05	1.30	0.43	0.60	36.7	15	35				15			35	0.107		6	18	76
RC35	Hwy 49	0.41	1355	1390	3200	1800	58	2	0.04	1.04	0.32	0.66	52.3	45	12	5		18				20	0.101				100
RC40	Hwy 49	0.35	1330	1355	2823	2055	47	2	0.06	1.56	0.49	0.60	29.2	30						10		60	0.085				100
RC45	Hwy 49	0.47	1265	1330	3601	1599	95	3	0.08	2.08	0.58	0.60	17.0	8		25		7				60	0.087				100
RC50	Dry Creek Road	0.28	1215	1345	2800	1260	245	3.5	0.10	2.60	0.53	0.60	7.8					20		40		40	0.07				100
RC55	Joeger Road	0.21	1180	1215	2437	1854	76	3.5	0.08	2.08	0.56	0.60	6.9					10	20	25	40	5	0.07				100
DM5	Deadman Canyon	0.63	1245	1360	3702	2403	164	3.5	0.11	2.86	0.85	0.60	8.1				5		5	60	25	5	0.073				100
DM10	Deadman Canyon	0.36	1060	1245	2300	1874	425	4	0.14	3.64	0.72	0.60	3.6							20	70	10	0.093		25		75
AR1A	Auburn (CH2M)	1.57			8000	3400	174		0.04		0.34	0.75	24.0										0.15				
AR1B	Auburn (CH2M)	0.29			5000	2600	153		0.02		0.22	0.80	38.0										0.15				
AR2A	Auburn (CH2M)	1.66			6200	2200	121		0.03		0.28	0.75	29.0										0.15				
AR15	Stonehouse Road	0.54	940	1180	5800	2800	218	4	0.13	3.38	1.16	0.60	13.8	10			10		5	10		65	0.1		20		80
AR20	Highway 80	0.52	940	1295	5200	3295	360	4	0.13	3.38	1.09	0.60	12.0	5		20						75	0.119		35	5	60
AR25	Ophir Road	0.10	930	940	1161	503	45	3.5	0.11	2.86	0.43	0.60	10.0							100			0.084		15		85
AR30	Highway 80	0.49	835	1190	5600	2000	335	3.5	0.12	3.12	0.88	0.60	9.6	5						40		55	0.089		18		82
AR35	Highway 80	0.64	1350	1500	3800	2400	208	2	0.04	1.04	0.30	0.60	36.3	25	10		25	15			5	20	0.1				100
AR40	S.P.R.R.	0.56	1240	1380	3700	1300	200	3	0.07	1.82	0.43	0.60	25.0	12	12	12	12				45	7	0.094				100
AR45	Bean Road	0.60	1100	1340	5400	2300	235	3.5	0.11	2.86	0.89	0.60	6.8						30	30	30	10	0.07				100
AR50	Atwood Road	0.35	1215	1415	6866	4378	154	3	0.08	2.08	0.93	0.60	22.2	20		3				22	40	15	0.082				100
AR55	Atwood Road	0.27	1215	1420	5400	3562	200	3.5	0.09	2.34	0.86	0.60	31.0	30		5				15	20	30	0.088				100
AR60	Hidden Oaks Rd.	0.18	1100	1215	3984	2294	152	3.5	0.11	2.86	0.86	0.60	9.2							90	10		0.07				100
AR62	Mt. Vernon Rd.	0.64	1100	1240	5900	4000	125	3.5	0.11	2.86	1.22	0.60	9.2							90		10	0.07				100
AR65	Vaca Ranch Rd.	0.63	1030	1100	3595	1657	103	3.5	0.12	3.12	0.87	0.60	7.2							65	35		0.078		7	8	85
AR70	Mt. Vernon Rd.	0.65	1040	1300	6300	3698	218	3.5	0.09	2.34	0.91	0.60	14.6	7					25	55	10	3	0.085		12		88
AR75	Bar Ranch Road	0.14	1020	1190	2800	1800	321	4	0.12	3.12	0.68	0.60	10.0							100			0.07		0.5		99.5
AR80	Millertown Road	0.59	835	1020	6571	4086	149	4	0.12	3.12	1.35	0.60	10.0							100			0.072		2		98
AR85	Highway 80	0.40	800	1080	4400	2800	336	3.5	0.12	3.12	0.91	0.60	6.0							50	50		0.071		1		99
DR5	Dutch Ravine	0.74	1100	1280	5137	3995	185	3.5	0.13	3.38	1.29	0.60	2.4							5	10	85	0.111		45		55
DR10	Dutch Ravine	0.27	980	1100	3085	1544	205	3.5	0.12	3.12	0.72	0.60	6.4						10	45	45		0.106		40		60
MR2	Mormon Ravine	0.10	895	1240	4400	2050	414	3.5	0.13	3.38	0.86	0.60	2.4							5	30	65	0.072		2		98
MR5	Mormon Ravine	0.35	920	1240	5398	3055	313	3.5	0.13	3.43	1.12	0.60	2.6							8		92	0.074			20	80
MR10	Mormon Ravine	0.10	835	920	2144	1439	209	3.5	0.11	2.86	0.57	0.60	10.0							100			0.077		3	20	77
MR15	Mormon Ravine	0.44	1005	1220	6548	4695	173	3.5	0.12	3.12	1.38	0.60	4.6							33	33	34	0.07			2	98
MR20	Mormon Ravine	0.19	1125	1240	2536	2083	239	3	0.10	2.60	0.61	0.60	5.3					25			65	10	0.081		12		88
MR25	Mormon Ravine	0.19	1040	1125	2660	1923	169	3	0.11	2.86	0.70	0.60	2.7					5			95		0.077			35	65

Table 38
FUTURE CONDITION SUB-BASIN HYDROLOGIC DATA

BASIN ID	BASIN DESCRIPTION	Basin Area (Sq Mi)	Chan DElev (ft)	Basin UElev (ft)	Basin Length (ft)	Basin Centrd (ft)	Basin Slope (ft/mi)	Basin Type	Basin 'n'	Basin Ct	Basin Lag (hr)	Basin Cp	Imp Area (%)	Community Plan Land Use Conditions									Loss Rates (in/hr)	SCS Soil Classification			
														Comm 0.90	HDR 0.60	MDR 0.30	LDR 0.20 (%)	RLDR 0.15	RR 0.10	RE 0.10	Ag 0.10	Open 0.02		A:.48 A:.31	B:.25 B:.16	C:.16 C:.09	D:.12 D:.07
BR2	Bear River	0.30	940	1355	3390	2368	646.37	4	0.15	3.9	0.89	0.60	2.0								100		0.084		15		85
BR5	Bear River	0.26	1080	1380	3025	2349	523.64	4	0.15	3.9	0.88	0.60	2.0								100		0.075		5		95
BR10	Bear River	0.57	1100	1460	4446	2794	427.53	4	0.15	3.9	1.10	0.60	2.0								100		0.07		0.5		99.5
BR15	Bear River	0.31	1200	1360	1913	2348	441.61	4	0.15	3.9	0.78	0.60	2.0								100		0.07				100
BR20	Bear River	0.15	1250	1480	3000	1801	404.8	4	0.15	3.9	0.84	0.60	2.0								100		0.072		2		98
BR25	Bear River	0.33	1250	1415	3400	1662	256.24	3	0.15	3.9	0.92	0.60	2.0								100		0.072		2	0.5	97.5
BR30	Bear River	0.19	1310	1430	3000	2100	211.2	4	0.15	3.9	0.99	0.60	2.0								100		0.118		43	44	13
CL1	Clipper Creek	2.17	1760	1980	8100	3960	143.41	4	0.15	3.9	1.80	0.60	2.0									100	0.118		43	44	13
CL2	Clipper Creek	1.46	1560	1760	4270	4270	247.31	4	0.15	3.9	1.37	0.60	2.0									100	0.118		43	44	13
CL5	Clipper Creek	1.48	1230	1560	13400	8300	130.03	4	0.15	3.9	2.76	0.60	2.0									100	0.118		43	44	13
CL10	Clipper Creek	0.55	700	1230	4387	3256	637.88	4	0.15	3.9	1.08	0.60	2.8							10	90		0.09		20	8	72
AM5	American River	0.45	575	1570	3530	2618	1488.3	4	0.15	3.9	0.81	0.60	12.8	10						25	10	55	0.123		48	15	37
AM10	American River	0.54	600	1480	4166	2958	1115.3	4	0.14	3.64	0.87	0.60	5.0				10		5	10	55	20	0.091		13	18	69
AM15	American River	0.37	580	1560	4800	3400	1078	3.5	0.11	2.86	0.76	0.60	23.6	15		10	20		25			30	0.098		5		95
AM20	American River	0.14	530	1320	3800	2386	1097.7	3.5	0.11	2.86	0.62	0.60	7.0				10		40			50	0.113		40		60
AM25	American River	0.46	530	1500	6000	2850	853.6	3.5	0.08	2.08	0.58	0.60	13.7			5	40	5	30			20	0.114		20		80
AM30	American River	0.30	600	1380	4400	2576	936	3.5	0.09	2.34	0.56	0.60	14.9	5		15	15			20		45	0.114		25		75
AM35	American River	0.15	540	1355	2100	1325	2049.1	4	0.12	3.12	0.41	0.60	10.4			30					30	40	0.144		57	3	40
AM40	American River	0.15	500	1280	4000	2502	1029.6	4	0.08	2.08	0.47	0.60	24.4			80					20		0.123		10	1	89
AM45	American River	0.49	500	1320	3800	2049	1139.4	3.5	0.11	2.86	0.59	0.60	6.2			15					85		0.089		12		88
AM50	American River	0.17	560	1220	3600	2550	968	3.5	0.13	3.38	0.75	0.60	2.0									100	0.121	1	54		45
AM55	American River	0.14	500	1360	3400	2000	1335.5	3.5	0.13	3.38	0.65	0.60	2.0									100	0.113	1	45		54
AM60	American River	0.17	500	1120	2800	1610	1169.1	4	0.15	3.9	0.67	0.60	2.0									100	0.083		14		86
AM65	American River	0.24	490	1240	4095	2966	967.03	3.5	0.13	3.38	0.83	0.60	2.0								40	60	0.084		16		84
AM70	American River	0.32	480	1200	4400	1927	864	4	0.14	3.64	0.81	0.60	2.7					5			90	5	0.077		8		92
OC2	Bear River Canal	0.46	1695	1800	3730	3260	148.63	3.5	0.13	3.38	1.13	0.60	2.8							10		90	0.132		63	25	12
OC5	Irrig. Reservoir	0.37	1660	1880	4400	2600	264	3	0.11	2.86	0.85	0.60	2.8							10		90	0.097		10	90	
OC10	Sugar Pine Mtn.	0.53	1560	1660	4163	3603	126.83	4	0.15	3.9	1.43	0.60	2.8							10		90	0.09			100	
OC15	Halsey Forebay	0.32	1695	1765	4400	3800	84	3.5	0.11	2.86	1.16	0.60	8.4							80		20	0.115		35	65	
OC20	Christian Valley R.	0.39	1545	1680	4904	2582	145.35	3.5	0.1	2.6	0.88	0.60	9.6						10	85		5	0.095		7	93	
OC25	Christian Valley R	0.59	1475	1640	4200	1870	207.43	3.5	0.09	2.34	0.64	0.60	8.8						40	45	10	5	0.104		20	80	
OC30	Stanley Drive	0.59	1400	1475	2907	2007	136.22	3.5	0.11	2.86	0.76	0.60	7.2						45	20	30	5	0.096		15	60	25
OC35	Shirley Lane	0.17	1340	1400	3388	1489	93.506	3.5	0.11	2.86	0.77	0.60	6.0						45	5	20	30	0.097		30		70
OC40	Sunshine Mdw. Dr.	0.31	1495	1640	3583	2250	213.68	3.5	0.11	2.86	0.78	0.60	9.6							95		5	0.073			14	86
OC45	Kimo Way	0.17	1340	1495	1954	1054	418.83	3	0.09	2.34	0.37	0.60	9.2						15	75		10	0.07				100

Table 38 (Cont.)
FUTURE CONDITION SUB-BASIN HYDROLOGIC DATA

BASIN ID	BASIN DESCRIPTION	Basin Area (Sq Mi)	Chan DElev (ft)	Basin UElev (ft)	Basin Length (ft)	Basin Centrd (ft)	Basin Slope (ft/mi)	Basin Type	Basin 'n'	Basin Ct	Basin Lag (hr)	Basin Cp	Imp Area (%)	Community Plan Land Use Conditions									Loss Rates (in/hr)	SCS Soil Classification			
														Comm 0.90	HDR 0.60	MDR 0.30	LDR 0.20 (%)	RLDR 0.15	RR 0.10	RE 0.10	Ag 0.10	Open 0.02		A:.48 A:.31	B:.25 B:.16	C:.16 C:.09	D:.12 D:.07
OC50	Stanley Drive	0.38	1300	1340	4252	2663	49.671	4	0.1	2.6	1.01	0.60	9.2						80	10	5	5	0.106		40		60
OC55	Gold Hill Canal	0.60	1340	1435	5280	3256	95	3.5	0.13	3.38	1.36	0.60	2.4							5	95		0.094		12	68	20
OC60	Lake Valley Drive	0.49	1300	1400	5200	3600	101.54	3.5	0.12	3.12	1.28	0.60	4.4							30	70		0.081		5	30	65
OC62	McElroy Drive	0.44	1320	2121	4200	2800	1007	3.5	0.12	3.12	0.75	0.60	8.4							80		20	0.081		5	30	65
OC65	Hwy 49 Bridge	0.32	1285	1300	2348	1978	33.731	3.5	0.12	3.38	1.05	0.60	2.0								95	5	0.084		15		85
OC70	Lone Star School	0.61	1320	1410	3038	1953	156.42	3	0.11	2.86	0.75	0.60	2.0								95	5	0.081		12		88
OC75	Hwy 49	0.70	1285	1360	6400	4200	61.875	3	0.11	2.86	1.43	0.60	2.0								95	5	0.084		7	40	53
OC80	Hwy 49	1.01	1160	1285	6617	4059	99.743	3.5	0.13	3.38	1.56	0.60	2.0								95	5	0.075		5		95
OC85	Lone Star Canal	0.33	1285	1460	4800	2300	192.5	3.5	0.13	3.38	1.05	0.60	2.0								100		0.071		1		99
OC90	Lone Star Spill	0.15	1160	1285	2300	1295	286.96	3.5	0.13	3.38	0.64	0.60	2.0								100		0.07				100
OC95	Lone Star Cmty	0.38	1050	1120	4211	2074	87.77	4	0.15	3.9	1.27	0.60	2.0								95	5	0.07				100
DC5	Hwy 80	0.68	1740	1970	6000	3512	202.4	4	0.13	3.38	1.28	0.60	4.6							33	33	34	0.087		0.5	84.5	15
DC10	Hwy 80	0.98	1600	1860	7335	3966	187.16	3.5	0.12	3.12	1.33	0.60	4.6							33	33	34	0.087			86	14
DC15	Christian Valley R.	0.48	1540	1820	4833	3469	305.9	4	0.14	3.64	1.20	0.60	4.4							30		70	0.096		12	75	13
DC20	Hwy 80	0.44	1540	1600	2776	2148	114.12	4	0.14	3.64	1.00	0.60	4.6							33	33	34	0.094		10	75	15
DC25	Dry Creek Road	0.47	1500	1600	3242	1587	162.86	3.5	0.12	3.12	0.77	0.60	5.2							40		60	0.128		60	20	20
DC30	Dry Creek Road	0.41	1420	1580	4200	2000	201.14	3.5	0.11	2.86	0.80	0.60	6.8							60		40	0.139		70	30	
DC35	Bowman Canal	0.62	1415	1700	5600	3950	268.71	3.5	0.1	2.6	0.96	0.60	9.6						8	87		5	0.135		67	25	8
DC40	Bell Road	0.57	1420	1600	5000	3800	190.08	3.5	0.11	2.86	1.06	0.60	12.4	5						75		20	0.119		45	25	30
DC45	Dry Creek Road	0.83	1335	1420	5620	3335	79.858	3.5	0.12	3.12	1.33	0.60	6.4							55		45	0.095		25	10	65
DC50	Gregg Way	0.27	1400	1645	3400	2138	380.47	3	0.1	2.6	0.63	0.60	10.0						50	50			0.139		70	30	
DC55	Black Oak Road	0.55	1335	1760	5200	2400	431.54	3.5	0.11	2.86	0.81	0.60	9.2							90		10	0.12		55		45
DC60	Dry Creek Road	0.32	1305	1490	4300	1300	227.16	3	0.09	2.34	0.56	0.60	9.2							90		10	0.074		4	2	94
DC65	Dry Creek Road	0.68	1260	1305	3301	1700	71.978	3.5	0.11	2.86	0.83	0.60	9.6							95		5	0.078		7	8	85
DC70	Dry Creek Road	0.24	1225	1470	3800	1653	340.42	3	0.07	1.82	0.43	0.60	18.6	10			10		40	35		5	0.081		1		99
DC75	Moss Rock Drive	0.28	1235	1360	3600	2188	183.33	3.5	0.11	2.86	0.80	0.60	10.0						5	95			0.07		0.5		99.5
DC80	Hwy 49	0.56	1200	1430	5200	950	233.54	3	0.07	1.82	0.42	0.60	23.1	15			15		30	35		5	0.086		0.5		99.5
DC85	Hwy 49	0.47	1180	1340	3600	2400	234.67	3.5	0.1	2.6	0.72	0.60	5.6							45	55		0.07				100
DC90	Joeger Road	0.69	1080	1180	6180	3472	85.437	3.5	0.1	2.6	1.14	0.60	5.6						5	40	50	5	0.07				100
DC95	Meadowbrook Dr.	0.29	1270	1410	5212	2777	141.83	3	0.06	1.56	0.55	0.60	16.1			20		50	25			5	0.08				100
DC100	Bell Road	0.94	1080	1270	5587	3365	179.56	3.5	0.11	2.86	1.07	0.60	9.6							95		5	0.07				100
DC105	Bell Road	0.44	1040	1080	3102	1618	68.085	3.5	0.13	3.38	0.96	0.60	2.0								100		0.084	6			94
RC5	S.P.R.R.	0.40	1500	1620	5400	2880	117.33	3	0.07	1.82	0.68	0.60	24.6	15			30			50		5	0.121		20	25	55
RC10	S.P.R.R.	0.21	1500	1600	4000	2800	132	3.5	0.11	2.86	0.95	0.60	19.7	10	2		15			63		10	0.127	1	39	5	55
RC15	S.P.R.R.	0.37	1450	1500	4629	2761	57.032	3	0.06	1.56	0.62	0.60	34.7	25			55			10		10	0.116		4	2	94
RC20	Bell Road	0.77	1450	1620	7000	2949	128.23	3	0.09	2.34	0.95	0.60	13.6	10						35		55	0.084		8	7	85

Table 38 (Cont.)
FITURE CONDITION SUB-BASIN HYDROLOGIC DATA

BASIN ID	BASIN DESCRIPTION	Basin Area (Sq Mi)	Chan DElev (ft)	Basin UElev (ft)	Basin Length (ft)	Basin Centrd (ft)	Basin Slope (ft/mi)	Basin Type	Basin 'n'	Basin Ct	Basin Lag (hr)	Basin Cp	Imp Area (%)	Community Plan Land Use Conditions									Loss Rates (in/hr)	SCS Soil Classification			
														Comm 0.90	HDR 0.60	MDR 0.30	LDR 0.20 (%)	RLDR 0.15	RR 0.10	RE 0.10	Ag 0.10	Open 0.02		A:.48 A:.31	B:.25 B:.16	C:.16 C:.09	D:.12 D:.07
RC25	Rock Creek Lake	0.47	1420	1485	3085	1360	111.25	1.5	0.06	1.56	0.38	0.60	32.9	10	35		10					45	0.099			5	95
RC30	Rock Creek Road	0.35	1330	1470	4550	2757	162.46	1	0.03	0.78	0.26	0.71	61.8	35	50							15	0.127		6	18	76
RC35	Hwy 49	0.41	1355	1390	3200	1800	57.75	1.5	0.02	0.52	0.16	0.77	73.5	65	20		15						0.12				100
RC40	Hwy 49	0.35	1330	1355	2823	2055	46.759	1	0.02	0.52	0.16	0.81	81.1	85	5	5						5	0.118				100
RC45	Hwy 49	0.47	1265	1330	3601	1599	95.307	2	0.04	1.04	0.29	0.60	40.2	20	15	40		5				20	0.108				100
RC50	Dry Creek Road	0.28	1215	1345	2800	1260	245.14	3	0.07	1.82	0.37	0.60	18.9	5	5		5	45	35			5	0.078				100
RC55	Joeger Road	0.21	1180	1215	2437	1854	75.831	3	0.07	1.82	0.49	0.60	10.1					10	85			5	0.07				100
DM5	Deadman's Gulch	0.63	1245	1360	3702	2403	164.02	3	0.08	2.08	0.62	0.60	10.4				5	5	45	40		5	0.073				100
DM10	Deadman's Gulch	0.36	1060	1245	2300	1874	424.7	3.5	0.11	2.86	0.57	0.60	9.6							95		5	0.093		25		75
AU1A	Auburn (CH2M)	1.57			8000	3400	174.2		0.035		0.30	0.75	37.0										0.15				
AU1B	Auburn (CH2M)	0.29			5000	2600	153.1		0.024		0.20	0.80	80.0										0.15				
AU2A	Auburn (CH2M)	1.66			6200	2200	121.4		0.028		0.20	0.75	65.0										0.15				
AR15	Stonehouse Road	0.54	940	1180	5800	2800	218.48	4	0.13	3.38	1.16	0.60	13.8	10			10		5	10		65	0.1		20		80
AR20	Highway 80	0.52	940	1295	5200	3295	360.46	4	0.13	3.38	1.09	0.60	12.0	5		20						75	0.119		35	5	60
AR25	Ophir Road	0.10	930	940	1161	503	45.478	3.5	0.11	2.86	0.43	0.60	10.0							100			0.084		15		85
AR30	Highway 80	0.49	835	1190	5600	2000	334.71	3.5	0.12	3.12	0.88	0.60	10.0							100			0.086		18		82
AR35	Highway 80	0.64	1350	1500	3800	2400	208.42	1.5	0.03	0.78	0.22	0.68	56.5	35	30		35						0.12				100
AR40	S.P.R.R.	0.56	1240	1380	3700	1300	199.78	2	0.04	1.04	0.24	0.60	34.1	12	13	35	10		30				0.105				100
AR45	Bean Road	0.60	1100	1340	5400	2300	234.67	2.5	0.08	2.08	0.65	0.60	11.5			5	5		40	50			0.075				100
AR50	Atwood Road	0.35	1215	1415	6866	4378	153.8	2	0.05	1.3	0.58	0.60	33.2	20	10	15			45			10	0.093				100
AR55	Atwood Road	0.27	1215	1420	5400	3562	200.44	2	0.04	1.04	0.38	0.60	22.1	10	5	25			15	10		5	0.069				100
AR60	Hidden Oaks Rd.	0.18	1100	1215	3984	2294	152.41	3.5	0.11	2.86	0.86	0.60	8.4							80		20	0.07				100
AR62	Mt. Vernon Rd.	0.64	1100	1240	5900	4000	125.29	3.5	0.11	2.86	1.22	0.60	9.2							90		10	0.07				100
AR65	Vada Ranch Rd.	0.63	1030	1100	3595	1657	102.81	3.5	0.11	2.86	0.80	0.60	9.6							95		5	0.078		7	8	85
AR70	Mt. Vernon Rd.	0.65	1040	1300	6300	3698	217.9	3	0.08	2.08	0.81	0.60	18.3	10				5	30	55			0.086		12		88
AR75	Bar Ranch Road	0.14	1020	1190	2800	1800	320.57	4	0.12	3.12	0.68	0.60	10.0							100			0.07		0.5		99.5
AR80	Millertown Road	0.59	835	1020	6571	4086	148.65	4	0.12	3.12	1.35	0.60	10.0							100			0.072		2		98
AR85	Highway 80	0.40	800	1080	4400	2800	336	2.5	0.06	1.56	0.46	0.60	40.5	35	5					60			0.091		1		99
DR5	Dutch Ravine	0.74	1100	1280	5137	3995	185.01	3.5	0.13	3.38	1.29	0.60	8.0						10	70			0.088		45		55
DR10	Dutch Ravine	0.27	980	1100	3085	1544	205.38	3.5	0.11	2.86	0.66	0.60	8.4						10	70		20	0.106		40		60
MR2	Mormon Ravine	0.10	895	1240	4400	2050	414	3.5	0.13	3.38	0.86	0.60	2.4							5	30	65	0.072		2		98
MR5	Mormon Ravine	0.35	920	1240	5398	3055	313	3.5	0.132	3.432	1.12	0.60	2.6							8		92	0.074			20	80
MR10	Mormon Ravine	0.10	835	920	2144	1439	209.33	3.5	0.11	2.86	0.57	0.60	10.0							100			0.077		3	20	77
MR15	Mormon Ravine	0.44	1005	1220	6548	4695	173.37	3.5	0.12	3.12	1.38	0.60	4.6							33	33	34	0.07			2	98
MR20	Mormon Ravine	0.19	1125	1240	2536	2083	239.43	3	0.1	2.6	0.61	0.60	5.3					25			65	10	0.081		12		88
MR25	Mormon Ravine	0.19	1040	1125	2660	1923	168.72	3	0.09	2.34	0.57	0.60	10.3					5		95			0.077			35	65

Table 39
2-, 10-, 25-, AND 100-YEAR PEAK FLOWS

CROSSING NUMBER	STREAM	CROSSING	DRAINAGE AREA (SQ. MI.)	2-YEAR		10-YEAR		25-YEAR		100-YEAR	
				PRESENT (CFS)	FUTURE (CFS)	PRESENT (CFS)	FUTURE (CFS)	PRESENT (CFS)	FUTURE (CFS)	PRESENT (CFS)	FUTURE (CFS)
1	ORR CREEK	INFLOW TO COON CR.	9.31	674	689	2180	2213	2931	2978	4176	4238
2		BELL RD.	9.29	673	688	2176	2209	2926	2972	4168	4230
3		TRIB. CONFLUENCE	8.93	643	658	2123	2157	2868	2915	4047	4112
4		TRIB. CONFLUENCE	7.44	571	582	1901	1936	2459	2504	3517	3578
5		HWY 49 (State)	6.13	477	488	1589	1623	2100	2141	2881	2936
6		TRIB. CONFLUENCE	5.81	511	522	1517	1550	2019	2060	2845	2902
7		W. STANLEY DR.	4.26	353	364	1092	1120	1464	1497	2031	2075
8		TRIB. CONFLUENCE	3.9	362	368	1063	1085	1410	1439	1916	1955
9		E. STANLEY DR.	3.36	306	310	917	935	1222	1247	1662	1692
10		COMBIE-OPHIR SIPHON	3.25	307	311	916	933	1194	1218	1631	1660
11		CHRISTIAN VALLEY RD.	2.66	265	271	823	838	1058	1077	1414	1435
12		TRIB. CONFLUENCE	2.07	254	267	646	667	835	862	1111	1144
13		STUDY BOUNDARY	1.15	151	161	368	387	469	492	624	653
14		TRIB. CONFLUENCE	0.78	114	124	248	264	316	335	420	444
15	ORR CK TRIB #1	LITTLE CREEK RD. (Private)	0.12	23	25	46	49	58	61	76	80
16	ORR CK TRIB #2	VIRGINIA WAY	0.48	69	69	194	194	250	250	334	334
17		KENNETH WY. (Private)	0.31	72	72	141	141	175	175	228	228
17	ORR CK TRIB #3	LONE STAR RD.	0.75	146	146	301	301	375	375	495	495
19	DRY CREEK	INFLOW TO COON CR	15.5	860	945	2787	2877	3844	3944	5575	5706
20		BELL RD.	15.32	848	932	2758	2847	3810	3908	5511	5638
21		TRIB. CONFLUENCE	15.06	831	915	2707	2800	3749	3832	5447	5555
22		ROCK CK. CONFLUENCE	13.14	660	729	2405	2464	3305	3355	4589	4675
23		HWY 49 (State)	8.38	431	461	1562	1630	2104	2195	2960	3100
24		TRIB. CONFLUENCE	7.82	399	428	1488	1550	1988	2082	2819	2938
25		BLUE GRASS RD.	7.3	368	391	1418	1476	1934	2012	2655	2759
26		BELOW DAM	6.62	392	411	1324	1366	1761	1814	2408	2483
27		INFLOW TO RES.	6.3	371	385	1291	1327	1704	1750	2323	2380
28		DRY CK. ROAD	5.48	334	343	1133	1151	1468	1485	1993	2017

Table 39 (Cont.)
2-, 10-, 25-, AND 100-YEAR PEAK FLOWS

CROSSING NUMBER	STREAM	CROSSING	DRAINAGE AREA (SQ. MI.)	2-YEAR		10-YEAR		25-YEAR		100-YEAR	
				PRESENT (CFS)	FUTURE (CFS)	PRESENT (CFS)	FUTURE (CFS)	PRESENT (CFS)	FUTURE (CFS)	PRESENT (CFS)	FUTURE (CFS)
29		TWIN PINES TR. (Private)	4.69	369	371	1056	1062	1379	1384	1877	1876
30		HAINES RD.	4.03	324	324	894	891	1171	1165	1589	1580
31		HALSEY AFTBAY OUTFLOW	3.05	298	298	750	748	955	951	1279	1275
32		BOWMAN RD.	2.82	288	289	702	702	898	898	1196	1195
33		LAKE ARTHUR RD.	2.58	262	264	649	652	831	834	1101	1104
34		LAKE ARTHUR RD.	1.81	178	178	407	407	525	525	695	696
35		BELOW LAKE ARTHUR	1.66	156	156	360	359	465	465	616	616
36	DRY CK TRIB #1	DRY CREEK RD	0.1	19	20	38	40	48	51	64	67
37	DRY CK TRIB #2	DRY CREEK RD	0.62	81	111	177	230	228	292	304	386
38	DRY CK TRIB #3	BLACK OAK RD.	0.35	100	104	203	208	256	261	338	344
39	DRY CK TRIB #4	DRY CREEK RD	0.1	22	30	44	56	55	70	72	92
40	DRY CK TRIB #5	JOEGER RD.	0.25	72	78	139	148	173	185	228	243
41	DRY CK TRIB #6	HOWE RD. (Private)	1.14	238	282	479	557	600	690	789	901
42		HUBBARD RD. (Private)	1.04	223	265	447	523	560	648	737	846
43		JOEGER RD.	0.29	46	77	96	149	120	186	158	244
44	ROCK CREEK	INFLOW TO DRY CREEK	4.29	386	457	1006	1229	1342	1711	1912	2424
45		JOEGER RD.	4.25	383	453	997	1217	1325	1688	1883	2387
46		SHERWOOD WY.	4.08	433	535	1019	1287	1312	1696	1773	2260
47		DRY CREEK RD.	3.8	381	478	922	1149	1195	1566	1596	2088
48		RICHARDSON RD.	3.78	381	478	922	1149	1195	1566	1596	2088
49		HWY 49 (State)	3.33	384	509	834	1045	1062	1380	1390	1861
50		ROCK CREEK RD.	2.24	394	396	466	499	603	641	772	812
51		ROCK CK LAKE OUTFLOW	2.22	400	400	464	497	601	641	769	809
52		ROCK CK LAKE INFLOW	2.22	370	421	898	1000	1104	1231	1435	1591
53		BELL RD.	0.98	134	159	284	322	359	404	472	532
54		NEW AIRPORT RD.	0.91	133	155	277	311	349	390	459	513
55		CRYSTAL SPRINGS RD.	0.85	131	152	271	302	342	379	449	498

Table 39 (Cont.)
2-, 10-, 25-, AND 100-YEAR PEAK FLOWS

CROSSING NUMBER	STREAM	CROSSING	DRAINAGE AREA (SQ. MI.)	2-YEAR		10-YEAR		25-YEAR		100-YEAR	
				PRESENT (CFS)	FUTURE (CFS)	PRESENT (CFS)	FUTURE (CFS)	PRESENT (CFS)	FUTURE (CFS)	PRESENT (CFS)	FUTURE (CFS)
56		TRIB. CONFLUENCE	0.61	123	136	247	265	309	332	406	435
57		CREEKVIEW CT.	0.19	36	37	73	74	92	93	122	122
58		RAILROAD	0.15	28	29	57	57	71	72	95	95
59	ROCK CK TRIB #1	RAILROAD	0.38	79	94	158	181	197	225	257	295
60	ROCK CK TRIB #2	NEW AIRPORT RD.	0.58	107	120	219	236	274	295	358	383
61		BELL RD.	0.31	57	64	117	126	146	157	191	204
62	ROCK CK TRIB #3	LOCKSLEY LN.	0.26	82	122	153	221	191	274	251	361
63	ROCK CK TRIB #4	ROCK CREEK RD.	0.66	174	246	385	527	499	708	669	976
64		BELL RD.	0.41	166	256	300	461	373	576	489	759
65	NORTH RAVINE	WISE RD.	5.25	591	646	1739	1862	2281	2459	3012	3241
66		WARREN WY. (Private)	5.1	578	632	1698	1823	2228	2408	2943	3176
67		CALNICK RD. (Private)	4.83	646	715	1701	1861	2207	2419	2908	3203
68		BELOW MILLERTOWN RD.	4.66	641	713	1674	1849	2176	2404	2863	3186
69		TRIB. CONFLUENCE	4.52	661	739	1654	1828	2126	2365	2792	3110
70		MILLERTOWN RD.	3.87	534	599	1395	1553	1805	2028	2373	2671
71		MT. VERNON RD.	3.24	523	600	1264	1473	1606	1928	2122	2549
72		HARRIS RD. (Private)	0.8	87	104	238	281	299	357	397	476
73		VISTA ROBLE RD. (Private)	0.62	126	177	247	333	306	413	401	541
74		ATWOOD RD.	0.35	32	42	62	80	77	99	100	129
75	N.RAV. TRIB #1	KEMPER RD. (Private)	0.23	46	61	89	115	110	142	144	187
76	N.RAV. TRIB #2	HIDDEN OAKS LN. (Private)	1.56	326	376	783	927	1017	1256	1372	1705
77		RAILROAD	0.64	203	259	375	478	470	618	648	842
78		HWY 49 (State)	0.35	112	142	206	263	259	340	356	463
79		PEAR RD. (Private)	0.28	87	119	164	219	204	273	268	360
80	N.RAV. TRIB #3	MILLERTOWN RD.	0.6	113	122	228	241	284	301	373	395
81		MT. VERNON RD.	0.36	69	75	139	147	173	184	228	241

Table 39 (Cont.)
2-, 10-, 25-, AND 100-YEAR PEAK FLOWS

CROSSING NUMBER	STREAM	CROSSING	DRAINAGE AREA (SQ. MI.)	2-YEAR		10-YEAR		25-YEAR		100-YEAR	
				PRESENT (CFS)	FUTURE (CFS)	PRESENT (CFS)	FUTURE (CFS)	PRESENT (CFS)	FUTURE (CFS)	PRESENT (CFS)	FUTURE (CFS)
82	N.RAV. TRIB #4	MILLERTOWN RD.	0.06	13	13	26	26	32	32	42	42
83		BAR RANCH RD. (Private)	0.04	10	10	20	20	24	24	32	32
84	AUBURN RAVINE	AUBURN RAVINE OUTFLOW	10.82	884	1047	3160	3406	4270	4589	6047	6411
85		N. RAVINE CONFLUENCE	10.42	856	1017	3042	3281	4060	4384	5835	6050
86		WISE RD.	4.68	968	1111	2366	2539	2993	3185	4300	4429
87		OPHIR RD.	4.58	948	1079	2326	2511	3033	3208	4217	4349
88		OPHIR RD.	4.23	934	1067	2233	2430	2901	3092	4034	4189
89		FORGOTTEN RD. (Abandoned)	3.54	1019	1192	2236	2440	2811	3038	3916	4088
90	AUBURN R. TRIB	I-80 (State)	0.49	75	75	161	161	202	202	271	271
91		RAILROAD	0.34	51	51	110	110	138	138	185	185
92	DUTCH RAVINE	RAILROAD	0.41	56	61	122	128	154	160	205	211
93		AUBURN-FOLSOM RD.	0.22	31	33	66	70	84	87	112	115
94	MORMON RAVINE	SHIRLAND RD.	0.04	6	6	14	14	17	17	22	22
95	MORMON R. TRIB	NO NAME RD	0.29	66	70	138	145	174	182	228	240
96		ANDREGG RD.	0.19	42	48	85	95	106	118	139	155
97	AMER.R.TRIB #1	HWY 49 (State)	0.32	78	78	155	155	194	194	257	257
98	AMER.R.TRIB #2	HWY 49 (State)	0.04	28	28	56	56	69	69	92	92
99	DEADMAN CANYON	JOEGER RD.	0.63	127	157	256	306	318	380	417	498
100		OAK CREEK CT.	0.19	38	47	77	92	95	114	125	149

The table indicates that over 70 percent of the bridges and culverts in the watershed are inadequate to pass the 100 year flood without overtopping under present land use conditions. Over 60 percent of the stream crossings are inadequate for even the 25-year flood.

Floodplain. The 100-year floodplains for Orr Creek, Rock Creek, Dry Creek and North Ravine were delineated on USGS 1:24,000 topographic maps based on flows developed from HEC-1 utilizing the 100-year design storm (with present land use conditions). The HEC-2 hydraulics model was then used in conjunction with the HEC-1 model to develop the water surface profiles and floodplain for the 100-year flood as presented in the Hydrology Study ("100 Year Floodplain: Maps A-C"). The floodplains for all of the streams are relatively narrow (average 200 -300 feet wide) and the 100-year flood would impact the relatively few structures built in the floodplains. However, the actual number of structures in the flood pain has not been identified.

Groundwater Supply

Rural residential uses in the northern and western portion of the Plan area generally depend on groundwater for domestic needs. Groundwater in sufficient quantities to supply domestic requirements occurs only along open fractures within metamorphic and granitic rock units. Terrace deposits are of insufficient occurrence to provide a significant groundwater supply, although there may be a few water wells producing from these surficial deposits along Dry Creek.

The sedimentary rock unit is of insufficient extent to provide a groundwater resource in this area. Permeability is very low because of high cementation of particles. The volcanic rock unit is impermeable and contains no groundwater. Surface water does penetrate to the underlying conglomerate along open vertical joints that occur within this mudflow.

The predominant rock type in the Plan area is metamorphic. The depth at which groundwater flows occur in metamorphic rock varies significantly. About 25% of domestic wells are completed at less than 90 feet and 75% at less than 160 feet. The fact that significant flows are reported for a few wells (less than 10%), at depths greater than 160 feet, indicates that there is reason for drilling deeper when the occurrence of additional water has been predicted and the need is sufficiently high. The average production figure reported is 14-15 gallons per minute (GPM).

There is also a significant amount of granitic rock in the Plan area. The most common depth intervals at which groundwater is encountered in the granitic rocks are 60- to 70-feet. The average production for granitic rock well within the Plan area is 9 to 10 GPM.

Water Quality

In addition to the impacts of flooding the water quality impacts from stormwater runoff in the Plan area are important issues. Water quality degradation from stormwater runoff is primarily the result of runoff carrying pollutants from the land surface (ie. streets, parking lots, pastures) to the receiving waters (ie. streams and

lakes). This type of pollution is termed "non-point source" pollution due to the fact that the pollutants are typically spread out over the land surface area (as opposed to "point source" pollution which refers to a specific managed source of pollution such as an industrial or wastewater treatment plant outfall to a stream). Non-point source pollution is of specific concern in the Auburn/Bowman Community Plan area not only because of the potential water quality impacts on streams, but also because of potential impacts on the numerous reservoirs and canals in the study area. In addition, the changing land uses (ie. conversion of agricultural land to residential) in the study area may also have an adverse impact on future water quality due to increased pollutant loads.

Streams As discussed in previous sections, the primary streams in the study area are Orr Creek, Dry Creek, Rock Creek, North Ravine and Auburn Ravine. The watersheds of these five streams comprise over 75% of the Auburn/Bowman Community Plan area with the remaining portions of the study area draining to the Bear River, American River (North Fork), and other smaller stream systems. The water quality in all of these streams is of concern for wildlife and fisheries as well as for other downstream uses. Stormwater runoff from rural and urban areas may contain excessive levels of pollutants (ie. pesticides, herbicides, hydrocarbons, etc.) that are toxic to fisheries and other aquatic life in the streams. In addition, the water which drains from the Auburn/Bowman Community Plan area eventually reaches the Sacramento River which is a primary source of water for the City of Sacramento as well as for the Sacramento - San Joaquin Delta. This water is put to numerous uses including water supply, recreation, fisheries and wildlife habitats.

Reservoirs. The potential impacts of stormwater runoff on the reservoirs in the study area is also of concern. Reservoirs in the study area include Halsey Forebay and Afterbay, Orr Creek Reservoir, Dry Creek Reservoir, Wise Forebay, and Rock Creek Lake. These reservoirs are primarily used as regulating points for the numerous canals in the study area. However, Rock Creek Lake is also a primary source of municipal water for Nevada Irrigation District's water treatment plant located adjacent to the lake. The watershed upstream of Rock Creek Lake is undergoing significant urbanization, and therefore the impacts of stormwater runoff from recent and planned developments are of special concern.

In addition to potential pollutants such as metals, hydrocarbons and pesticides, pollutants in the form of soluble nutrients (nitrogen and phosphorous) may also have a significant impact on the water quality of reservoirs in the study area. Excessive nutrient loading may promote eutrophication (algae blooms) in these reservoirs which can have an adverse impact on both the aquatic habitat as well as the overall water quality. Algae blooms often lead to anoxic conditions which can impact fisheries and many of the aquatic organisms. In addition anoxic conditions can promote the release of soluble metals from bottom sediments and under these conditions, metals such as iron, manganese, and mercury may enter the water column at toxic levels.

Canals Stormwater runoff may also enter directly into the canals in the study area. As discussed in previous sections, most of the canals in the Auburn/Bowman Community Plan area are not encased and, therefore, have the potential for intercepting and transporting stormwater runoff and associated pollutants. Hence, as with streams and reservoirs, any contaminant in the stormwater runoff has the potential

for entering the canal system. The canals in the study area primarily supply water for agricultural use and power generation; however, the canal water is also used for domestic purposes (after home treatment) in some rural areas. In addition, the Wise Canal supplies Rock Creek Lake which, along with the Combie-Ophir Canal, is the primary source of water for NID's water treatment plant at Rock Creek Lake.

Nationwide Urban Runoff Program. The Environmental Protection Agency conducted the Nationwide Urban Runoff Program (NURP) with the purpose of investigating the extent to which urban runoff was causing water quality problems in receiving waters. A secondary purpose of the program was to test the effectiveness of various measures (ie. infiltration basins) on reducing the amount of pollutants carried to receiving waters. The program was conducted from 1978 to 1983 in urban locations throughout the country and the results from the study are the basis for the National Pollution Discharge Elimination System (NPDES) program which is administered by the EPA. This program presently requires that both industries and municipalities (with populations exceeding 100,000) obtain permits for the discharge of stormwater runoff to receiving waters. The application for these permits requires identification of existing storm drainage facilities, characterization of existing stormwater quality, and the development of a detailed Stormwater Management Program.

The results from the NURP study may not be directly applicable to the study area due to the fact that the program covered different urban areas in different parts of the country. However, results from the program do provide a general indication of the types of pollutants and their impacts on water quality of runoff in urban areas such as the urbanized areas of the Auburn/ Bowman Community Plan area. The following discussion on potential pollutants and their sources in the study area is largely based on results from the NURP study as well other studies in urban and rural areas.

Potential Sources of Pollutants. Water quality degradation from non-point source pollutants is primarily the result of stormwater runoff carrying pollutants from the land surface to the receiving waters. The types of pollutants that may be transported to the receiving waters are dependent on the land use and the associated land use activities. In the Auburn/Bowman Community Plan area the specific land uses that may contribute to non-point source pollution are:

- Urban/Commercial Land Uses,
- Rural/Agricultural Land Uses, and
- Construction Sites.

In recent years much focus has been placed on runoff from urban and industrial areas. As mentioned above, the EPA's NPDES program currently requires that cities of 100,000 or more obtain NPDES permits for discharging stormwater into streams or rivers. It is anticipated that in the near future discharge permits will be required for smaller cities and urban areas as well. In addition to urban areas, rural and agricultural areas may also contribute to non-point source pollution through various farming and livestock management practices. Construction activities may also contribute to stormwater runoff pollution by increasing the potential for erosion. The following lists the potential sources of pollutants from the above mentioned land use activities:

Table 40
POTENTIAL SOURCES OF POLLUTANTS IN PLAN AREA

Type of Land Use	Source of Pollutant
Urban/Commercial Land Uses	Automobiles
	Tires
	Oil leaks
	Brake linings
	Catalytic converters
	Chemicals (improper use and disposal)
	Pesticides
	Fertilizers
	Herbicides
	Paints, Paint Thinners, Solvents
	Erosion of unprotected surfaces
	Structural surfaces
	Street pavement
	Galvanized pipes
	Roofing materials
	Wood preservatives
	Solid Waste
	Litter and debris
	Vegetative matter
	Pet droppings
Rural/Agricultural Land Uses	Chemicals (improper use and disposal)
	Pesticides
	Fertilizers
	Herbicides
	Erosion
	Farming activities
	Overgrazing of pastures
	Streamside erosion from livestock
	Animal Waste
	Septic Tanks
	Improper design and maintenance
Construction Sites	Erosion
	Removal of vegetation
	Disturbing land surfaces
	Construction debris
	Construction chemicals
	Paints
	Solvents
	Waterproofing compounds
	Petroleum products
	Gasoline, oil and grease

SOURCE: Montgomery, 1992.

Potential Pollutants. The pollutants most commonly associated with nonpoint source pollution in urban and rural areas are sediment and suspended solids, nutrients, oxygen demand (organic matter), oil and grease, trace metals, toxic chemicals and bacteria. Each of these pollutants and the potential for the existence in the stormwater runoff in the study area is discussed below.

- **Sediment** High concentrations of sediment are most often associated with construction activity where the natural land surface becomes disturbed. High concentration of suspended sediments in streams may cause increased turbidity, reduced light penetration, increased temperature, reduced spawning and other adverse effects to fisheries. In addition, sediment may be deposited in slower moving waters causing adverse effects to the benthic community and changes in the stream hydraulics.

- **Nutrients** Excessive levels of nutrients can occur in rural as well as agricultural runoff. In agricultural runoff the nutrient sources are typically fertilizers, animal waste, and other organic matter. In urban areas sources of nutrient are typically from urban landscaping, and gardens, lawns, golf courses, pet waste and litter. Sediments can also contain nutrients. Excessive levels of nutrients (ie. nitrogen and phosphorous) can lead to eutrophication (algae blooms) in downstream receiving water. The majority of the nutrients in urban runoff are in their soluble forms, which are readily utilized by algae, and therefore, aggravate the eutrophication process.

- **Oxygen Demand** Dissolved oxygen depletion in lakes or slow moving waters is a problem related to excessive pollutant loading of organic matter. The process of oxygen depletion is a result of decomposition of organic matter by microorganisms. The degree of potential dissolved oxygen (DO) depletion is measured by the biochemical oxygen demand (BOD) test that measures the amount of easily oxidized organic matter in the water. During storm events, runoff can capture and transport a wide variety of organic matter, such as lawn cuttings, that has accumulated on the land surface. BOD levels in receiving waters from urban areas may reach levels of 10 to 20 mg/l and in lakes or slow moving streams, this may result in anoxic conditions and be detrimental to aquatic life and the overall water quality. Schueler (1987) reports that the greatest export of organic matter comes from older, high density neighborhoods that have much vegetative growth and large populations of pets. Newer subdivisions with well maintained landscaping tend to have less organic matter loading from stormwater runoff.

- **Oil and Grease** The primary source of oil and grease (hydrocarbons) in urban runoff is the automobile. Oil leakage from crankcases as well as leakage of other lubricating agents are the major mechanisms by which automobiles release hydrocarbons to urban areas, Hydrocarbon levels are highest in runoff from parking lots, streets and service stations and somewhat less in residential areas. However, local problems may occur from illegal dumping of motor oil into storm drains or gutters. Hydrocarbons are lighter than water and when first captured by runoff, tend to form a film on the surface of the water. Due to the strong affinity hydrocarbons have for sediment, much of the hydrocarbons eventually adsorb to particles and settle out in slow moving waters. After deposition, the

hydrocarbons may persist for a long period of time and have toxic impacts on the benthic organisms.

- **Trace Metals** Trace metals in urban runoff are of concern due to their potential long term toxic effects on aquatic life and the potential to contaminate drinking water supplies. Sources of trace metals in urban runoff include automobiles and surfaces such as roofs, galvanized pipes, etc. in which water may dissolve or leach out metals. The trace metals of primary concern are lead, cadmium, copper and zinc. The largest source of lead in urban runoff has been from leaded gasoline in automobiles. However, the phasing out of leaded gasoline has significantly reduced the amount of lead introduced to the environment (Schueler, 1987). In addition, as with hydrocarbons, a significant percentage of trace metals in urban runoff are attached to sediment, and hence the trace metals tend to accumulate in sediment deposits.

- **Toxic Chemicals** In most urban and rural areas there are relatively few sources of toxic chemicals that create a significant impact on the quality of the stormwater runoff. In most urban and residential areas the primary source of toxic pollutants is illegal disposal of household hazardous wastes such as waste oil, wood preservatives, paint thinner, and pesticides. Pesticides are also a primary source of toxic pollutants in agricultural area. The greatest source of toxic pollutants, is often industrial sites (existing or abandoned).

- **Bacteria** The NURP study conducted by the EPA found that coliform bacteria were present at high levels in urban runoff in most of the sites sampled. The coliform bacteria levels exceeded EPA water quality criteria for water contact sports during and immediately after storm events in most of the receiving waters even when a degree of dilution was provided by the receiving waters. Schueler (1987) reports that nearly every urban and suburban land use exports enough bacteria during storm events to violate health standards. Problems may be especially severe in areas that have combined or sanitary sewer overflows that export bacteria from human waste. Although the Auburn/Bowman Community Plan area is not served by a combined sewer system, improperly designed or maintained septic systems in rural areas may be a significant source of bacteria in receiving water (as are livestock and other farm animals).

Existing Surface Water Quality. Data on the existing water quality of streams and reservoirs in the study area is sparse. As part of this study, a wide variety of agencies were contacted in an effort to obtain water quality data. These agencies included NID, PG&E, PCWA, City of Auburn and various agencies within Placer County (Public Works Department, Flood Control District, Environmental Health Department, Special Services District). The lack of any existing or previous DWR or USGS gages on streams in the Plan area precluded the contacting of state or federal agencies for water quality data. From this investigation, two sets of existing water quality data were obtained: (1) data from Placer County's monitoring

program at its wastewater treatment plant on Rock Creek and, (2) data from a discontinued water quality monitoring program of Auburn Ravine conducted by the City of Auburn.

The State Water Quality Control Board requires that the wastewater treatment plant operated by Placer County monitor the receiving water both upstream and downstream of the effluent discharge sites. Grab samples are taken on a weekly basis on Rock Creek and Dry Creek and the samples are analyzed for the following constituents:

- Dissolved oxygen
- pH
- Turbidity
- Temperature

The weekly measurements for December 1990 to December 1991 are contained within the Hydrology Study.

It should be noted that the sampling program at the treatment plant is conducted primarily to assess the impact the effluent discharge may have on the receiving waters. Hence, constituents which are analyzed are not particularly beneficial in assessing water quality impacts from stormwater runoff. However, from discussions with the officials at Placer County and as evident by the plots, the pH of Rock Creek (upstream of the discharge) averages approximately 8 to 8.5 whereas the pH of Dry Creek (upstream of the confluence with Rock Creek) averages approximately 7.5. The higher pH levels in Rock Creek are attributed to pollution in the runoff from the more heavily urbanized and commercial areas in the lower Rock Creek watershed (conversation with Warren Tellefson, Placer County).

The turbidity of the sampled stream waters also provides an indication of water quality impacts from non-point sources. In Dry Creek the turbidity levels are much higher in the month of March, when heavy rainfall occurred in the area. However, the measurements in Rock Creek at the same time period do not indicate higher turbidity levels. The increased turbidity levels in Dry Creek may be due to increased erosion from construction activities or other land disturbances in the Dry Creek watershed. At the same time, the lower Rock Creek watershed is already heavily urbanized and there may have been little construction or other activity to disturb the soils in the watershed.

Data on water quality of Auburn Ravine was also obtained from the City of Auburn. The purpose of the study was to assess the impacts, if any, of non-point source pollutants on the stream. On October 16, 1990 the City sampled Auburn Ravine at nine different locations within the city limits. Grab samples were obtained and analyses were performed for a wide variety of pollutants including trace metals, volatile organic priority pollutants, chlorinated pesticides and PCB's. With the exception of methylene chloride (an organic pollutant), no priority pollutants or pesticides were detected at any of the stream sampling locations. However, these samples were taken during a dry period and the results may not be truly representative of storm water runoff quality.Due to funding problems and the fact that pollutants were not detected in high enough concentrations to warrant further study, the monitoring program was discontinued.

Existing Groundwater Quality. Groundwater, its occurrence and quality, is greatly variable due to the complex geology in the Plan area. There are no aquifers due to shallow soils and dense bedrock. Groundwater is found in surface fractures and cracks in the bedrock. The quality of groundwater varies with location and tends to be more mineralized when extracted from serpentine soils. An example of such mineralization can be found in the Green Valley area near Lone Star Road. Geology in the Auburn Valley Country Club area consists of "greenstone" and is generally known to contain low water yields.

The Placer County Environment Health Department currently lacks a complete data base for identifying and monitoring yield and water quality problems. The County cannot identify major groundwater-bearing formations and has not establish a classification system for determining safe water yield in geologic formations. The absence of a data base prohibits analysis of quality using such indicators as nitrates and coliform, and mineral quality.

However, according to Lynn Johnson of the Environmental Health Division, a pattern of contamination is becoming apparent as indicated in the following excerpt from the Division's Notice of Preparation comments:

> Although the information is not yet all in on the problem, nitrate concentrations are evaluated in the shallower groundwaters encountered in the southeast portion of the Plan area. Lands in this area have historically been used agriculturally for the growing of fruit trees, and this nitrate contamination indicate that past fertilization of these orchards may have adversely affected groundwater quality. There is also a possibility that the use of on-site sewage disposal (septic) systems may exacerbate this problem, owing to the fact that there are relatively high concentrations of nitrate in septic tank effluent.

Impact Evaluation Criteria

According to Appendix G of the CEQA Guidelines, a project will normally have a significant effect on the environment if it will, among other things:

(f) substantially degrade water quality;
(g) Contaminate a public water supply;
(h) Substantially degrade or deplete groundwater resources;
(i) Interfere substantially with groundwater recharge: . . .
(q) Cause substantial flooding, erosion or siltation;

Note: only the hydrology-related impacts of the list are included here.

The Federal water quality criterion that applies to sediment is expressed for solids and turbidity (USEPA, 1976). The criterion was established for fish and aquatic life, stating that the ". . . should not reduce the depth of compensation point for photosynthetic activity by more than 100 percent from the seasonally established norm for aquatic life." Basically, this means that sediments should not cloud the water and reduce light penetration for photosynthesis more than 10%.

According to the EPA (1976) standards, the maximum allowable concentration of oil and grease in domestic water supply is "Virtually free from oil and grease . . . ". The EPA standard for oil and grease with respect to aquatic life is not to exceed 0.01 times the lowest continuous flow which results in a 50% lethal concentration in 96 hours to important freshwater species. This criteria must be established in a laboratory for individual species. This criteria must be established in a laboratory

for individual species and a particular chemical constituent. For example, the listed lethal toxicity for freshwater fish is 39 mg/l for waste oil.

Impacts — Introduction

At full buildout under the updated Plan, the Auburn/Bowman area will have a substantially greater amount of land covered by impervious surfaces than existed in 1991. Table 41 shows the percentage of impervious surfaces in each sub-basin in the existing and full buildout conditions. Figure 18 shades sub-basins according to percentage coverage. Existing sub-basin percentage coverages range from 2% in various rural areas to 52.3% in an area along Highway 49 just south of Bell Road (sub-basin RC35). Future sub-basin percentage coverages range from 2% in the planned agricultural areas to 73.5% in the Highway 49 sub-basin described above (RC35). Percentage impervious surface coverage changed in the increments shown in Figure 19.

Over the entire Plan area a 5% increase in impervious surface coverage is created by Community Plan buildout (from 8.8% existing to 13.8% future).

Coverage statistics for the interim 20-year plan development and buildout of the previous general plan are not available. However, it is possible to note that the 20-year development should entail substantially less impervious coverage than full buildout of the updated Community Plan. The Plan's economic analysis by Recht Hausrath and Associates indicates that there is 72 years worth of retail land, 27 years worth of office land and 251 years of industrial land made available by the Community Plan (page 20).

The development under the previous Community Plan results in impervious surfaces of approximately the same magnitude as the updated Community Plan.

TABLE 41
EXISTING AND FUTURE IMPERVIOUS SURFACES

Basin ID	Basin Description	..Percent Coverage... Base Cnd	Future Cnd	Increase/Decrease in % Coverage	Avg % for Watershed
BR 2	Bear River	2.0	2.0		
BR 5	Bear River	2.0	2.0		
BR 10	Bear River	2.0	2.0		
BR 15	Bear River	2.0	2.0		⇑
BR 20	Bear River	2.0	2.0		No Change
BR 25	Bear River	2.0	2.0		⇓
BR 30	Bear River	2.0	2.0		
CL 1	Clipper Creek	2.0	2.0		No Change
CL 2	Clipper Creek	2.0	2.0		No Change
CL 5	Clipper Creek	2.0	2.0		No Change
CL 10	Clipper Creek	2.8	2.8		No Change
AM 5	American River	3.2	12.8	9.6	
AM 10	American River	8.6	5.0	-3.6	
AM 15	American River	17.4	23.6	6.2	
AM 20	American River	2.9	7.0	4.1	
AM 25	American River	13.7	13.7		
AM 30	American River	14.9	14.9		1.16%

(TABLE 41 CONT'D)

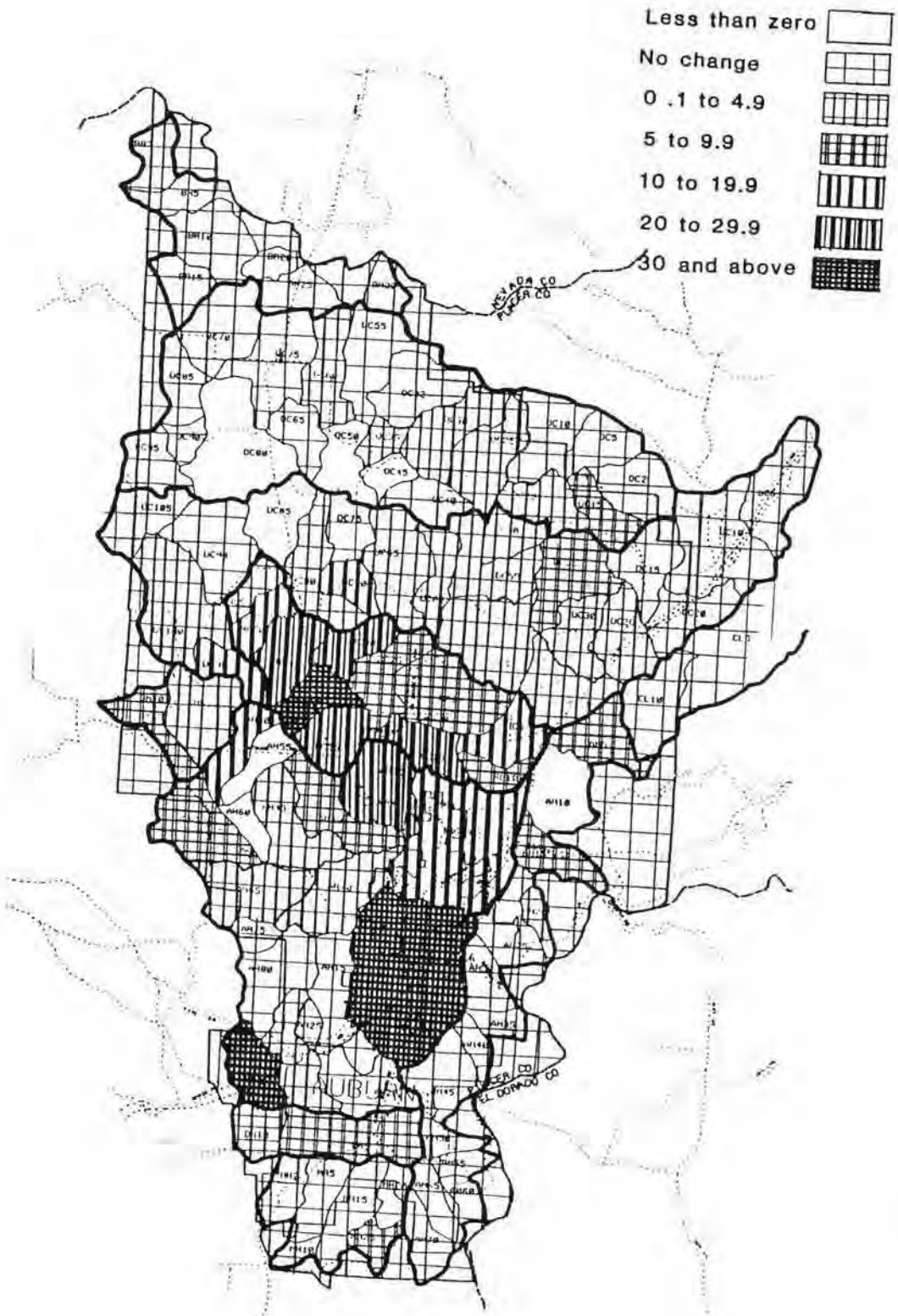
Basin ID	Basin Description	...Percent Coverage... Base Cnd	Future Cnd	Increase/Decrease in % Coverage	Avg % for Watershed
AM 35	American River	10.4	10.4		
AM 40	American River	24.4	24.4		
AM 45	American River	6.2	6.2		
AM 50	American River	2.0	2.0		
AM 55	American River	2.0	2.0		
AM 60	American River	2.0	2.0		
AM 65	American River	2.0	2.0		
AM 70	American River	2.7	2.7		
OC 2	Bear River Canal	2.8	2.8		
OC 5	Irrigation Reservation	2.8	2.8		
OC 10	Sugar Pine Mountain	2.8	2.8		
OC 15	Halsey Forebay	2.8	8.4	5.6	
OC 20	Christian Valley R.	7.6	9.6	2.0	
OC 25	Christian Valley R.	5.6	8.8	3.2	
OC 30	Stanley Drive	6.4	7.2	.8	
OC 35	Shirley Lane	5.2	6.0	.8	
OC 40	Sunshine Meadow Dr	9.6	9.2		
OC 45	Kimo Way	9.6	9.2	-.4	
OC 50	Stanley Dr	9.6	9.2	-.4	
OC 55	Gold Hill Canal	2.4	2.4		.58%
OC 60	Lake Valley Dr	3.6	4.4	.8	
OC 62	McElroy	8.4	8.4		
OC 65	Hwy 49 Bridge	2.0	2.0		
OC 70	Lone Star School	2.0	2.0		
OC 75	Highway 49	2.0	2.0		
OC 80	Highway 49	2.2	2.0	-.2	
OC 85	Lone Star Spill	2.0	2.0		
OC 90	Lone Star Spill	2.0	2.0		
OC 95	Lone Star Cmty	2.0	2.0		
DC 5	Highway 80	4.6	4.6		
DC 10	Highway 80	4.6	4.6		
DC 15	Christian Valley R.	4.4	4.4		
DC 20	Highway 80	4.6	4.6		
DC 25	Dry Creek Rd	8.2	5.2	3.0	
DC 30	Dry Creek Rd	6.4	6.8	.4	
DC 35	Bowman Canal	3.2	9.6	6.4	
DC 40	Bell Road	9.4	12.4	3.0	
DC 45	Dry Creek Road	5.2	6.4	1.2	
DC 50	Gregg Way	8.4	10.0	1.6	
DC 55	Black Oak Road	5.6	9.2	3.6	
DC 60	Dry Creek Rd	8.0	9.2	1.2	
DC 65	Dry Creek Rd	4.8	9.6	4.8	
DC 70	Dry Creek Rd	6.8	18.6	11.8	
DC 75	Moss Rock Dr	10.0	10.0		2.9%
DC 80	Highway 49	14.7	23.1	8.4	
DC 85	Highway 49	6.0	5.6		
DC 90	Joeger Rd	5.6	5.6		
DC 95	Meadowbrook Dr	2.0	16.1	14.1	
DC 100	Bell Road	7.6	9.6	2.0	
DC 105	Bell Road	2.0	2.0		

(TABLE 41 CONT'D)

Basin ID	Basin Description	...Percent Coverage... Base Cnd	Future Cnd	Increase/Decrease in % Coverage	Avg % for Watershed
RC 5	SPRR	11.5	24.6	13.1	
RC 10	SPRR	11.9	19.7	7.8	
RC 15	SPRR	88.0	34.7	25.9	
RC 20	Bell Road	4.4	13.6	9.2	
RC 25	Rock Creek Lake	25.2	32.9	9.2	
RC 30	Rock Creek Rd	36.7	61.9	7.7	18.13%
RC 35	Highway 49	52.3	73.5	21.2	
RC 40	Highway 49	29.2	81.1	51.9	
RC 45	Highway 49	17.0	40.2	23.2	
RC 50	Dry Creek Rd	7.8	18.9	11.1	
RC 55	Joeger Road	6.9	10.1	3.2	
DM 5	Deadman Canyon	8.1	10.4	2.3	
DM 10	Deadman Canyon	3.6	9.6	6.0	4.15%
AR 1A	Auburn (CH2M)	24.0	37.0	13.0	
AR 1B	Auburn (CH2M)	38.0	80.0	42.0	
AR 15	Stonehouse Rd	13.8	13.8		
AR 20	Highway 80	12.0	12.0		
AR 25	Ophir Rd	10.0	10.0		
AR 30	Highway 80	9.6	10.0	.4	
AR 35	Highway 80	36.3	56.5	20.2	
AR 40	SPRR	25.0	34.1	9.1	
AR 45	Bean Road	6.8	11.5	4.7	7.47%
AR 50	Atwood Road	22.2	33.2	11.0	
AR 55	Atwood Road	31.0	22.1	-8.9	
AR 60	Hidden Oaks Rd	9.2	8.4	- .8	
AR 62	Mt. Vernon Rd	9.2	18.3	9.1	
AR 65	Vada Ranch Rd	7.2	9.6	2.4	
AR 70	Mt. Vernon Rd	14.6	18.3	3.7	
AR 75	Bar Ranch Rd	10.0	10.0		
AR 80	Millertown Rd	10.0	10.0		
AR 85	Highway 80	6.0	40.5	34.5	
DR 5	Dutch Ravine	2.4	8.0	5.6	
DR 10	Dutch Ravine	6.4	8.4	2.0	3.8%
MR 2	Mormon Ravine	2.4	2.4		
MR 5	Mormon Ravine	2.6	2.6		
MR 10	Mormon Ravine	10.0	10.0		1.27%
MR 15	Mormon Ravine	4.6	4.6		
MR 20	Mormon Ravine	5.3	5.3		
MR 25	Mormon Ravine	2.7	10.3	7.6	

Covering the ground with impervious surfaces increases the amount and rate of stormwater runoff and it typically results in water quality degradation when automobile and other urban-based wastes are washed off of the surfaces into creeks. The updated Community Plan contains policies and programs intended to offset the potential flooding and water quality problems. These policies and programs are taken into account in the impact analysis which follows.

AUBURN/BOWMAN COMMUNITY PLAN
1992



EIR FIGURE 18
PERCENT COVERAGE INCREASE DUE TO PLAN BUILD-OUT

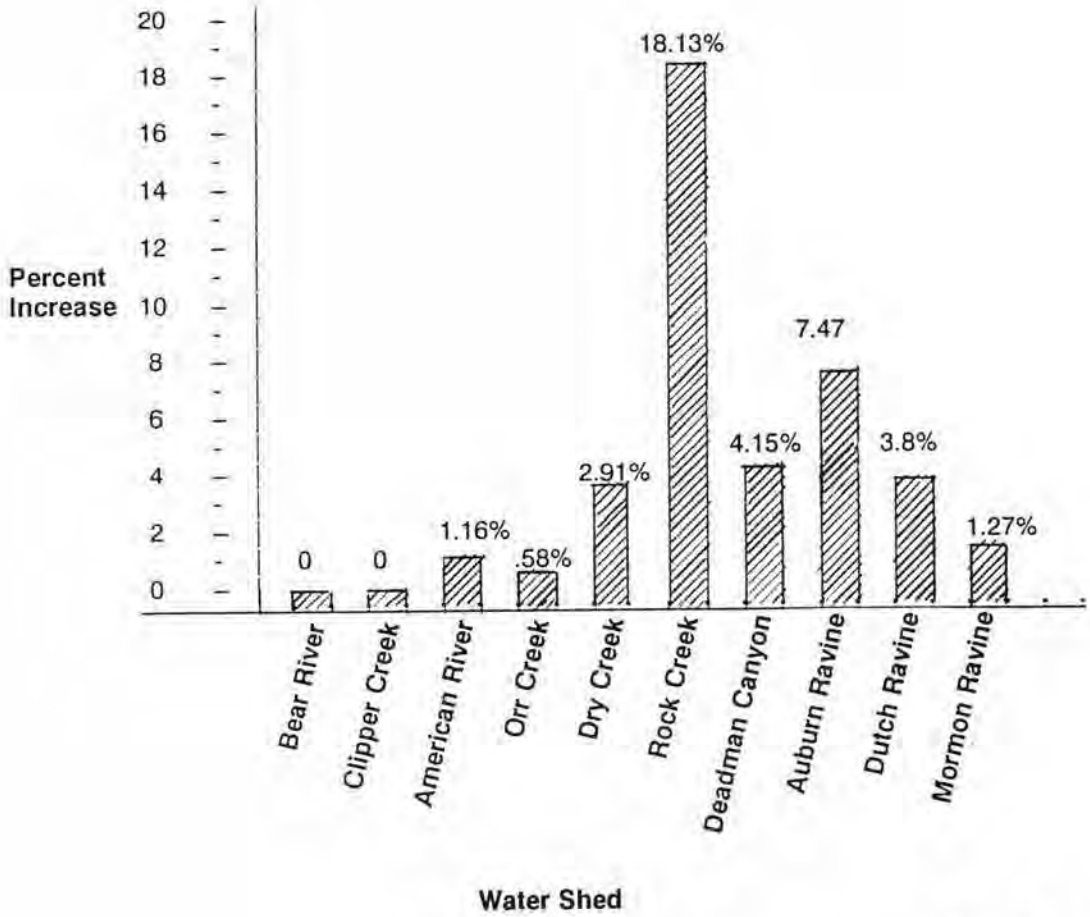


FIGURE 19
AVERAGE PERCENT OF INCREASE IN IMPERMEABLE AREA OF WATERSHEDS FROM PLAN BUILDOUT

Impacts

1. **Increases in stormwater runoff and flooding at bridges and culverts.** Table 39 in the Setting section shows the increases in stormflows at selected locations due to Community Plan buildout for the 2-, 10-, 25-, and 100-year storm events. Flows increase in the sub-basins range from 2 to 22% depending on the size of the sub-basins and the amount of development allocated to the sub-basin. The net result of these peak flow increases is to worsen the conditions at already impacted locations and to create new impacted locations.

Table 44 shows the locations at which bridges and culverts are overtopped (the rows with numbers indicate an overtopping location). The degree to which overtopping is increased or created can be seen by comparing the present to the future numbers for each storm category. Of the 47 locations which are overtopped in a 100 year event under existing land use conditions, 37 locations will have worsened overtopping (see underlined locations in Table 44) and one location, the Mt. Vernon Road crossing of North Ravine, will be newly impacted in the 100-year event due to Community Plan buildout. During lesser storm events, other locations are newly impacted by Community Plan buildout (Table 42):

Table 42
LOCATIONS IN COMMUNITY PLAN AREA
FLOODING DUE TO PLAN BUILDOUT

Location	Event
Mt. Vernon Road/North Ravine	100-year
Dry Creek Road/Dry Creek Tributary #2	10-year
Warren Way/North Ravine	25-year
Cabnick Road/North Ravine	10-year
Harris Road/North Ravine	2-year
Wise Road/Auburn Ravine	10-year
Joeger Road/Deadman Canyon	10-year

The seriousness of these overtopping events will vary based on the amount of the overtopping and the degree to which it will damage roads or affect traffic on the roads. According to James M. Montgomery, Consulting Engineers, Inc., overtopping alone does not necessarily mean that damage will occur to the road surface or structure itself, but it does mean that traffic on the roadway, including emergency traffic, may be severely impeded creating a serious safety hazard (Auburn/Bowman Community Plan Hydrology Study, July 1992, p. 3-3). This problem would appear to be the most serious where sole access points are blocked. For the 100 year flood event, these are:

Table 43
PROBLEM ACCESS ROADS TO PLAN AREA

Little Creek Rd (private road) crossing Orr Crk Tributary #1
Twin Pines Tr (private road) crossing Dry Creek
Black Oak Rd crossing Dry Creek Tributary #2
Howe Road (private road) crossing Dry Creek Tributary #6
Sherwood Way crossing Rock Creek
Bar Ranch Road (private road) crossing No. Ravine Tributary #4

Table 44
BRIDGE AND CULVERT OVERTOPPING LOCATIONS

CROSSING NUMBER	STREAM	CROSSING	CROSSING CAPACITY (CFS)	2-YEAR PRESENT (CFS)	2-YEAR FUTURE (CFS)	10-YEAR PRESENT (CFS)	10-YEAR FUTURE (CFS)	25-YEAR PRESENT (CFS)	25-YEAR FUTURE (CFS)	100-YEAR PRESENT (CFS)	100-YEAR FUTURE (CFS)
2	ORR CREEK	BELL RD.	5291								
5		HWY 49 (State)	3107								
7		W. STANLEY DR.	1800							231	275
9		E. STANLEY DR.	1800								
11		CHRISTIAN VALLEY RD.	210	55	61	613	628	848	867	1204	1225
15	ORR CK TRIB #1	LITTLE CREEK RD. (Private)	45			1	4	13	16	31	35
16	ORR CK TRIB #2	VIRGINIA WAY	110			84	84	140	140	224	224
17		KENNETH WY. (Private)	210							18	18
18	ORR CK TRIB #3	LONE STAR RD.	35	111	111	266	266	340	340	460	460
20	DRY CREEK	BELL RD.	2917					893	991	2594	2721
23		HWY 49 (State)	8125								
25		BLUE GRASS RD.	1800					134	212	855	959
28		DRY CK. ROAD	2312								
29		TWIN PINES TR. (Private)	200	169	171	856	862	1179	1184	1677	1676
30		HAINES RD.	1100					71	65	489	480
32		BOWMAN RD.	600			102	102	298	298	596	595
33		LAKE ARTHUR RD.	1040							61	64
34		LAKE ARTHUR RD.	1100								
36	DRY CK TRIB #1	DRY CREEK RD.	15	4	5	23	25	33	36	49	52
37	DRY CK TRIB #2	DRY CREEK RD.	220				10 *	8	72	84	166
38	DRY CK TRIB #3	BLACK OAK RD.	110			93	98	146	151	228	234
39	DRY CK TRIB #4	DRY CREEK RD	100								
40	DRY CK TRIB #5	JOEGER RD.	2625								

[1] Numbers in the storm columns represent the flow rates by which the drainage structures are exceeded.
[2] Asterisks represent overtopping created by Plan buildout.
[3] Underlined crossings indicate locations where existing flooding conditions are worsened by Plan buildout (100 year event)
[4] Circled numbers indicate all locations impacted by Plan buildout.

Table 44 (Cont.)
BRIDGE AND CULVERT OVERTOPPING LOCATIONS

CROSSING NUMBER	STREAM	CROSSING	CROSSING CAPACITY (CFS)	2-YEAR PRESENT (CFS)	2-YEAR FUTURE (CFS)	10-YEAR PRESENT (CFS)	10-YEAR FUTURE (CFS)	25-YEAR PRESENT (CFS)	25-YEAR FUTURE (CFS)	100-YEAR PRESENT (CFS)	100-YEAR FUTURE (CFS)
41	DRY CK TRIB #6	HOE RD. (Private)	100	138	182	379	457	500	590	689	801
42		HUBBARD RD. (Private)	700							37	146
43		JOEGER RD.	45	1	32	51	104	75	141	113	199
45	ROCK CREEK	JOEGER RD.	3860								
46		SHERWOOD WY.	977			42	310	335	719	796	1283
47		DRY CREEK RD.	2387								
48		RICHARDSON RD.	696			226	453	499	870	900	1392
49		HWY 49 (State)	1368						12	22	493
50		ROCK CREEK RD.	290	104	106	176	209	313	351	482	522
53		BELL RD.	1346								
54		NEW AIRPORT RD.	405							54	108
55		CRYSTAL SPRINGS RD.	602								
57		CREEKVIEW CT.	450								
60	ROCK CK TRIB #2	NEW AIRPORT RD.	25	82	95	194	211	249	270	333	358
61		BELL RD.	185							6	19
62	ROCK CK TRIB #3	LOCKSLEY LN	30	52	92	123	191	161	244	221	331
63	ROCK CK TRIB #4	ROCK CREEK RD.	105	69	141	280	422	394	603	564	871
64		BELL RD.									
65	NORTH RAVINE	WISE RD.	3730								
66		WARREN WY. (Private)	2327						81*	616	849
67		CALNICK RD. (Private)	1800				61*	407	619	1108	1403
70		MILLERTOWN RD.	1172			223	381	633	856	1201	1499
71		MT. VERNON RD.	2169								380*
72		HARRIS RD. (Private)	90		14*	148	191	209	267	307	386
73		VISTA ROBLE RD. (Private)	228			19	105	78	185	173	313
74		ATWOOD RD.	135								

[1] Numbers in the storm columns represent the flow rates by which the drainage structures are exceeded.
[2] Asterisks represent overtopping created by Plan buildout.
[3] Underlined crossings indicate locations where existing flooding conditions are worsened by Plan buildout (100 year event)
[4] Circled numbers indicate all locations impacted by Plan buildout.

Table 44 (Cont.)
BRIDGE AND CULVERT OVERTOPPING LOCATIONS

CROSSING NUMBER	STREAM	CROSSING	CROSSING CAPACITY (CFS)	2-YEAR PRESENT (CFS)	2-YEAR FUTURE (CFS)	10-YEAR PRESENT (CFS)	10-YEAR FUTURE (CFS)	25-YEAR PRESENT (CFS)	25-YEAR FUTURE (CFS)	100-YEAR PRESENT (CFS)	100-YEAR FUTURE (CFS)
75	N.RAV. TRIB #1	KEMPER RD. (Private)	8	38	53	81	107	102	134	136	179
76	N.RAV. TRIB #2	HIDDEN OAKS LN. (Private)									
78		HWY 49 (State)	144			62	119	115	196	212	319
79		PEAR RD. (Private)	2	85	117	162	217	202	271	266	358
80	N.RAV. TRIB #3	MILLERTOWN RD.	60	53	62	168	181	224	241	313	335
81		MT. VERNON RD.	100			39	47	73	84	128	141
82	N.RAV. TRIB #4	MILLERTOWN RD.	7	6	6	19	19	25	25	35	35
83		BAR RANCH RD. (Private)	5	5	5	15	15	19	19	27	27
85	AUBURN RAVINE	N. RAVINE CONFLUENCE									
86		WISE RD.	2400				139*	593	785	1900	2029
87		OPHIR RD.	3600							617	749
88		OPHIR RD.	6000								
89		FORGOTTEN RD. (Abandoned)	1000	19	192	1236	1440	1811	2038	2916	3088
93	DUTCH RAVINE	AUBURN-FOLSOM RD.	175								
94	MORMON RAVINE	SHIRLAND RD.	65								
95	MORMON R. TRIB	NO NAME RD	18	48	52	120	127	156	164	210	222
96		ANDREGG RD.	35	7	13	50	60	71	83	104	120
97	AMER.R.TRIB #1	HWY 49 (State)	120			35	35	74	74	137	137
98	AMER.R.TRIB #2	HWY 49 (State)	25	3	3	31	31	44	44	67	67
99	DEADMAN CANYON	JOEGER RD.	270				36*	48	110	147	228
100		OAK CREEK CT.	300								

[1] Numbers in the storm columns represent the flow rates by which the drainage structures are exceeded.
[2] Asterisks represent overtopping created by Plan buildout.
[3] Underlined crossings indicate locations where existing flooding conditions are worsened by Plan buildout (100 year event)
[4] Circled numbers indicate all locations impacted by Plan buildout.

As shown above, four of the six problem access roads are private; the two public roads are among those recommended for improvement.

It should be noted that the backwater from bridge/culvert overtopping will increase only slightly due to the increased future flows (Montgomery, p. 3-28) and thus no adverse impacts are anticipated from the increase. The Auburn/Bowman Community Plan contains several policies related to flooding impacts as shown in Table 45.

Table 45
AUBURN/BOWMAN COMMUNITY PLAN
RELEVANT FLOODING GOALS AND POLICIES

Hydrology

a. GOALS
   3) Reduce flood hazards both on-site and downstream.
   4) Reduce potential for loss of life and damage to property resulting from current floodway deficiencies.
   6) Educate the public regarding the potential impacts of their actions on drainage, flooding and water quality.

b. Policies
   3) Coordinate with the Bureau of Reclamation, PG&E, Placer County Water Agency (PCWA), and Nevada Irrigation District (NID) to promote the use of water reservoirs for multiple purposes where appropriate; i.e., water conservation, flood control, recreation, generation of hydroelectric power, and wildlife habitat.
   9) Manage all stream environment zones, including flood plains, and riparian vegetation areas to promote multiple usage for flood control, open space, recreation, and wildlife.
   12) Establish special procedures (including setbacks, etc.) for land use, building locations, grading operations, and vegetation removal adjacent to all drainageways, canals, and significant water features.
   14) Develop brochures and other methods to educate the public and developers regarding the potential impacts of development on drainage, flooding and water quality.
   15) Continue to implement and enforce the Grading Ordinance and Flood Damage Prevention Ordinance.
   16) Ensure that new development storm drainage systems are designed in conformance with the Placer County Flood Control and Water Conservation District's "Stormwater Management Manual" and the County "Land Development Manual."
   17) Require new development to detain increases in peak stormwater runoff, or to pay appropriate in-lieu fees for compensating improvements, in all areas recommended for local detention in the "Auburn/Bowman Community Plan Hydrology Study" (Appendix D of the Plan's Background Report)
   23) Evaluate potential flood hazards in an area prior to the approval of future development projects.

24) New construction (i.e., structures requiring building permits) should not be permitted within 100 feet of the centerline of permanent streams, within 50 feet of the centerline of intermittent streams, or within the future (fully developed) 100-year floodplain, whichever is greater. Where floodplain information does not exist, require determination of this information by the project proponent prior to issuance of development permits.

25) Maintain natural conditions within the 100-year floodplain of intermittent and permanent streams except where work is required to maintain the streams' drainage characteristics and where such work is done in accordance with the Placer County Flood Damage Prevention Ordinance.

26) Assure that new development conforms with the adopted programs, recommendations, and plans of the Placer County Flood Control and Water Conservation District.

These policies call for the replacement of the various bridge and culverts recommended in the Auburn/Bowman Community Plan Hydrology Study" (July, 1992, Chapter 6). The locations of the recommended bridge/ culvert replacements are listed in Table 46 and shown on the "Proposed Structural Improvements" maps (Figures 6-1, A-C) of the Hydrology Study. In total, twenty-six culverts or bridges are identified for a cost of $1,494,966 Table 6-3, Hydrology Study). These costs are recommended to be allocated to the watershed where the crossing is located with new development paying a proportion based upon its proportion of total peak flows (Hydrology Study, p. 7-10). The funding methods recommended for consideration include development fees for new development and a benefit assessment or user fee for existing development.

Table 46
BRIDGE AND CULVERT REPLACEMENT

1. 7 Orr Creek at W. Stanley Dr.
2. 16 Orr Creek Trib. #2 at Virginia Way
3. 20 Dry Creek at Bell Road
4. 30 Dry Creek at Haines Road
5. 32 Dry Creek at Bowman Road
6. 36 Dry Creek at Dry Creek Road
7. 37 Dry Creek Trib. #2 at Dry Creek Road
8. 38 Dry Creek Trib. #3 at Black Oak Road
9. 43 Dry Creek Trib. #6 at Joeger Road
10. 46 Rock Creek at Sherwood Way
11. 48 Rock Creek at Richardson Road
12. 50 Rock, Creek at Rock Creek Road
13. 54 Rock Creek at New Airport Road
14. 60 Rock Creek Trib. #2 at New Airport Road
15. 62 Rock Creek Trib. #3 at Locksley Lane
16. 63 Rock Creek Trib.#4 at Rock Creek Rd
17. 70 North Ravine at Millertown Rd
18. 71 North Ravine at Mt. Vernon Road
19. 80 North Ravine Trib.#3 at Millertown Rd.
20. 81 North Ravine Trib.#3 at Mt Vernon Rd
21. 82 North Ravine Trib.#4 at Millertown Road
22. 86 Auburn Ravine at Wise Road
23. 87 Auburn Ravine at Ophir Road
24. 95 Mormon Ravine Trib. at No Name Road
25. 96 Mormon Ravine Trib. at Andregg Road
26. 99 Deadman Canyon at Joeger Road

Of these recommended financing methods, development fees are relatively assured. The Hydrology Study provides a basis for their adoption which would be a logical extension of the Community Plan adoption process. In contrast, the imposition of costs on existing development is not entirely assured. Assessment districts require a vote of the property owners, unless they are imposed by the local agency for reasons of health or safety. In this case safety considerations might make the imposition of a district a possibility though one which might not be popular.

According to James M. Montgomery, user fees are a viable means of funding, as evidenced in various communities where they have been successfully implemented (Montgomery, Memorandum 6/24/92). However, they have never been implemented in Placer County and may not be locally feasible.

One potential outcome, then, is that only those improvements needed for new development are funded and constructed. This would create adequate crossings in the seven locations where problems are entirely assignable to new development. In the other locations, the improvements would offset increased impacts, but impacted situations would remain. In general, this means that the buildout of the Community Plan would not create impacts, except for one factor: the growth permitted by the Plan would mean that more people would be exposed to the risks presented by the flooding road segments.

A second factor to consider is that the Plan recommends that the following public road crossings which have increased flooding in the 100 year event not be improved (9 private roads also experience increased flooding in the 100-year event and will not be improved):

Table 47
PUBLIC ROAD CROSSINGS NOT RECOMMENDED FOR EXPANSION

1. Christian Valley Road crossing Orr Creek
2. Blue Grass Road crossing Dry Creek
3. Lake Arthur Road crossing Dry Creek
4. Dry Creek Road crossing Dry Creek Tributary #1
5. Highway 49 crossing Rock Creek
6. Bell Road crossing Rock Creek Tributary #2
7. Highway 49 crossing North Ravine Tributary #2

None of these locations are critical in the sense of providing sole access to populated areas. The two Highway 49 crossings may be considered critical, however, because of the Highway's importance as a regional facility. Improvement of these crossings may be part of the planned Highway 49 improvements.

Some of these crossings not recommended for improvement are those located in rural areas which have been designed as low flow crossings and would not be damaged by floodwaters (#s 1,2), as well as those which were built in the floodplain in such a way that it would not be feasible to pass the 100-year flows without significant channel improvements and modifications in addition to the replacement of the structure.

Effects of 20 year buildout based on economic projections. The most important difference between projected 20-year buildout and full buildout is in the amount of commercial and industrial use. The economic study prepared for the Plan predicts a 72 year buildout period for commercial use and a 251 buildout period for industrial use; in 20 years it is likely that only a fraction of these uses will be developed. Since commercial and industrial uses account for a major share of an urban area's impervious surfaces, it is apparent that the impacts associated with those surfaces, most notably increased stormwater runoff and non-point source surface water pollution, will be substantially lower at 20 years in comparison to full buildout. However, significant impact could still occur if funding and implementation of recommended drainage improvements does not occur, or if Best Management Practices fail to protect sensitive surface waters.

Conclusion: Based upon the criteria and analysis above, avoidance of significant structural flooding is likely though not completely assured due to possible difficulties in approval of funding methods. Consequently, the impact is considered significant and unmitigable.

2. **Impacts of proposed bridge and culvert improvements.** The riparian habitat impacts associated with the bridge and culvert improvements are anticipated to be generally minor. Small areas of riparian vegetation immediately adjacent to the structures will be damaged by construction activities. Where this damage is more than a few hundred square feet in size or involves trees or special plants or animals impacts could be substantial. However, It is anticipated that these impacts would be avoided through individual site review by biologists and special construction and/or restoration techniques, as required by Community Plan policies (Hydrology Policy 12, Vegetation Policies 4,5,7 and Fish and Wildlife Policy 8).

Conclusion: Based upon the above criteria and analysis, the impacts of proposed bridge and culvert improvements will be less than significant.

3. **Increases in stormwater runoff and flooding in floodplains.** As described in the Setting section, the existing floodplains for the streams of the Plan area are relatively narrow, averaging 200-300 feet in width, and affect relatively few structures. According to the Hydrology Study (p. 3-7) the increase in flood flows from the planned land uses does not significantly change the area where problems are experienced. Because of this, and because the environmental and development review process is likely to uncover and mitigate any significant flooding problems, the impact is expected to be minor (Bob Costa, Public Works Dept., Personal Communication, 3/31/94)

Conclusion: Based on the discussion above it appears that the effects of flooding in floodplains is expected to be less than significant.

4. **Impacts of recommended Dry Creek Channel improvement.** The Hydrology Study recommended the excavation of creek bed along a segment of Dry Creek—approximately 4500 linear feet and as much as 16 acres would be impacted. The impacts of the proposed improvements would be significant and potentially unmitigable. Because of this level of impact, and because of the limited degree of benefit afforded by the recommended channel improvements, the County is not including them among planned improvements.

Conclusion: Since the improvements are no longer envisioned, there will be no impact from them.

5. **Increases in stormwater runoff and flooding on canals.** The land uses permitted in updated Community Plan have the potential to increase stormwater runoff into canals; this could increase the potential for damage to canals and unanticipated spills. The precise location and extent of damage and spills cannot be predicted. To a large extent, this problem will be offset by the recommended local on-site stormwater detention structures for new development (Hydrology Study, p. 5-10). The Hydrology Study also recommends the following methods of protecting the canals from direct new sources of runoff (pp. 5-11 to 5-12):

Canal Protection

As discussed in previous sections there are numerous canals in the study area that supply water for both municipal and agricultural purposes. These canals are owned and operated by either Placer County Water Agency (PCWA), Nevada Irrigation District (NID), or Pacific Gas and Electric Company (PG&E). The canals range in size from small unlined ditches with capacities of less than five cubic feet per second (cfs) to the Wise Canal which has a capacity exceeding 500 cfs. The protection of these canals from surface runoff is of importance due to water quality concerns as well as the potential of canal damage due to flooding.

The various methods available for canal protection include: (1) land use controls, (2) canal encasement, and (3) structures such as interceptor ditches to prevent surface runoff from entering the canals.

Land Use Controls. Land use controls may be used to protect canals by preventing the building of structures such as roads, buildings or parking lots directly adjacent to an open canal. Structures such as these may cause an increase into the surface water runoff into the canals as well as an increase in pollutant loads entering the canals. Hence, by limiting commercial and urban development directly adjacent to the canals, the water quality and flooding impacts on the canals from development in the study area can be reduced.

Canal Encasement. Encasing all of the canals in the study area is perhaps the best method available to protect the canal water quality and to reduce the impact of flooding on the conveyance and spill structures. However, encasing all of the canals in the study area is not feasible due to the high costs. For example, the total costs for encasing all canals except the Wise Canal is estimated to be approximately

$30 million. This estimate was based on utilizing reinforced concrete pipes sized to carry with the existing canal capacities at an average slope of 0.2%

While canal encasement may not be a realistic option on a regional scale, it is a viable option for canal protection on a local scale. For instance, in areas where new development may impact an existing canal, the protection of the canal from the effects of the new development could be accomplished by encasing the canal in the area of the development. As new developments occur, the canals would be encased where protection is needed most. Also, the canals would not need to be encased in the rural areas where the impacts of the land use changes on the canals are minimal (i.e. conversion of agricultural land to rural estates). Current PCWA, NID and PG&E policy requires that developers incase canals that border or cross new developments.

Interceptor Ditches, Diversion Structures. Another method available for localized protection of canals is to construct interceptor ditches or other division structures such that runoff from a developed area cannot flow into an open canal. The diverted runoff could be routed to a storm drain, or routed under or over the canal to an existing drainage. By requiring new developments to provide this localized protection, this option may also be an effective method in protecting canals from water quality problems associated with new Development.

Conclusion: Based upon the above criteria and analysis, the impacts of stormwater on canals, exclusive of water quality, will be less than significant. Previous efforts to require encasement where an urban use is developed near a canal have been successful, indicating the feasibility of the hydrology mitigation proposals.

6. **Impacts of recommended canal protection features.** The recommended features for protecting canals would be implemented differently than would the bridge, culvert, and channel improvements described previously because they would be built as part of proposed developments rather than funded as community capital improvements. Consequently, any canal protection improvements will be evaluated in the context of environmental review of development projects. Any impacts of those improvements will be disclosed and potentially avoided or mitigated as part of the project approval process. Possible impacts could include disruption of small areas of riparian and upland habitat and short-term erosion until the improvements are completed. An emphasis on mitigation of these impacts is inherent in the Community Plan wetland protection and water quality policies, and consequently it appears the impacts would be avoided or mitigated.

Conclusion: Based upon the above criteria and analysis, the impacts of recommended canal protection improvements will be less than significant.

7. **Impacts of regional downstream flooding.** In addition to the local issues of Plan area culvert, bridge, and channel inadequacies addressed above, is the issue of flooding downstream of the Plan area. The design of the recommended bridge and culvert improvements is such that the amount of storm water detention behind the road crossings is kept as high as is prudent without allowing continued overtopping. This minimizes the transfer of peak flows downstream. Additionally the Plan generally discourages channel improvements which more efficiently transfer peak flows.

The increased flows from designated urban uses are proposed to be mitigated by requiring local, or on-site, stormwater detention on individual development project sites. The effectiveness of this detention can be seen by comparing columns in Table 48. The following passage from the Hydrology Study summarizes the increased flows and effect of detention:

> As is evident by the table, the most significant impacts of local detention occurs in the Rock Creek and North Ravine watersheds. In the Rock Creek watershed the 100-year peak flow increases by approximately 22% (1796 cfs to 2205 cfs) with the change of existing to future land use conditions. However, with the implementation of local detention in the watershed, the 100-year peak flows for future conditions are reduced to 1879 cfs (less than a 5% increase in flows over present conditions). In the North Ravine watershed the future 100-year peak flow (without local detention is approximately 3241 cfs, or an 8% increase over present conditions. With the implementation of local detention in the recommended areas, the future 100-year flow is reduced to within 1% of present conditions.
>
> In the Orr Creek and Dry Creek watersheds the 100-year future peak flows (without local detention) do not significant increase from present peak flows (an increase of less than 3% in each watershed). However, with the limited local detention that is recommended in each of the watersheds, the 100-year future peak flows can be reduced to the present levels in the Orr Creek watershed and within 2% of the present levels in the Dry Creek watershed.

Thus, effective control of peak storm flows has been built into the Hydrology Study recommendations However, total runoff (non-peak) will increase due to buildout of the Plan area and other locations, leading to potential flooding in some downstream locations. The County Flood Control District is currently investigating the possibility of regional detention facility at the confluence of Coon Creek, Dry Creek, Auburn Ravine and Pleasant Grove Creek. A Master Plan of the contributing watershed has been completed which outlines alternative flood control scenarios, but no specific proposal has been approved as funded (Tim Nash, Associate Engineer, Placer County Flood Control and Water Conservation District, personal communication, 6/26/92).

It should be noted that the City of Auburn has expressed concern about increased runoff from unincorporated areas creating flooding problems within the City (City of Auburn, October 18, 1992 letter in Response to Comments). Within the unincorporated area, only one drainage basin is of any substantial acreage which drains into the City. All other watershed areas of any significance drain away from the incorporated area, and thus do not impact City facilities. This particular basin is described as Auburn Ravine Basin #1A

Table 48
RESULTS OF PLAN IMPLEMENTATION

CROSSING NUMBER	STREAM	CROSSING	DRAINAGE AREA (SQ. MI.)	100-YEAR PRESENT (CFS)	100-YEAR FUTURE (CFS)	100-YEAR WITH PLAN (LOCAL DETENTION) (CFS)
1	ORR CREEK	INFLOW TO COON CR.	9.31	4176	4238	4182
2		BELL RD.	9.29	4168	4230	4174
3		TRIB. CONFLUENCE	8.93	4047	4112	4047
4		TRIB. CONFLUENCE	7.44	3517	3578	3479
5		HWY 49 (State)	6.13	2881	2936	2843
6		TRIB. CONFLUENCE	5.81	2845	2902	2721
7		W. STANLEY DR.	4.26	2031	2075	1893
8		TRIB. CONFLUENCE	3.9	1916	1955	1769
9		E. STANLEY DR.	3.36	1662	1692	1508
10		COMBIE-OPHIR SIPHON	3.25	1631	1660	1467
11		CHRISTIAN VALLEY RD.	2.66	1414	1435	1238
12		TRIB. CONFLUENCE	2.07	1111	1144	906
13		STUDY BOUNDARY	1.15	624	653	481
14		TRIB. CONFLUENCE	0.78	420	444	305
15	ORR CR TRIB #1	LITTLE CREEK RD. (Private)	0.12	76	80	68
16	ORR CR TRIB #2	VIRGINIA WAY	0.48	334	334	323
17		KENNETH WY. (Private)	0.31	228	228	214
18	ORR CR TRIB #3	LONE STAR RD.	0.75	495	495	421
19	DRY CREEK	INFLOW TO COON CR	15.5	5575	5706	5692
20		BELL RD.	15.32	5511	5638	5625
21		TRIB. CONFLUENCE	15.06	5447	5555	5574
22		ROCK CR. CONFLUENCE	13.14	4589	4675	4749
23		HWY 49 (State)	8.38	2960	3100	2913
24		TRIB. CONFLUENCE	7.82	2819	2938	2760
25		BLUE GRASS RD.	7.3	2655	2759	2563
26		BELOW DAM	6.62	2408	2483	2321
27		INFLOW TO RES.	6.3	2323	2380	2238
28		DRY CR. ROAD	5.48	1993	2017	1930
29		TWIN PINES TR. (Private)	4.69	1877	1876	1807
30		HAINES RD.	4.03	1589	1580	1504
31		HALSEY AFTBAY OUTFLOW	3.05	1279	1275	1174
32		BOWMAN RD.	2.82	1196	1195	1090
33		LAKE ARTHUR RD.	2.58	1101	1104	998
34		LAKE ARTHUR RD.	1.81	695	696	616
35		BELOW LAKE ARTHUR	1.66	616	616	546

Table 48 (Cont.)
RESULTS OF PLAN IMPLEMENTATION

CROSSING NUMBER	STREAM	CROSSING	DRAINAGE AREA (SQ. MI.)	100-YEAR PRESENT (CFS)	100-YEAR FUTURE (CFS)	100-YEAR WITH PLAN (LOCAL DETENTION) (CFS)
39	DRY CR TRIB #4	DRY CREEK RD	0.1	72	92	92
40	DRY CR TRIB #5	JOEGER RD.	0.25	228	243	223
41	DRY CR TRIB #6	HOWE RD. (Private)	1.14	789	901	701
42		HUBBARD RD. (Private)	1.04	737	846	656
43		JOEGER RD.	0.29	158	244	226
44	ROCK CREEK	INFLOW TO DRY CREEK	4.29	1912	2424	2024
45		JOEGER RD.	4.25	1883	2387	1996
46		SHERWOOD WY.	4.08	1773	2260	1891
47		DRY CREEK RD.	3.8	1596	2088	1720
48		RICHARDSON RD.	3.78	1596	2088	1720
49		HWY 49 (State)	3.33	1390	1861	1440
50		ROCK CREEK RD.	2.24	772	812	784
51		ROCK CR LAKE OUTFLOW	2.22	769	809	781
52		ROCK CR LAKE INFLOW	2.22	1435	1591	1441
53		BELL RD.	0.98	472	532	481
54		NEW AIRPORT RD.	0.91	459	513	459
55		CRYSTAL SPRINGS RD.	0.85	449	498	442
56		TRIB. CONFLUENCE	0.61	406	435	369
57		CREEKVIEW CT.	0.19	122	122	103
58		RAILROAD	0.15	95	95	80
59	ROCK CR TRIB #1	RAILROAD	0.38	257	295	276
60	ROCK CR TRIB #2	NEW AIRPORT RD.	0.58	358	383	383
61		BELL RD.	0.31	191	204	204
62	ROCK CR TRIB #3	LOCKSLEY LANE.	0.26	251	361	251
63	ROCK CR TRIB #4	ROCK CREEK RD.	0.66	669	976	666
64		BELL RD.	0.41	489	759	759
65	NORTH RAVINE	WISE RD.	5.25	3012	3241	3042
66		WARREN WY. (Private)	5.1	2943	3176	2973
67		CALNICK RD. (Private)	4.83	2908	3203	2948
68		BELOW MILLERTOWN RD.	4.66	2863	3186	2908
69		TRIB. CONFLUENCE	4.52	2792	3110	2840
70		MILLERTOWN RD.	3.87	2373	2671	2403
71		MT. VERNON RD.	3.24	2122	2549	2108
72		HARRIS RD. (Private)	0.8	397	476	380

Table 48 (Cont.)
RESULTS OF PLAN IMPLEMENTATION

CROSSING NUMBER	STREAM	CROSSING	DRAINAGE AREA (SQ. MI.)	100-YEAR PRESENT (CFS)	100-YEAR FUTURE (CFS)	100-YEAR WITH PLAN (LOCAL DETENTION) (CFS)
73		VISTA ROBLE RD. (Private)	0.62	401	541	364
74		ATWOOD RD.	0.35	100	129	107
75	N. RAV. TRIB #1	KEMPER RD. (Private)	0.23	144	187	154
76	N. RAV. TRIB #2	HIDDEN OAKS LN. (Private)	1.56	1372	1705	1372
77		RAILROAD	0.64	648	842	649
78		HWY 49 (State)	0.35	356	463	357
79		PEAR RD. (Private)	0.28	268	360	360
80	N.RAV. TRIB #3	MILLERTOWN RD.	0.6	373	395	395
81		MT. VERNON RD.	0.36	228	241	241
82	N.RAV. TRIB #4	MILLERTOWN RD.	0.06	42	42	42
83		BAR RANCH RD. (Private)	0.04	32	32	32
84	AUBURN RAVINE	AUBURN RAVINE OUTFLOW	10.82	6047	6411	6015
85		N. RAVINE CONFLUENCE	10.42	5835	6050	5862
86		WISE RD.	4.68	4300	4429	4314
87		OPHIR RD.	4.58	4217	4349	4232
88		OPHIR RD.	4.23	4034	4189	4070
89		FORGOTTEN RD. (Abandoned)	3.54	3916	4088	3985
90	AUBURN R. TRIB	I-80 (State)	0.49	271	271	258
91		RAILROAD	0.34	185	185	177
92	DUTCH RAVINE	RAILROAD	0.41	205	211	211
93		AUBURN-FOLSOM RD.	0.22	112	115	115
94	MORMON RAVINE	SHIRLAND RD.	0.04	22	22	22
95	MORMON R. TRIB	NO NAME RD	0.29	228	240	240
96		ANDREGG RD.	0.19	139	155	155
97	AMER. RIV. TRIB #1	HWY 49 (State)	0.32	257	257	257
98	AMER. RIV. TRIB #2	HWY 49 (State)	0.04	92	92	92
99	DEADMAN CANYON	JOEGER RD.	0.63	417	498	498
100		OAK CREEK CT.	0.19	125	149	149

in the Auburn Bowman Community Plan Hydrology study. (See Figure 2-3 of that study.) The City has already conducted a study on that drainage basin which has lead to the Dairy Road Watershed Master Plan (City of Auburn General Plan, November, 1993 p. V-52). The Master Plan finds that since improvements to correct projected flooding problems are prohibitively expensive, the City should require detention basins in new developments (City of Auburn General Plan, p. V-54). Though this is contrary to the recommendations of the Auburn/Bowman Hydrology study, it is recognized that detention would help mitigate impacts within the City. Consequently, the County should require detention in Auburn Ravine Basin #1A (see Mitigation Measure 7b).

Conclusion: Based upon the above criteria and analysis, the buildout of the Community Plan may contribute to significant downstream flooding impacts by increasing the overall nonpeak drainage levels. These impacts appear to be mitigable with a regional detention facility, but this mitigation is not assured because no plans and no funding proposals are in place. It should be noted that the local detention requirements of the Plan will mitigate Plan area peak flow impacts to a less than significant level.

8. **Impacts of detention facilities.** Four primary types of impacts can occur from detention facilities: Habitat destruction, hazard to toddlers, mosquito breeding, and hazardous waste accumulation. Small areas of habitat typically must be destroyed to create a detention basin. This habitat may either be upland or wetland; basins in wetland areas are often chosen because convenient stormwater collection locations are often in swales or stream channels. However, it is possible to design the stormwater collection system in such a way as to allow the basins to be placed outside of the wet drainages. This will not necessarily ensure that habitat impacts will not occur, because some other sensitive habitat type or special species could be affected. However, the latter impact could typically be avoided through biological surveys and appropriate design. Wetland recreation can also occur as part of the basin design as a wetland mitigation alternative.

The hazard to toddlers occurs when detention basins are placed within toddling distance of homes and are unprotected by fences. For detention basins the likelihood of an accident is reduced by the fact that water is present only during and shortly after a storm event. This impact is typically avoided in project design by the placement of low fences around the basins and other measures. These measures are included in this document as part of the Community Plan mitigation measures.

Mosquitos can become a nuisance and even a health concern if improperly designed detention basins retain water long enough to become stagnant. A basin design which adequately flushes itself and regular maintenance can avoid mosquito problems.

An additional potential impact which may result from the utilization of detention basins is the accumulation of metals, oils and greases, and other

hazardous substances. This impact can be avoided through soils testing and proper disposal of sediments removed during regular maintenance and classified as hazardous.

Conclusion: The problems of habitat destruction, hazard to toddlers, mosquito breeding and hazardous materials accumulation are potentially significant impacts which can be avoided by implementing the measures contained in this document (see Mitigation Measure #8).

9. **Degradation of surface waters.** The Setting section contains a description of the types of non-point source pollutants that are, and will continue to be, a concern in the Plan area. The types of pollutants include:

- Nutrients
- Oxygen Demand
- Oil and Grease
- Trace Metals
- Toxic Chemicals
- Bacteria

Increased urbanization of the Plan area will increase the amounts of these pollutants in the stormwater. The Nationwide Urban runoff Program (NURP) monitored over 300 runoff events in the Washington D.C. area and conducted other studies in other locations throughout the nation. The results, shown in the table below, provide an indication of how pollutant levels change with urbanization.

Table 49
AVERAGE FLOW-WEIGHTED CONCENTRATIONS OF POLLUTANTS FROM METROPOLITAN WASHINGTON NURP STUDY (1980-81)

Pollutant	Undeveloped Area (mg/l)	New Suburban Nurp Sites (mg/l)	Older Urban Areas (mg/l)	National Nurp Stdy Average (mg/l)
Phosphorus				
Total	0.15	0.26	1.08	0.46
Ortho	0.02	0.12	0.26	–
Soluble	0.04	0.16	–	0.16
Organic	0.11	0.1	0.82	0.13
Nitrogen				
Total	0.78	2	13.6	3.31
Nitrate	0.17	0.48	8.9	0.96
Ammonia	0.07	0.26	1.1	–
Organic	0.54	1.25	–	–
TKN	0.61	1.51	7.2	2.35
COD	>40.0	35.6	16.3	90.8
BOD (5-day)	–	5.1	–	11.9
Metals				
Zinc	–	0.037	0.397	0.176
Lead	–	0.018	0.389	0.18
Copper	–	–	0.105	0.047

The amount and type of proposed land use changes vary among the different watersheds of the Auburn/Bowman area as shown in Table 50.

Table 50
OVERALL LAND USE CHANCES BY WATERSHED

WATERSHED	WATERSHED AREA (sq.mi.)	COMMERCIAL/ INDUSTRIAL Present (sq.mi)	COMMERCIAL/ INDUSTRIAL Future (sq.mi)	RESIDENTIAL (less than 1 ac) Present (sq.mi)	RESIDENTIAL (less than 1 ac) Future (sq.mi)	RURAL (1-4.6 ac) Present (sq.mi)	RURAL (1-4.6 ac) Future (sq.mi)	AGRICULTURAL (4.6-20 ac) Present (sq.mi)	AGRICULTURAL (4.6-20 ac) Future (sq.mi)	OPEN SPACE Present (sq.mi)	OPEN SPACE Future (sq.mi)
Orr Creek	8.1	0.0	0.0	0.0	0.0	2.3	2.8	4.2	4.5	1.6	0.8
Dry Creek	9.2	0.1	0.1	0.1	0.2	3.9	6.3	2.0	0.9	3.1	1.6
Rock Creek	4.3	0.4	1.1	0.6	1.2	0.9	1.1	0.2	0.0	2.2	0.9
Aub/No Ravine	6.3	0.5	0.6	0.5	1.0	2.6	3.3	1.1	0.0	0.8	0.4
Bear River	2.0	0.0	0.0	0.3	0.0	0.0	0.8	0.8	2.0	1.2	0.0
American River	2.9	0.1	0.1	0.0	0.4	0.3	0.5	1.2	1.1	1.1	0.9
Deadman Canyon	0.9	0.0	0.0	0.0	0.0	0.5	0.9	0.4	0.0	0.1	0.0
Dutch Ravine	0.8	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.0	0.0	0.1
Mormon Ravine	0.8	0.0	0.0	0.1	0.0	0.3	0.4	0.4	0.2	0.2	0.2

The following excerpt from the Hydrology Study describes potential water quality impacts in each watershed (pp. 4-11 to 4-12).

> **Orr Creek and Dry Creek Watersheds**. The present land use in the Orr Creek and Dry Creek watersheds is primarily rural residential, agricultural, and open space. There is, however, a

small amount of residential and commercial development in the Dry Creek watershed near the Highway 49 corridor. The future land use conditions in these watersheds calls for the conversion of approximately 25% of the existing open space and agricultural land to rural estates and rural residences. Only a small amount of land (one tenth of a square mile in the Dry Creek watershed) is designated for residential development and there is no future commercial development in this area.

Due to the increase in rural residences in these watersheds there is the potential for increased pollutant loads of hydrocarbons from automobiles, nutrients from landscaping activities and other chemicals from pesticides and herbicides. In addition as open space and agricultural areas are converted to rural lots, there may be an increase in livestock and other ranch animals in these watersheds. This may increase the pollutant loads (ie, bacteria) into the canals and streams from animal waste transported by stormwater runoff.

Rock Creek Watershed. The Rock Creek watershed presently has a wide variety of land uses. The lower watershed (below Rock Creek Lake) is primarily commercial (along the Highway 49 corridor) and residential whereas the upper watershed has larger amounts of open space along with limited residential and rural development. In addition, the Auburn Airport and associated business park are also located in the upper Rock Creek watershed. Future land use changes in the Rock Creek watershed include continued commercial development in the lower watershed and commercial and residential development in the upper areas of the watershed. Over 50% of the existing open space in the upper watershed will be developed.

The future development in the Rock Creek watershed has the potential for adverse impacts on the water quality of the canals, streams and Rock Creek Reservoir primarily from the urban and commercial land uses. The potential impacts include increased hydrocarbon levels from increased automobile traffic, increased nutrients from landscaping activities, bacteria from animal waste and increases in other pollutants associated with urban runoff.

Auburn Ravine/North Ravine Watershed. The present land use of the Auburn Ravine/North Ravine watershed (excluding the City of Auburn) is primarily rural residential and agricultural. There is limited commercial and residential development in the watershed, mostly in the areas adjacent to the Highway 49 corridor. Future land use changes in the area calls for conversion of all of the agricultural areas and a portion of the open space areas to rural lots. There is (sic) no planned changes to residential or commercial land uses in this area.

The future water quality impacts from land use changes in the Auburn/North Ravine watershed should be similar to that of Orr Creek and Dry Creek watersheds. There may be increases in pollutant loads associated with the rural development (ie, nutrients, hydrocarbons, bacteria).

Remaining Watersheds. The remaining watersheds in the Auburn/ Bowman Community Plan area (Bear River, American River, Deadman Canyon, Dutch Ravine and Mormon Ravine) are presently all rural, agricultural and open space. Future land use changes in these areas are minimal with the primary changes being the conversion of a portion of the existing agricultural land and open space to rural lots. As with other watersheds in the study area, the future water quality impacts on the streams and canals will primarily result from the rural development and the associated pollutants (nutrients, hydrocarbons, bacterial, etc.).

The use of surface water in each of these watersheds varies from aquatic habitat to domestic consumption. Within the Orr creek watershed, a segment of Orr Creek itself serves as part of a Nevada Irrigation District (NID) canal system linking the Combie-Ophir Canal to the Gold Hill Canal. The latter canal presently delivers water for irrigation but in the past it supplied water for domestic purposes -- some residences may still use the water in the home. Similar unauthorized use may occur of water from other canals. The Nevada Irrigation District has adopted the regulation shown in Table 51 to address water quality and other canal-related concerns.

A more formal domestic use of surface water occurs in the Rock Creek watershed. The water in Rock Creek Reservoir is treated and distributed by NID as drinking water. Potential water quality impacts of urbanization in the Rock Creek Watershed have been described in previous EIRs as significant and unmitigable, largely due to the possible disposal of household hazardous wastes, such as herbicides pesticides, solvents (Planning Concepts, "Lotus Ridge EIR" – name subsequently changed to Princeton Club Estates", 1986, pp. 57-60).

The following passage from the above-cited EIR explains the difficulty of removing pollutants once they are in the Reservoir:

> The N.I.D. water treatment plant is designed to remove most pollutants; sedimentation, sands and flocculation procedures remove most suspended matter, and chlorination kills bacterial contaminants. These processes can remove most urban pollutants. However, there are some chemicals, particularly complex hydrocarbons, such as types of pesticides and herbicides, which will not be completely removed. An increase in concentrations of these chemicals may require modification of the N.I.D. treatment plant.
>
> The State Department of Public Health publishes "Reliability Standards" for the treatment and testing of water from different watersheds. Briefly, there are three classes of watersheds:
>
> - Class I – There are few if any houses, and land uses are controlled;
> - Class II – There are some houses, and land uses are controlled;
> - Class III – The watershed is developed with homes and other uses.

Each class has increasingly restrictive treatment and testing requirements. The Rock Creek Watershed is currently Class I, urbanizing toward Class II, and when it reaches this class, water quality testing will have to be done every 6 months instead of the current two year interval. N.I.D. is concerned that, as development occurs in the basin, pollutants will increase to the point where State and Federal water quality standards are exceeded for one or more constituents. This could require that the treatment plant undergo an expensive upgrading, perhaps including the installation of carbon filters, which are costly to maintain.

Additional pollution sources within the watershed include the Auburn Airport industrial area. Traditional point source industries have not located in this area and are not anticipated. However, the presence of manufacturing establishments heightens the concern about non-point discharge of hazardous substances. For example, the EIR consultants have observed the runoff of paints from tipped barrels at the industrial area.

These considerations make the Rock Creek Watershed the most sensitive of those in the Plan area in terms of water quality; the American River is similar in that its waters are used for domestic consumption (after reaching Folsom Lake). However, the American River is somewhat different in that the dilution effect in Folsom Lake far exceeds that of Rock Creek Reservoir. However, significant impacts are possible in all of the area watersheds even on the basis of aquatic habitat considerations alone.

The Community Plan contains several goals and policies calling for the protection of water quality — the use of stream setbacks and Best Management Practices (BMP) are recommended (see EIR Table 52). Implementation measures include requirements through the environmental and development review process, an ordinance protecting stream channels, and informational brochures. The Hydrology Study is not explicitly mentioned, but it is assumed that its recommendations would also be followed. The Hydrology Study, recommends the following methods of protecting water quality:

Table 51
CANAL PROTECTION MEASURES - NEVADA IRRIGATION DISTRICT

INTRODUCTION

Background - The Nevada Irrigation District operates over 400 miles of raw water transportation facilities, most of which are open canal. These facilities supply water to 10 treatment facilities which provide water to over 14,000 customers. The canals also provide raw water to over 1,300 annual customers and over 4,000 seasonal irrigation customers. It is estimated that about 85 percent of the annual raw water customers pipe this water into their homes.

Water Quality - The District's open canals are subject to contamination due to upstream development. As urbanization of lands within the watershed areas of the open canal system continues, the chance of further bacteriological and chemical contamination of this raw water supply increases. Dumping of trash, lawn clip-

pings, and other debris in or near the canal can occur. Uphill runoff contains various lawn chemicals and petroleum products, and can increase turbidity levels of the water in the canal. Failing septic tank systems further contaminate the water quality. The State and Federal Safe Drinking Water Acts place the District under ever increasing mandates to minimize the potential for contamination of water from its source to the treatment plant intakes.

Risk of Injury - Open canals attract children as well as barnyard and domestic animals. Risk of injury or death is present in these facilities. As parcels become smaller in size, the urban encroachment takes place around the canals, these risks substantially increase.

Operation and Maintenance Cost - The District's costs of operating and maintaining its canal system increases dramatically with urbanization. These canals could be historically maintained and operated in open rural areas where access for workers and equipment of all types was readily available. Development of lands around a canal can limit access and cause additional maintenance burdens such as those caused by landscaping encroachment and facility destruction caused by domestic pets and barnyard animals.

Leakage - Unlined open canals invariably leak and cause damage to property improvements. As development near District canals takes place the risk of such damage increases.

PROTECTIVE MEASURES

General - In order to protect the water quality in District canals, as well as minimize risk of injury, reduce operation and maintenance costs and eliminate seepage claims the following protective measures will be utilized.

Canal Easements - Canals providing water to downstream District treatment plants will be encased adjacent to and within areas for development as residential subdivisions with average lot sizes of three acres or less. Other canals will require encasing for lot sizes of two acres or less.

Residential subdivisions will also require encasement in areas where new roads are created with 100 feet of a canal.

The need for encasement through industrial, commercial, municipal, institutional, and multi-family residential developments will be determined on a case-by-case basis. Factors used to determine the need for encasement include location and size of buildings, parking lots, roads and other improvements within the development, the canal's size and type of downstream water use, the nature of the development, presence of children, and the use of hazardous materials within the development. If a canal encasement is not provided during the initial development of the property. the land owner may be required to sign a recordable agreement with the District calling for future encasement of

changes in use of the property mandate a higher level of protection for the canal.

Minimum size pipe for on-grade easements shall be 18-inch diameter and 12-inch for inverted siphons. Design capacity shall be at least twenty-five percent greater than established by District's raw water master plan criteria. Plans and specifications for the encasement must be approved by the District.

Other - No increased surface runoff or deterioration of water quality from predevelopment levels will be allowed into the canal.

Landowners with developments located on the downhill side of open canals will be notified that subsurface seepage may be present and appropriate steps should be taken to ensure that the proposed improvements are not affected.

Based on the specifics of each development, additional protective measures may be added.

Table 52
COMMUNITY PLAN GOALS AND POLICIES RELATED TO WATER QUALITY

4. Hydrology
   a. GOALS
      1) CONSERVE AND ENHANCE, AND PROTECT FROM DEGRADATION, SURFACE AND GROUNDWATER SUPPLIES AND ADEQUATELY PLAN FOR THE DEVELOPMENT AND PROTECTION OF THESE RESOURCES FOR FUTURE GENERATIONS.
   b. Policies
      1) Improve water quality by eliminating existing water pollution sources and by discouraging activities which include the use of hazardous materials around wetland and groundwater recharge areas.
      2) Preserve and enhance watersheds, particularly those adjacent to domestic water supply sources. Where urban or suburban development is permitted within such watersheds, require that urban runoff be adequately treated before being released.
      3) Coordinate with the Bureau of Reclamation, PG&E, Placer County Water Agency (PCWA), and Nevada Irrigation District (NID) to promote the use of water reservoirs for multiple purposes where appropriate; i.e., water conservation, flood control, recreation, generation of hydroelectric power, and wildlife habitat.
      4) Ensure that an adequate quality and quantity of water is delivered to residents of the Auburn/Bowman area through continued cooperation with the Placer County Water Agency and the Nevada Irrigation District.

5) Support regional, state, and federal agencies in their efforts to exact high levels of water quality from sewage dischargers.

7) Coordinate with the Placer County Health Department and the Department of Public Works in identifying critical watershed are as and in designating Best Management Practices appropriate to those areas for use by new development projects which are undertaken in those watersheds.

8) Establish a water well monitoring program in areas with known or potential water quality problems or reduced yields. Take action to mitigate water quality problems and review development proposals in low water yield areas.

9) Manage all stream environment zones, including flood plains, and riparian vegetation areas to promote multiple usage for flood control, open space, recreation, and wildlife.

10) Maintain and improve, where necessary, the quality of water in perennial and intermittent streams.

11) Encourage owners of property adjacent to waterways and/or responsible agencies to maintain healthy vegetation along drainage courses, or to provide other suitable means of preventing bank erosion and siltation.

12) Establish special procedures (including setbacks, etc.) for land use, building locations, grading operations, and vegetation removal adjacent to all drainageways and significant water features.

13) Prepare and adopt a stream management plan and ordinance to protect and enhance waterways and stream channels.

14) Develop brochures and other methods to educate the public and developers regarding the potential impacts of development on drainage, flooding and water quality.

18) Reduce the negative impacts on water quality resulting from urban runoff for all commercial, industrial, and residential projects by treating such runoff before it enters intermittent or permanent streams. All feasible mitigation measures should be considered, including, but not limited to, artificial wetlands, infiltration/sedimentation basins, riparian setbacks, oil/grit separators, wet scrubbing of parking areas with a scrubbing/vacuum machine and proper wash water disposal, or other effective Best Management Practices, where appropriate.

19) The community's canal systems should be protected from excessive contamination resulting from spillage or runoff of impurities originating from land development projects.

20) Require that canals be encased whenever they pass through developments with lot sizes of 2.3 acres or less; where subdivision roads are constructed within 100 feet upslope or upstream from canals; and within all com-mercial, industrial, institutional, and multi-family developments.

21) Require fencing of canals wherever lot size is between 2.3 and 4.6 acres, and on a case-by-case basis as determined by the entity responsible for the canal.

22) Require that each new development project potentially affecting a canal must provide proper protection to that canal as part of the development review committee (DRC) review of the project. Require that DRC coordinate its requirements with the entity responsible for the canal.

Rock Creek Reservoir Protection. A bypass channel and upstream sedimentation basins are recommended to protect the quality of Rock Creek Reservoir water as described below (Hydrology Study pp. 6-2 to 6-3).

Bypass Channel. The bypass channel should be constructed such that it intercepts flows from the three primary tributaries to Rock Creek Reservoir and diverts the flows to Rock Creek downstream of the reservoir. At a minimum, the channel should be constructed to have a capacity to divert the 2-year storm runoff downstream of the reservoir such that the "first flush" of a storm event would be diverted around the reservoir. Spill structures should be constructed along the channel so that flows greater than the 2-year runoff will spill into the reservoir.

The bypass channel will impact Rock Creek below the dam because rather than passing diluted flows through the dam outlet works to the stream, the "first flush" would bypass the reservoir and go directly to the stream. Some dilution may occur in the stream depending on the current reservoir releases. The sedimentation basins are recommended to help mitigate the impacts of the bypass channel on Rock Creek below the dam by removing the majority of the sediment load and any of the pollutants that are absorbed onto the sediments, as described below.

Sedimentation Basins. The idea behind the use of sedimentation basins to treat urban runoff is to detain runoff from storm events in a basin such that suspended solids (and the associated pollutants) have the time to settle out before the runoff leaves the basin. In the Rock Creek watershed, sedimentation basins should be constructed on each of the three tributaries of Rock Creek which enter the reservoir. This includes the construction of two sedimentation basins on property owned by Pacific Gas and Electric (PG&E) on the northern tributary and on Rock Creek upstream of Bell Road. In addition, a sedimentation basin should be constructed on the eastern tributary (east of New Airport Road). A golf course has been proposed for that property, and a sedimentation basin should be incorporated into the design of the golf course if it is built.

Canal Protection. The following canal protection methods are recommended (Hydrology Study, p. 6-5):

Land Use Controls. A zoning ordinance should be implemented which limits the development of commercial, industrial, institutional and multi-family residential developments directly upstream of an

open canal. The ordinance should state that a 100-foot setback is required from the uphill bank of a canal, with a 50-foot setback from the downhill bank of a canal.

Drainage Controls. To the extent practical, no development uphill of an open canal should be allowed to let storm drainage enter a canal through a storm drainage collection system.

Canal Encasement. Canals should be encased in new residential developments with lot sizes of two acres or less and in new residential subdivisions where roads are constructed within 100 feet of a canal. In addition, canals should be encased in mew residential developments with lot sizes of three acres or less if the canal carries the raw water supply for a downstream water treatment plant. Canals should also be encased in commercial, industrial, institutional and multi-family residential developments.

The size and types of pipes used to encase the pipes and the installation procedure should be approved by the City Engineer and the responsible canal agency.

Canal Fencing. Fencing should be required for canals which are not required to be encased but which are within residential developments with lot sizes of five acres or less. The requirement for fencing along open canals in other developments should be determined on a case-by-case basis depending on the location and size of buildings, parking lots, roads and other improvements, the canal size and downstream water use, and the presence or use of hazardous or toxic materials.

The location of the fences as well as their design and construction should be approved by the County Engineer as well as the responsible canal agency.

Since the Hydrology Study was prepared, the Nevada Irrigation District has deleted its previous recommendations for fencing based in part upon comments by the Department of Fish and Game.

Development Runoff Control. The Hydrology Study recommends that all new developments be required to implement Best Management Practices (BMPs) such that the net increase in pollutant loads is minimized. A list of BMPs appropriate to the Plan area is given in Table 53 below and discussed more fully in the Hydrology Study (Chapter 4).

Table 53
BEST MANAGEMENT PRACTICES (BMPs) FOR THE AUBURN/BOWMAN AREA

Rural and Agricultural BMPs
- Animal Waste Management
- Range and Pasture Management
- Streamside Management Zones
- Agricultural Chemical Management

Urban and Commercial BMPs
- Litter Control/Solid Waste Management
- Street Cleaning
- Minimization of Directly Connected Impervious Areas
- Grass-lined or Vegetated Swales
- Public Education
- Filter Strips
- Dry Extended Detention Basins
- Wet Extended Detention Basins
- Constructed Wetlands
- Trapped Catch Basins
- Urban Landscaping
- Water Quality Inlets (Oil/Grit Separators)

Construction Site BMPs
- Dike and Berm Controls
- Ditch and Swale Controls
- Sediment Collection
- Land Grading Controls
- Vegetation and Mulching Controls
- Structure Slope Stabilization
- Litter Control/Solid Waste Management

Monitoring Program. Automatic water quality samples are recommended at seven locations in conjunction with stream level monitoring. The seven locations were selected to provide data for all of the primary watersheds in the study area including Orr Creek, Dry Creek, Rock Creek and North Ravine. In addition, two extra monitoring stations: Rock Creek at Bell Road and Rock Creek Reservoir (water quality monitoring only) will provide additional data on the Rock Creek Reservoir and the upper Rock Creek watershed where significant development is anticipated over the next twenty years. This automated monitoring program is designed to sample several times over a given storm event such that the first flush of a storm event can be monitored. In addition, this program can be upgraded to monitor for all EPA priority pollutants (Level III monitoring). However, this would require that grab samples be taken in the field as the automated samplers do not have the capacity to obtain the large samples required for the analysis of all priority pollutants. Another major feature of the updated Plan for the protection of water quality is the body of policies calling for the protection of water-purifying wetlands.

Rigorous implementation of these recommendations will avoid most of the significant effects of increased urbanization. According to the Hydrology Study (p. 6-11) "Best Management Practices have proven to be effective methods of controlling pollutants carried in stormwater runoff in many rural and urban areas throughout the United States." Canal encasement will be effective to protect canal water from future urban runoff; land use controls will be partially effective, but animal wastes from undeveloped lands and urban runoff from upstream areas during large storm events will still be problems.

The Hydrology Study notes that the sedimentation basins recommended to protect Rock Creek Reservoir will remove 70% of the suspended solids that

are of the size of very fine sand or larger. Additionally the bypass channel will convey all of the two-year runoff event and the first flush of the larger events around the Reservoir. Overall, this is an effective program. However, those constituents of most concern, the hydrocarbons, are the least likely to be addressed by the system.

Effects of 20 year buildout based on economic projections. The most important difference between projected 20-year buildout and full buildout is in the amount of commercial and industrial use. The economic study prepared for the Plan predicts a 72 year buildout period for commercial use and a 251 buildout period for industrial use; in 20 years it is likely that only a fraction of these uses will be developed. Since commercial and industrial uses account for a major share of an urban area's impervious surfaces, it is apparent that the impacts associated with those surfaces, most notably increased stormwater runoff and non-point source surface water pollution, will be substantially lower at 20 years in comparison to full buildout. However, significant impact could still occur if funding and implementation of recommended drainage improvements does not occur, or if Best Management Practices fail to protect sensitive surface waters.

Conclusion: Based upon the above criteria and analysis, general water quality impacts will be significant but mitigable through the BMP's and other measures recommended for individual development projects. However, impacts on the Rock Creek Reservoir will be significant and unmitigable. It should be recognized that this conclusion is made in comparing the updated Plan to existing levels of development; the updated Plan is of a mitigating nature when compared to the previous Plan.

10. **Impacts of recommended water quality protection facilities.** The primary impact of the recommended water quality facilities is potential destruction of wetland habitat. The comments regarding detention basins under Impact #8 apply to the BMPs involving detention – impacts are significant and avoidable with regard to wetland impacts, mosquito breeding, hazards to toddlers and hazardous materials accumulations. This conclusion may not apply to the Rock Creek Reservoir protection facilities; the recommended sedimentation basins have not been sized or located, making the avoidability of impacts impossible to predict. The Reservoir Bypass Channel would cross riparian corridors in two to three locations – significant long-term, unavoidable impacts may occur from disruption of the riparian forest which lines the large perennial stream entering the Reservoir from the east.

Conclusion: Based upon the above criteria and analysis, the impacts of water quality protection measures will generally be significant and mitigable with the exception of those of the Rock Creek Reservoir protection measures which will be significant and unmitigable.

11. **Impacts on ground water quality.** As described in the Setting section, the groundwater of the Plan area is found in surface fractures and cracks in bedrock. In these areas there is potential for surface contamination of the groundwater. In urban areas, the runoff constituents discussed above (under Impact #10) would be of principal concern. In rural areas, coliform, fertilizers, and pesticides would have the potential to affect both fractured rock groundwater and shallow "perched" groundwater (the specific impact of septic systems on groundwater is discussed in the Public Facilities: Sewer section). Some of the Best Management Practices discussed above will address groundwater contamination, but mitigation cannot be completely assured without knowing the specifics of each situation.

While new wells can be protected through proper location and sealing, the groundwater is still being contaminated and existing wells may be affected. An example of the potential significance of this effect is the risk of excessive nitrate concentrations and the resultant health risk (notably methemoglobinemia in infants).

Conclusion: Based upon the above criteria and analysis, impacts on groundwater quality have the potential to be significant and unmitigable.

12. **Effects of urbanization on groundwater recharge.** Buildout under the updated Plan will result in increased impervious surfaces and possible decrease in groundwater recharge. The extent of this effect will depend upon the location of groundwater bearing bedrock fractures in relationship to permeable soil conditions and potential impervious surfaces. In general, the extent of the impervious surfaces does not appear to be sufficient to substantially lower groundwater levels, particularly since the area's streams are planned for protection.

Conclusion: Based upon the above criteria and analysis, impacts to groundwater recharge will be less than significant.

13. **Cumulative effects of joint City and County development — considered above.** The Hydrology Study, which was the basis of the impact analysis, considered County development together with City development. The City's Draft General Plan contains policies and implementation addressing drainage and water quality, but appear to rely on environmental review of individual projects - increases in stormflows and non-point pollutants from incremental development of impervious surfaces are still likely.

Conclusion: Based on the impact evaluation criteria and discussion, as in the case of Community Plan area impacts, cumulative City/County effects will be significant because avoidance measures are not completely assured.

Additional Discussion

The following discussion is provided for informational purposes only; it does not relate to an impact of the project at hand – the implementation of the Auburn/Bowman Community Plan.

Updated Plan effects compared to those of the Previous Plan. The 1978 Auburn Area and Bowman General Plans propose a level of development which exceeds that proposed in the updated Plan, without specific proposals on how to solve flooding and water quality problems.

Summary

The Community Plan compared to existing conditions is expected to have self-mitigating effects on flooding, although this is not entirely assured due to potential funding feasibility problems. The recommended Dry Creek channel improvement and the Rock Creek Reservoir protection improvements will have significant, unmitigable effects on riparian areas and significant water pollution cannot be avoided. However, compared to the previous Plan, the updated Plan will have a mitigating effect.

Mitigation Measures

1. **Increases in stormwater runoff and flooding at bridge culverts - No additional measures are available to assure funding for drainage improvements.** One of the factors complicating the Hydrology Study's funding proposals is the extent of improvements needed for existing flooding conditions; even if substantial development fees are enacted, approval by existing residents of assessment districts or other funding may not be possible, with the result being added population exposed to flooding. There are no obvious options for avoiding this problem.

Effectiveness of Measure/Relevant Plan Provisions: Hydrology Goals 3,4, and 5, and Policies 14-17, 23 and 26 partially address this issue, but impacts remain significant and unmitigable.

Implementation: N/A

2. **Impacts of proposed bridge and culvert improvements - No additional mitigation measures are needed beyond those contained in the Community Plan.**

Effectiveness of Measure/Relevant Plan Provisions: Significant impacts are avoided through the following Plan provisions: Hydrology Policy 12, Vegetation Policies 4,5,7 and Fish and Wildlife Policy 8.

Implementation: N/A

3. **Flooding in floodplains - No measures are recommended for this less than significant effect.**

Effectiveness of Measures/Relevant Plan Provisions: Hydrology Goal 3, Hydrology Policies 9,15,16 and 23-25.

Implementation: N/A

4. **Effects of the proposed Dry Creek Channel improvement on riparian vegetation - No measures are recommended for this less than significant impact (the channel improvements are no longer being considered).**

Effectiveness of Measures/Relevant Plan Provisions: Relevant Plan provisions include: Hydrology Policy 12, Vegetation Policies 4,5,7 and Fish and Wildlife Policy 8.

Implementation: N/A

5. **Increase in stormwater runoff and flooding on canals - No additional measures are needed beyond those of the Plan** to mitigate the effects of floodwaters on canals.

Effectiveness of Measures/Relevant Plan Provisions: Relevant Plan provisions include: Hydrology Policies 12, 14-17, 20-22, and 26.

Implementation: N/A

6. **Impacts of recommended canal protection features - No additional measures are needed beyond those contained in the Plan.**

Effectiveness of Measures/Relevant Plan Provisions: Impacts are less than significant due to the following Plan provisions: Hydrology Policy 12, Vegetation Policies 4,5,7, and Fish and Wildlife Policy 8.

Implementation: N/A

7a. **Impacts of regional downstream flooding - Continued efforts by the Placer County Flood Control and Water Conservation District to establish regional stormwater management facilities, including regional detention facilities if necessary.**

7b. **Impacts of regional downstream flooding - Addition of the Dairy Road Watershed/Auburn Ravine Basin #1A to the list of basins in which detention should be required for new development.**

Effectiveness of Measures/Relevant Plan Provisions: a) This measure is potentially effective in reducing regional flooding impacts below the level of significance but their implementation is not assured because no plans or funding proposals are in place. Relevant Plan provisions include Hydrology Goal 3 and Policies 17 and 26. b) This measure will be effective in reducing the impacts within the City of Auburn.

Implementation: a) Implementation ongoing; b) Revision of list of local detention zones.

8. **Impacts of detention facilities - Required biological surveys, wetland replacement, basin fencing, proper basin drainage and maintenance, and soils testing and proper disposal of sediments. The following studies and basin design features should be included in the project description submitted for environmental review:**

a. **Botanical and biological surveys of areas to be affected by proposed detention basins.**

b. **Recommended measures, such as wetland replacement, to offset impacts on biotic resources.**

c. **Non-visually obtrusive fencing capable of restricting small children from any basins with permanent or semi-permanent standing water.**

d. **Proper basin design and maintenance to prevent the occurrence of stagnant water and mosquito breeding.**

e. **Periodic soils testing of accumulated sediments for hazardous substances and disposal at a site approved to receive hazardous materials.**

Effectiveness of Measures/Relevant Plan Provisions: These measures will be effective in preventing the various impacts associated with detention basins and impacts will be reduced below the level of significance. Relevant Plan provisions include: Hydrology Policy 12, Vegetation Policies 4,5 and 7, and Fish and Wildlife Policy 8.

Implementation: Project and environmental review.

9. **Degradation of surface water - No additional measures are available to mitigate surface water pollution beyond those contained in the Plan.**

Effectiveness of Measures/Relevant Plan Provisions: In the case of the Rock Creek watershed, impacts remain significant. Relevant Plan provisions include Hydrology Policies 2,12 and 18, Hydrology Implementation Measure I.

Implementation: N/A

10. **Impacts of recommended water quality protection facilities - The mitigation measures described under #8 above apply to recommended water quality protection facilities.**

Effectiveness of Measures/Relevant Plan Provisions: The above measures will lessen the impacts on recommended water quality protection facilities, but not below the level of significance in the case of those recommended for the Rock Creek Reservoir. Relevant Plan provisions include: Hydrology Policy 12, Vegetation Policies 4,5 and 7, and Fish and Wildlife Policy 8.

Implementation: Project and environmental review

11. **Impacts on groundwater quality - No additional measures are available beyond those contained in the Plan.**

Effectiveness of Measures/Relevant Plan Provisions: This impact is less than significant due to the following Plan Provisions: Hydrology Policy 8 and Implementation Measure Hydrology k.

Implementation: N/A

12. Effects of urbanization on groundwater recharge - No measures are recommended for this less than significant impact.

Effectiveness of Measures/Relevant Plan Provisions: Less than significant impact. Relevant Plan provisions include: Hydrology Policies 9 and 25.

Implementation: N/A

13. Cumulative Impacts - No additional measures are available to the County regarding cumulative City/County impacts beyond those given above.

Effectiveness of Measures/Relevant Plan Provisions: Cumulative impacts related to flooding at bridges/culverts, to regional flooding, to water quality in the Rock Creek watershed and to the impacts of Rock Creek watershed water quality facilities remain unmitigated. Relevant Plan provisions: Various Hydrology provisions.

Implementation: See various measures above.