Hydrology, Floodplains, and Water Quality

Affected Environment

Regulatory Framework

The Wild and Scenic Rivers Act directs managing agencies to preserve free-flowing conditions and water quality of designated rivers. "Free flowing," as applied, means existing or flowing in natural condition without impoundment, diversion, straightening, riprapping, or other modification. Water quality is to be maintained or improved to levels that meet federal criteria or federally approved state standards for aesthetics, fish, and wildlife propagation.

The Clean Water Act of 1972 (CWA), as amended (33 USC, section 1251 et seq.), establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters (33 CFR 323.3). Under the CWA, the U.S. Environmental Protection Agency (EPA) sets water quality standards for all contaminants in surface waters and implements pollution control programs, such as the National Pollutant Discharge Elimination System permit program, which requires a federal permit for any proposed point source of water pollution (EPA 1972). CWA section 404 regulates the placement of dredged or fill materials into wetlands and other jurisdictional waters of the U.S.; section 401 requires federal agencies to obtain certification from the state or federally recognized Indian tribe (on tribal lands) before issuing permits that would increase pollutant loads to a body of water. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's waters. The surface water features in Yosemite National Park support the unique value of the park. Director's Order # 83 *(*"Public Health") (NPS 2004c), and the National Park Service's (NPS's) *Management Policies 2006,* instructs the NPS to work with appropriate governmental bodies to obtain the highest possible standards available under the CWA. Further these policies instruct park management to take all necessary actions to maintain or restore the quality of surface water and groundwater within national parks, consistent with the CWA and all other applicable federal, state, and local laws and regulations. With respect specifically to drinking water quality, Reference Manual 83F, "Backcountry Operations," instructs park managers to ensure that minimum standards for public health are maintained in the backcountry where frontcountry standards are not achievable (NPS 2004; NPS 2008D).

In addition to the CWA, water quality is protected by provisions of the Safe Drinking Water Act; the Resource Conservation and Recovery Act (RCRA); and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). For example, under the Safe Drinking Water Act, the Underground Injection Control Program prohibits the subsurface emplacement of fluids that could contaminate current or future underground sources of drinking water, and under the RCRA, underground storage tanks are regulated to prevent leaking and possible contamination of the environment, including surface and groundwater resources.

The Porter-Cologne Water Quality Control Act (California Water Code, section 13020) and the federal CWA provide the jurisdictional basis for the Regional Water Quality Control Boards and the State Water Resources Control Board. These agencies are responsible for enforcement of water quality

laws and coordination of water quality control activities. The regional board for the Yosemite area is the Central Valley.

As required by Executive Order 11988 ("Floodplain Management") (NPS 2006), NPS Director's Order 77-2 ("Floodplain Management") (NPS 2003A), and NPS Procedural Manual 77-2 ("Floodplain Management") (NPS 2004), it is NPS policy to preserve floodplain values and minimize potentially hazardous conditions associated with flooding. Specifically, the NPS is directed to (1) protect and preserve the natural resources and functions of floodplains; (2) avoid the long- and short-term environmental effects associated with the occupancy and modification of floodplains; (3) avoid direct and indirect support of floodplain development and actions that could adversely affect the natural resources and functions of floodplains or increase flood risks; and (4) restore, when practicable, natural floodplain values previously affected by land use activities within floodplains. Natural floodplain values are attributes of floodplain that contribute to ecosystem quality, including, but not limited to, soils, vegetation, wildlife habitat, dissipation of flood energy, sedimentation processes, and groundwater (including riparian groundwater) recharge. Periodic disturbance of natural floodplain soils and geomorphic and vegetation attributes by floods also contribute to ecosystem quality.

When it is not practicable to locate or relocate development or inappropriate human activities to a site outside and not affecting the floodplain, the NPS is directed to (1) take all reasonable actions to minimize the impact on the natural resources of floodplains; (2) use nonstructural measures, as much as practicable, to reduce hazards to human life and property; and (3) ensure that structures and facilities are designed to be consistent with the intent of the standards and criteria of the National Flood Insurance Program (44 CFR part 60).

Flood hazard areas regulated by the NPS include the 100-year floodplain (or the Base Floodplain), the 500-year floodplain, and the Extreme Floodplain. The 100-year floodplain is the area that would be inundated by the 100-year flood, or the peak flow that has a 1% chance of being equaled or exceeded in any given year. Likewise the 500-year floodplain is the area that would be inundated by a 500-year, or 0.2% chance, flood. The extreme floodplain is the area inundated by the extreme flood, the flood considered to be the largest in magnitude possible at a site. NPS Director's Order 77-2 ("Floodplain Management") also states that if a proposed action is found to be in the applicable regulatory floodplain, the agency shall prepare a floodplain assessment, known as a Statement of Findings (see Appendix D). A Statement of Findings will be prepared for the *Merced River Plan/EIS* in accordance with NPS Director's Order 77-2 ("Floodplain Management"), and the associated Procedural Manual 77-2.

The Federal Refuse Act prohibits the discharge or deposition of any refuse matter of any kind into waters of the United States. This act supports the monitoring of stormwater runoff from developed surfaces discharged, directly or indirectly, into the Merced River. Refuse includes garbage, trash, oil, and other liquid pollutants.

Regional Hydrologic Setting

The Merced River originates along the crest of the Sierra Nevada at an elevation of about 13,000 feet and flows west for 145 miles to its confluence with the San Joaquin River in the Central Valley. From its headwaters, the main stem flows through Little Yosemite Valley, Yosemite Valley, and the Merced

River gorge before leaving Yosemite National Park. The South Fork Merced River originates near Triple Divide Peak at an elevation of over 10,500 feet. It flows west through Wawona, then joins the Merced River near Indian Flat. Outside of the park, the Merced River continues through the Merced River canyon before entering Lake McClure. From the outlet of Lake McClure, the Merced River continues westward toward the confluence with the San Joaquin River near Hills Ferry.

The Merced River basin (the northern or main stem of the river), includes Segments 1, 2, 3, and 4, and the South Fork Merced River basin includes Segments 5, 6, 7, and 8. Within the park, the Merced River drains about 256,000 acres (400 square miles), and the South Fork Merced River drains about 70,000 acres (110 square miles). In total, they drain about one-third of Yosemite National Park.

The Sierra Nevada region is characterized by a Mediterranean-type climate with cool, wet winters and warm, dry summers. About 85% of the precipitation occurs between November and April. December, January, and February have the highest average precipitation, with a monthly average of 6 inches in Yosemite Valley at 4,000 feet. Average annual precipitation in Yosemite Valley is 37.4 inches (WRCC, 2012). Annual precipitation decreases to 25 inches in El Portal at 2,000 feet and increases to 70 inches in the red fir forest at 6,000 to 8,000 feet (Eagan 1998). Most precipitation in Yosemite Valley falls as rain. At elevations above 5,000 feet, 80% of the annual precipitation falls as snow. Seasonal streamflows are primarily driven through melting of the snowpack that accumulates between October and April. Typically, the highest runoff occurs between late April to June when snowmelt reaches its peak (Mast and Clow 2000).

Over the past 50 to 60 years, rising temperatures in the Sierra Nevada have resulted in a greater proportion of precipitation falling as rain (Knowles et al. 2006) and an earlier initiation of snowmelt (Mote et al. 2005; Stewart et al. 2005). These observed changes have a number of implications for the hydrology of the Merced River. Studies suggest that as a greater proportion of precipitation falls as rain as opposed to snow, flood risks during the winter months were more pronounced (Hamlet et al. 2007). As snowmelt begins earlier in the season, less water could be available for habitat or water supply during the summer months (Hamlet et al. 2007). According to commonly accepted climate change scenarios, temperatures in the Sierra Nevada region are expected to rise significantly during the 21st century (Cayan et al. 2007), continuing these trends.

Merced River Hydrology

Segment 1: Merced River Above Nevada Fall

The Merced River above Nevada Fall descends from its headwaters through a glacially carved canyon, dropping from about 13,000 feet to 6,000 feet over a distance of 12 miles. Topography is characterized by jagged peaks, precipitous cliffs, steep canyons, broad interstream areas of glacially smoothed granite; small lakes and meadows; and thin, granitic soils. Four tributaries to the Merced River (the Lyell Fork, Triple Peak Fork, Merced Peak Fork, and Red Peak Fork) meet in a low-gradient, glacially carved valley at approximately 7,500 feet. Below Bunnell Cascade, the Merced River enters Little Yosemite Valley, another low-gradient, glacially carved valley. Here, the river meanders across its floodplain, creating oxbow lakes and meander cutoffs. Average annual precipitation at treeline (about 10,500 feet) is about 55 inches with as much as 95% occurring in the form of snow (Mast and Clow 2000).

The average annual discharge of the upper Merced River (measured at Happy Isles, the uppermost gage on the river) is approximately 355 cubic feet per second, and the average annual total discharge is approximately 257,100 acre-feet (USGS 2010). Average monthly discharge varies from 38.8 cubic feet per second in October to 1,250 cubic feet per second in May (Mast and Clow 2000).

Segment 2: Yosemite Valley

In Yosemite Valley, the Merced River is influenced by alluvial processes, producing a dynamic river that changes course periodically through erosion and deposition. In most locations, the river flows through a shallow channel approximately 100 to 300 feet wide. In the middle of Yosemite Valley, the Merced River can convey between the 2- and 5-year floods before beginning to inundate its floodplain (Jackson, Smillie, and Martin 1997).

The main tributaries to the Merced River in Yosemite Valley are Tenaya Creek, Illilouette Creek, Yosemite Creek, and Bridalveil Creek. Historic discharge in the river, measured at the Pohono Bridge gauging station, has ranged from a high of 24,600 cubic feet per second on January 3, 1997 to a low 5.4 cubic feet per second on October 26, 1997. The mean daily discharge rate is 627 cubic feet per second, with an average annual total discharge of 454,200 acre-feet (USGS 2010).

Between Nevada Fall and the Happy Isles Bridge the river is heavily controlled by bedrock and massive talus boulders. From Happy Isles Bridge to Clark's Bridge, the channel has a gradient of 1% and is confined on the right bank by moraines for much of its length. Below Clark's Bridge, the river gradient drops to 0.16% (Madej et al. 1991) and becomes a meandering alluvial system.

In 1879, large boulders were blasted to deepen and widen the river gap through the El Capitan moraine, which lowered the base level of the Merced River by 4 to 5 feet (Milestone 1978). As a result, the extent and frequency of flooding in the upstream meadows was reduced within approximately three to four miles of the moraine (approximately up to Superintendent's Bridge), leading to drier conditions and the loss of historic wetlands.

Evidence (such as historical maps and floodplain topography) suggests that the Merced River in this segment has always had a high rate of lateral erosion, which may have increased in response to human activities such as trampling along the banks, which removes vegetation and roots that bind soil. Between 1879 and the early 1970s, the NPS stabilized the bank to prevent channel migration near campsites and infrastructure. By 1987, 25% of the Merced River bank was lined with riprap between Clark's Bridge and Sentinel Bridge, the area with the greatest infrastructure and human presence. In west Yosemite Valley (downstream of Swinging Bridge) only 2% of the channel is riprapped. Riprap, where it is successful in preventing channel erosion, inhibits the free-flowing condition of the river by preventing natural stream processes, such as lateral migration and point bar formation (Florshiem et al. 2008; Schmetterling et al. 2001). Between 1919 and 1986, visitor trampling along the banks and use of the banks as access points to the river between Clark's Bridge and Sentinel Bridge damaged riparian vegetation. This condition, along with bridge openings that are too narrow, and to a lesser extent, removal of large wood and gravel mining, contributed to bank widening. Overall, between 1919 and 1986, these factors contributed to the widening of banks by an average of 27% along this reach and by over 100% in some locations (Madej et al. 1991). At the time of designation, 39% of the river between

Clark's Bridge and Sentinel Bridge was actively eroding, even though 25% of the eroding channel had been lined with riprap in an effort to control bank erosion (Madej et al. 1991). Downstream in the west Valley, 25% of the banks were actively eroding and only 2% were lined with riprap, allowing more natural channel dynamics. Madej et al. (1991) found a strong association between levels of human use around campsites and river access points and the loss of riparian vegetation cover and accelerated bank erosion.

Erosion has recently been observed on the outside of meander bends, with the most significant location being near Sentinel Beach Picnic Area. Channel widening is also occurring through erosion of both banks between Swinging Bridge and El Capitan Picnic Area, and on the outer bends between El Capitan Picnic Area and El Capitan Meadow (Cardno Entrix 2011).

Recently, the riverbank condition has been restored in Segment 2 at Housekeeping Camp, North Pines Campground, Sentinel Bridge, the former Lower River Campground, and the original El Capitan Picnic Area. The El Capitan Picnic Area was also relocated farther from the river as part of these restoration projects. Restoration techniques have included soil decompaction, revegetation, bioengineering stabilization, riprap removal, and installation of fencing to protect restored areas. Through these restoration projects, approximately 1,700 cubic yards of riprap have been removed from the banks of the Merced River, 2,600 feet of biotechnical bank stabilization have been installed, and 15,000 feet of fencing have been installed (numbers estimated from Cardno Entrix 2011). The installation of riprap largely ceased in the early 1970s, and no new hardened bank stabilization has been added since the time of designation of the Merced as a Wild and Scenic River. Since that time, the river has undermined riprap in some locations, and bank erosion is occurring behind the lines of riprap.

Segments 3 and 4: Merced Gorge and El Portal

In contrast to the alluvial nature of the Merced River within Yosemite Valley, the Merced River gorge is characterized by steeper, high-energy cascades. As the river exits Yosemite Valley, it flows through the narrow, steep-sided Merced River gorge with an average gradient of 3% (FEMA 2009). The riverbed and banks are largely composed of boulders and cobbles, ranging in size from a few inches to several yards in diameter. There are no stream gages on the Merced River within Segments 3 and 4, but hydrology is similar to the Pohono Bridge gaging station (Segment 2). Tributaries within the gorge are small; Cascade Creek flows into the Merced River as the river enters the steepest part of the gorge.

In late 2003 and early 2004, the Cascades Diversion Dam was removed from the gorge segment of the river. The Cascades Diversion Dam was located near the far western end of Yosemite Valley where the river transitions from the Valley floodplain into the steep river gorge. This dam was originally constructed to divert water from the Merced River into a hydroelectric power plant that is no longer in use. The removal of the dam allowed the accumulation of sediments retained behind the dam to redistribute downriver during periods of higher river flows.

El Portal is an area located downstream of the Merced River gorge where gradients flatten, and water velocity decreases after being routed through the gorge. El Portal includes various bar type deposits, with large boulder bars that include boulders up to several feet across and weighing many tons located

on the eastern end. Cobble sizes reduce across the area from east to west. Thus, river morphology in this area transitions from steep boulder cascades to step pools to a pool-riffle system. River meanders begin to occur in this area.

The Merced River within El Portal is confined by roads and revetment, which in some areas encroaches into the river's historical bed. A small deflection bar protects the Trailer Court, along with a berm along El Portal Road that cut off the river's floodplain and a historic meander (Odgers Pond), remnant rock diversions, and the remnants of the Greenmeyer sand pit, which was used until 1997.

Segments 5, 6, 7, and 8: South Fork Merced River

The watershed area of the South Fork Merced River at Wawona is approximately 63,000 acres (98 square miles) and expands to 154,000 acres (76,000 acres within the park boundary) by the South Fork Merced River's confluence with the main stem outside of the park boundary. The headwaters of the South Fork Merced River originate near Triple Divide Peak at an elevation of approximately 10,500 feet. The South Fork Merced River flows westward over an area underlain by granitic bedrock to Wawona and then flows northwest over an area underlain by meta-sedimentary rocks at a 3,500-foot elevation (USGS 1996). Upstream from Wawona, tributaries enter the steep-walled canyon (glacial gorge) of the South Fork Merced River from the north and south. In the Wawona area, the river meanders through a large floodplain meadow with substantial gravel bars within the channel.

In Wawona (elevation 4,000 feet), precipitation occurs either as rain or snow, which melts quickly. At higher altitudes of the South Fork Merced River basin, precipitation usually occurs as snow, which melts more slowly and sustains the flow of the river during the spring and early summer. Average annual precipitation at the South Entrance Station is approximately 40 inches. Precipitation averages 50–60 inches per year in the upstream reaches of the South Fork Merced River basin.

The total length of the South Fork Merced River is 43 miles from its headwaters to its confluence with the main stem of the Merced River, several miles downstream from the western park boundary (USGS 1992). Streamflow records exist for the South Fork Merced River at the Merced River confluence from 1911–1921 and at Wawona, upstream of the Big Creek confluence, from 1958–1968. From these records, between 1911 and 1921, the average annual discharge was 356 cubic feet per second at the Merced River confluence. Between 1958 and 1968, upstream of the Big Creek confluence, the average annual flow was 174 cubic feet per second.

Within the Wawona area, a small impoundment created to pool water at the intake of Wawona's surface water supply is located near the end of Forest Drive. This area is designed to maintain a sufficient water level for the intake. Over time, the pool has filled with small cobbles, sands, and other sediments but does not represent a major source of sediment or act as a significant barrier to river flow and dynamics.

Infrastructure in the River Corridor

Segment 1: Merced River Above Nevada Fall

Human infrastructure along the Merced River corridor above Nevada Fall includes hiking trails, bridges, a diversion wall, small utility systems, the Lower Yosemite Valley Ranger Station, three wilderness designated camping areas, and the Merced Lake High Sierra Camp facilities. Bridges in this upper watershed consist of footbridges made of wood and stone that can obstruct the free flow of the river during high flows. Before the 1900s, a diversion dam was constructed at Nevada Fall to divert flow away from what is now the Mist Trail to protect the trail that once led to the former La Casa Nevada Hotel just below Nevada Fall.

Segment 2: Yosemite Valley

The Yosemite Valley segment of the river corridor contains numerous picnic areas, hiking trails, campgrounds, lodging facilities, roadways, parking areas, bridges, and utility systems. A more expansive discussion of infrastructure is presented in the "Park Operations and Facilities" section, below.

Three large campgrounds exist within the Valley. These include Upper Pines Campground, North Pines Campground, and Lower Pines Campground. Tent-style lodging facilities are available in Curry Village and at Housekeeping Camp. Some of the campsites and tent-style lodging units are located in proximity to the Merced River and are subject to periodic flooding. In addition, the location of some of these facilities has resulted in soil compaction, vegetation denudation, and increased erosion along some shoreline areas. Past and present structures constructed within the floodplain can impede hydrologic flows and/or are subject to recurring flooding. Eleven bridges cross the Merced River between Happy Isles and the Pohono Bridge. Many of these bridges influence the width, location, and velocity of the Merced River (Madej et al. 1991). All bridges constrict flow to some degree, but hydraulic constrictions are especially pronounced at the four arch bridges built in the 1920s (Clark's Bridge, Ahwahnee Bridge, Sugar Pine Bridge, and Stoneman Bridge) as well as at Housekeeping Bridge. Milestone (1978) found the average constriction to be almost 50 feet, or 40%, of the natural channel width. Flow constriction by bridges creates eddies upstream and downstream causing bank erosion, and enhances channel bed scour that results in bar formation downstream forcing lateral migration of the river. Bridges have also created hard points that anchor channel migration, preventing channel evolution. The effects of some of these bridges are exacerbated by the elevated road causeways leading to them, which intercept and concentrate floodplain flows at high water.

One bridge (the Happy Isles Gage Bridge) was removed from the channel following the 1997 flood, and Sentinel Bridge was reconstructed immediately upstream of its original location. **Table 9-1** describes the level of concern associated with each bridge, as identified in an earlier study of Segment 2 (Madej et al. 1991).

Segments 3 and 4: Merced Gorge and El Portal

The Merced River through the gorge and El Portal is locally confined by riprap, Highway 140/El Portal Road, and Foresta Road. The Merced River in El Portal is also confined by the deflection bar near the trailer village and the levee that protects the infrastructure near the market and gas station. There are

TABLE 9-1: BRIDGES CAUSING HYDRAULIC CONSTRICTIONS IN YOSEMITE VALLEY

Bridge	Level of Concern[a]
Sugar Pine Bridge	Severe
Stoneman Bridge	Serious
Housekeeping Footbridge	Moderate
Sentinel Bridge[b]	Moderate
Ahwahnee Bridge[c]	Moderately low
Clark's Bridge	Low

[a] The level of concern is based on the expected damage that would occur to park resources if corrective work is not undertaken. Potential damage ranges from severe, in the case of Sugar Pine Bridge (where major changes in channel patterns could easily be triggered by continued enlargement of the cutoff channel), to low, in the case of Clark's Bridge (where the channel is steep and bridge effects are confined to local scouring downstream of the right abutment).
[b] Based on 1989 field work. Sentinel Bridge was later reconstructed.
[c] Ahwahnee Bridge was not evaluated without Sugar Pine Bridge in place.

SOURCE: Madej et al. 1991

numerous vehicle turnouts and a picnic area along the gorge segment of the Merced River, but no bridge crossings. There are two bridge crossings in the El Portal segment: the Highway 140 Bridge, near Middle Road, and the Foresta Bridge. Numerous formal and informal parking areas exist along Foresta Road, near the NPS administrative building. On the southeast side of the river, opposite Rancheria Flat, lies the former Greenemeyer sand pit. Fill material associated with the former mining operation precludes flooding and regeneration of riparian plant communities in this area.

Segments 5, 6, 7, and 8: South Fork Merced River

Infrastructure within Segments 5, 6, 7, and 8 includes numerous roads and hiking trails, three bridge crossings, two picnic areas, and two campgrounds, among other things. Bridge crossings include the Wawona Swinging Bridge (a footbridge), Wawona Covered Bridge, and the Wawona Bridge. Camping facilities include the Wawona campgrounds. Picnic areas are near the Wawona Store and near the Wawona Campground. Other structures in Wawona include the gas station and various small barns and other small structures. In addition, a small impoundment created to pool water at the intake of Wawona's surface water supply is near the end of Forest Drive. This area is designed to maintain a sufficient water level for the intake.

Water Supply and Use

Water supply within the study area comes primarily from groundwater aquifers, though the Merced Lake High Sierra Camp and Wawona rely on some diversions form the Merced River (surface water). There are four general types of groundwater in Yosemite National Park: large alluvial valleys such as Yosemite Valley; small deposits of alluvium, colluvium, and glacial till; porous geologic formations; and fractured rocks. The shallow aquifers of alluvial deposits tend to be highly responsive to groundwater recharge and withdrawals. The deep aquifers within the fractured rock are mostly unresponsive to any yearly hydrologic change, though these deep systems have not been fully studied.

Segment 1: Merced River Above Nevada Fall

The Merced River High Sierra Camp has a seasonal water system that draws surface water from the Merced River. This water system serves tent-style lodging, a kitchen/store, shower facilities, flush toilets, and a backpacker campground. Approximately 50—150 persons can use this water system on a daily basis. The camp is operational from early July through early September. The system has a design capacity of approximately 3,000 gallons per day and is regulated by a permit from the California Department of Health Services.

Segments 2, 3, and 4: Yosemite Valley, Merced Gorge, and El Portal

In 1985, the NPS stopped using surface water in Yosemite Valley and the El Portal area (diversions from the Merced River) and began drawing from newly drilled groundwater wells. Currently, groundwater pumping in Yosemite Valley provides up to 200 million gallons of water annually from three supply wells with a capacity up to 1,000 gallons per minute (ROCHE 2012). During peak visitation, between July and September, groundwater pumping can reach up to 700,000 gallons per day. This pumping rate can equal as much as 5% of the total flow of the Merced River. However, observations and modeling of the surface-groundwater interactions of the Merced River and the underlying water table have concluded that the impact of groundwater pumping on streamflows in the Merced River is small (Newcomb and Fogg 2011). Groundwater is used in both Yosemite Valley and El Portal for potable water supplies. In El Portal, six wells support a capacity of approximately 220 gallons per minute (Whitfield and Barton 2004).

Segments 5, 6, 7, and 8: South Fork Merced River

Water supplies along the South Fork Merced River and Wawona segments come from both surface water withdrawals and groundwater wells. Four potable water distribution systems and multiple private wells supply water to the Wawona area. The NPS is responsible for operating one of the distribution systems that supplies surface water from the impoundment on the South Fork Merced River to NPS and concessioner employee residences, the Wawona Hotel, the Wawona Campground, and 30 private residences. The NPS's potable water production system is regulated under a Regional Water Quality Control Board permit and is designed to draw 480 gallons per minute (1.1 cubic feet per second). In 1987, NPS implemented the *Wawona Water Conservation Plan*, which set the rate of diversion from the Wawona water intake at 288 gallons per minute (0.59 cubic feet per second) (NPS 1987C). To protect in-stream flows for aquatic habitat, the plan enacted mandatory water conservation whenever the river reaches flows of less than 6 cubic feet per second. At flows of less than 6 cubic feet per second, diversions are limited to 10% of the river flow. Recently modeling efforts have concluded that aquatic habitats in the South Fork Merced River have likely not been affected by water diversions in Wawona, though a potential for detrimental effects occurs at very low flows associated with droughts (Holmquist and Waddle 2011).No other diversions take place on the South Fork Merced River (Wood 2004).

Water Quality

The U.S. Geological Survey began monitoring water quality constituents at the Happy Isles gage in 1968, and water quality monitoring in the Merced River is ongoing. The NPS published a comprehensive water quality report in 1994, which established baseline water quality data for the

Merced River. This report found that the river's water quality was exceptionally high, with relatively few impacts caused by development and visitor use. More recently, studies that measured a wider range of constituents have revealed that some anthropogenic pollutants (e.g., petroleum hydrocarbons) are present in the Merced River, though concentrations of these pollutants are well below established water quality thresholds (Clow et al. 2011; Peavler et al. 2008). Yosemite's Visitor Use and Impact Monitoring Program has collected water quality and streambank stability information since 2004. Through the monitoring program, NPS tests for such water quality constituents as nutrients, E. coli, and petroleum hydrocarbons, and characterizes streambank stability by measuring channel dimensions, bank vegetation cover, substrate size, and the amount of large wood in the channel (Newburger et al. 2009d).

The Central Valley Regional Water Quality Control Board's *Water Quality Control Plan* designates the Merced River and South Fork Merced River with existing beneficial use for irrigation; wildlife habitat; and freshwater habitat; as well as recreational activities that include canoeing, rafting, noncontact recreation, and water contact recreation (Central Valley Regional Water Quality Control Board 2010).

High water quality is critical for the survival and health of species associated with riparian and aquatic ecosystems. Water quality elements that affect aquatic ecosystems include water temperature, dissolved oxygen, suspended sediment, nutrients, and chemical pollutants. These elements interact in complex ways within aquatic systems to directly and indirectly influence patterns of growth, reproduction, and mobility of aquatic organisms. Potential contributors to water quality impacts within the study area are briefly summarized below. A discussion of water quality within the Merced River segments follows.

Sources of Water Quality Impacts

Bank Erosion. Water quality has the potential to be affected in areas where visitor use of the Merced River is high. High use of the streambank induces bank erosion through the loss of vegetative cover and soil compaction. Bank erosion can result in the widening of the river channel and loss of riparian and meadow floodplain areas. Water quality can then be altered through increased suspended sediments caused by erosion, higher water temperatures from a lack of riparian cover, and lower dissolved oxygen levels due to elevated temperatures and shallower river depths.

Nonpoint Pollution Sources. Human activities and the use of vehicles can result in potential water pollutants that may collect on land surfaces and later be transported into the river or its tributaries by stormwater runoff. Recreational activities, such as pack animal use, swimming, and hiking, can lead to the introduction of organic, physical, and chemical pollutants into aquatic systems. Nonpoint-source runoff from roads and parking lots may potentially affect water quality by contributing hydrocarbons and heavy metals to land surfaces. Additionally, sediment derived from road sanding during winter can contributed elevated sediment loads to area waterways.

Stormwater runoff from developed surfaces is discharged directly or indirectly into the Merced River and other streams and lakes throughout the park. In the Yosemite Wilderness, nonpoint-source pollutants include human and pack animal wastes and sediments contributed through erosion (Derlet et al. 2008). These sources have the potential to affect water quality in all segments of the Merced River.

In addition to local sources, water resources in the park can be affected by regional air pollution through atmospheric deposition (Clow et al. 1996). The entire Sierra Nevada range is sensitive to acid precipitation due to its granitic substrate and the resulting low-buffering capacity of its water resources (Melack et al. 1982). The Sierra Nevada are also sensitive to nitrogen deposition from remote fossil fuel emissions (Clow et al. 2010). Ongoing studies are examining the effects of external and internal air pollutants on natural resources, including surface water resources.

Underground Tanks and Abandoned Landfills. Numerous underground storage facilities exist within the park, including fuel and waste storage tanks. Since 1986, more than 100 underground tanks have been located and removed. The park currently has over 30 known contamination sites from leaking underground storage tanks. The park also contains a number of old landfill and surface dumpsites that are potential contaminant sources impacts to water quality.

Point Sources of Pollution. Point sources of pollution include discharges from pipes or other devices where the discharge can be traced to a single point or location. Facilities in Yosemite Valley and El Portal are connected to a wastewater collection system that terminates at the El Portal Wastewater Treatment Plant. Treated wastewater is discharged to percolation and evaporation ponds at the treatment facility. Water quality impacts from wastewater may occasionally occur as a result of sanitary sewer overflow. A tertiary wastewater treatment plant serves public and private sources in Wawona, and the treated wastewater is used to irrigate the Wawona Golf Course. Periodically, the treated wastewater is discharged to the South Fork of the Merced River, when the storage capacity is insufficient and use for golf course irrigation is not feasible. Both wastewater facilities are regulated by the Central Valley Regional Water Quality Control under the National Pollutant Discharge Elimination System.

Fires. Fire is a natural component of the Sierra Nevada region and Yosemite National Park. The recurrence of fire shapes the ecosystems of the park, with many common plants exhibiting specific fire-adapted traits. The NPS has adopted a *2004 Fire Management Plan/EIS* (NPS 2004b), which has clear guidelines about when and where to allow natural and prescribed fires to burn. The effects of fire on water quality are potentially large due to increases of fine sediment, mass wasting events (e.g., landslides), and alteration of runoff patterns. However, the impacts of fire on water quality are generally short-lived and part of the natural watershed response. With respect to the use of fire retardants, the *Fire Management Plan* addresses the use of fire retardant and its potential effects on water quality, which are generally temporary effects primarily associated with the addition of nutrients.

Segment 1: Merced River Above Nevada Fall

Although limited data has been collected for Segment 1, the available information indicates that water quality is high (Clow et al. 1996). Nutrient levels are generally low (Clow et al. 2011). Nitrogen concentrations are higher above Nevada Fall than in Yosemite Valley, which is consistent with the lower rate of nitrogen assimilation that occurs at higher elevations (Clow et al. 2011).

Several studies have attempted to discern a link between pack stock use and transport of pathogens to receiving waters in rivers (Derlet and Carlson 2002; Derlet and Carlson 2006; and Derlet et al. 2008). These studies establish that pack stock manure can potentially contain pathogens, though the extent to which these same pathogens can be transported into rivers and streams remains unclear. A more

comprehensive water quality study on the main stems of rivers in Yosemite conducted over multiple months in multiple years has found low levels of E. coli in Yosemite wilderness waters (Clow et al. 2011). It is possible that localized impacts to water resources from pack stock use may occur (at trail crossings on smaller tributary streams for example), though these impacts do not appear to propagate to the main river channels. While rigorous scientific studies establishing the nature and extent of potential impacts to water quality resulting from pack stock use are not yet available, existing peer-reviewed research (Clow et al. 2011) indicates that overall water quality in Yosemite wilderness remains high.

Segment 2: Yosemite Valley

Water quality in Yosemite Valley is high, with minor indications of impacts from human activities. Surface water is generally low in nutrients, salts, and suspended sediment and high in dissolved oxygen. Most water quality constituents are measured near natural background levels. Occasional concentrations above freshwater criteria are noted for lead, cadmium, and mercury (NPS 1994a). Given the proximity of the Merced River to development in Segment 2, these pollutants may have originated as runoff from impervious surfaces (such as parking lots and roads) or leakage from underground tanks or landfills. Bacteria levels are higher in the vicinity of Sentinel Bridge and Pohono Bridge than elsewhere in the watershed, but levels are well below public health limits (Clow et al. 2011).

Nutrient concentrations are very low (Brown and Short 1999) and have been near background levels for similar undeveloped areas (Clow et al. 2011). Nitrogen concentrations are lower in Yosemite Valley than in the watershed above Nevada Fall, which is consistent with the effects of atmospherically deposited nitrogen and the lower rate of nitrogen assimilation that occurs at higher elevations. Phosphorus levels are higher in Yosemite Valley than levels above Nevada Fall, reflecting typical patterns of phosphorus weathering due to increased drainage area size (Clow et al. 2011). Dissolved oxygen levels are very high, with most samples near 100% saturation (Brown and Short 1999). Nine to 14% of water quality samples in Yosemite Valley indicate some presence of petroleum hydrocarbons (Peavler et al. 2008), most likely due to stormwater runoff from parking lots and roads, however concentrations are well below water quality limits. Eleven percent of samples contained detectable concentrations of petroleum hydrocarbons. The median concentration of samples with petroleum hydrocarbons detected was 0.023 milligrams per liter (Peavler et al. 2008), whereas the water quality action level for California waterbodies is 15 milligrams per liter (California State Water Resources Control Board 2007).

Segment 3 and 4: Merced Gorge and El Portal

Limited water quality data have been collected in the Merced gorge, but available data indicates that water quality characteristics are similar to those in the Merced River in Yosemite Valley. Nutrient concentrations are very low (Brown and Short 1999) and have been found to be near the background levels in similar undeveloped areas (Clow et al. 2011). Dissolved oxygen levels are very high, with most samples near 100% saturation (Brown and Short 1999).

Water quality in the Merced River near El Portal is high, with minor indications of impacts from human activities. The water is low in nutrients, salts, and suspended sediment and high in dissolved oxygen (NPS 1994a). Bacteria levels are generally low (Peavler et al. 2008), and dissolved oxygen is near saturation (Peavler et al. 2008). Nutrient concentrations are slightly elevated near the El Portal Wastewater Treatment Plant, especially during periods of low streamflow. However, water quality is still within established limits (Peavler et al. 2008; Clow et al. 2011).

Segment 5, 6, 7, and 8: South Fork Merced River

Water quality in the South Fork Merced River in Segments 5, 6, 7, and 8 is high, with minor indications of impacts from human activities. The water is low in nutrients, salts, and suspended sediment (NPS 1994a). Bacteria levels are generally low (Peavler et al. 2008), and dissolved oxygen is near saturation (Peavler et al. 2008). Elevated phosphorus levels have been detected on the South Fork Merced River downstream from the Wawona Campground. The presence of hydrocarbons was found in 11% of water quality samples in Wawona, but was far below water quality limits (Peavler et al. 2008).

Floodplains

Within the park, flood levels depend on the amount of snowpack, water content of the snowpack, rate of snowmelt, and amount and timing of rainfall. Although most of the park's precipitation occurs between October and April, melting of the snowpack caused by warming springtime temperatures usually signals the beginning of an increase in streamflow that persists into June (Madej1994). Flood events associated with this flow increase are often termed spring floods. Under normal conditions most of the runoff occurs from mid-April through July, with peak flows in May and June. From 1916 through 1989, 124 of 140 recorded high flows on the Merced River in Yosemite Valley occurred in response to snowmelt (Madej 1994). A second type of flood typical of the Merced River can occur between September and April and is commonly referred to as a winter flood or a rain-on-snow event (Madej 1994). These floods occur when a storm is accompanied by warm air temperatures and rainfall and coincides with the presence of snow in the vicinity of the storm. Although these events account for only about 10% of the floods in the park, they are responsible for the highest floods recorded, as seen by the events of January 1997. The January 1997 flood resulted from high elevation, heavy, warm rains that melted snow, thereby contributing to excessively high volumes of surface runoff (NPS 1997b). Rain alone occasionally causes peak discharge events that are usually local in nature but sometimes cover a large area.

Frazil ice, while less common, is another cause of flooding within the park. Frazil ice is a phenomenon that occurs in connection with waterfalls. Small ice crystals develop in turbulent, super-cooled stream water at the base of a waterfall when air temperature suddenly drops below freezing. The ice crystals join to become slush and then press together as more crystals form. Frazil ice lacks the erosional force of regular stream ice, but it can cause streams to overflow their banks and change course. Frazil ice sometimes reaches a depth of more than 20 feet along Yosemite Creek at the Lower Yosemite Fall Bridge. A 1954 flow of frazil ice completely filled the streambed of the creek and covered the footbridge near Lower Yosemite Fall with many feet of ice (Hubbard and Brockman 1961). The Yosemite Falls footbridge was covered with frazil ice in February 1996.

Flooding plays a necessary role in the overall adjustment of a river system. Periodic flooding provides sediment and nutrients that are essential for the aquatic and vegetative health of the floodplain. Floodplains are features that are both the products of the river environment and important functional parts of the system. However, human-made structures, such as bridges and buildings, placed within a floodplain can impede natural flow and result in injury to visitors and damage to structures. Discussion of flooding and floodplains is most relevant to the potential loss of life and the influence on the Merced River from development in the floodplain.

In areas where dynamic natural processes cannot be avoided, developed facilities should be sustainably designed (e. g., removable in advance of hazardous storms or other conditions). When facilities must be located in such areas, their design and siting would be based on (1) a thorough understanding of the nature of the physical processes, and avoiding or mitigating the risks to human life and property; and (2) the effect of the facility on natural physical processes and the ecosystem (Director's Order #77-2 [*Floodplain Management*]).

Segment 1: Merced River Above Nevada Fall

The Merced River's floodplains in remote areas above Nevada Fall have not been defined. Steep topography limits the floodplain in the upper canyon areas. Within Little Yosemite Valley, the floodplain likely encompasses most of the valley floor; however, the 100-year floodplain has not been mapped here.

Segment 2: Yosemite Valley

Regular flooding and subsequent deposition of alluvial sediments have been instrumental in the formation of Yosemite Valley. Flooding continues to support a variety of natural processes in Yosemite Valley, such as deposition of flood-borne sediment; channel avulsion (i.e., abandonment of an old river channel and the creation of a new one); and the development of complex channel patterns and valuable riparian and wetland habitat. Significant flood events continue to alter the floodplain of Yosemite Valley. The largest events occurred in 1937, 1950, 1955, and 1997, with peak discharges measured in the range of 22,000 to 25,000 cubic feet per second at Pohono Bridge. These floods were the result of rain-on-snow events during which rain fell on winter snowpack and caused snowmelt in combination with rain-related runoff.

The January 1997 flood was the largest recorded flood within the park with a peak discharge of 10,000 cubic feet per second at Happy Isles and 25,000 cubic feet per second at Pohono Bridge (Eagan 1998). The flood inundated roads, picnic areas, park offices, and lodging units. It caused extensive damage to NPS facilities, including roads, bridges, buildings, and Yosemite Valley's electric, water, and sewer systems. The flood also altered natural features and caused downed trees, movement of landslide talus into streams, channel erosion, and substantial changes in channel morphology (NPS 1997b). This flood was estimated to have a recurrence interval of 90 years (NPS 1997b), or about a 1.1% chance of occurring in any given year. NPS staff mapped the actual extent of the 1997 flood inundation in Yosemite Valley and El Portal. These data were used to establish the 100-year floodplain in Yosemite Valley.

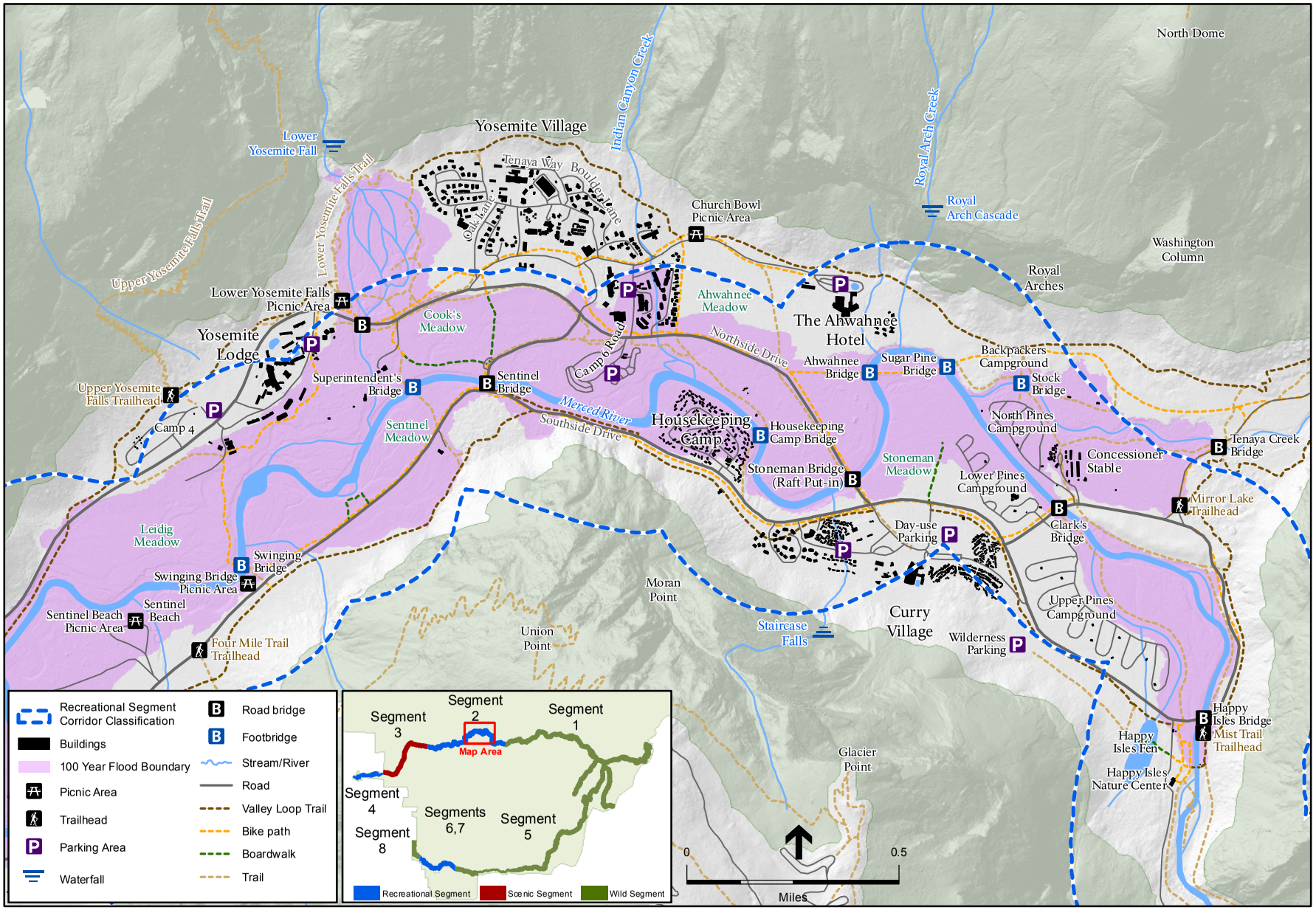
In Yosemite Valley, the character of the floodplain varies in different locations due to local hydraulic controls. From Clark's Bridge to Housekeeping Camp in the east Valley, the Merced River floods areas outside the main river channel with shallow swift flows that cut across meander bends. Near Yosemite Lodge and downstream to the El Capitan moraine, flood waters back up against the dense vegetation and tend to be deep, low velocity, and low energy. From the El Capitan moraine downstream, the river channel is steeper and confined in the narrow river canyon, the floodplain is narrow, and flow velocities are high.

As shown in **figures 9-3** and **9-4**, the following facilities are located within the 100-year floodplain in Segment 2:

- portions of the Upper Pines Campground area, including six individual campsites and a recreational vehicle dump station
- portion of Lower Pines Campground, including four restrooms
- most of North Pines Campground, including four restrooms and a lift station
- portion of Backpackers Campground
- most of the Curry Village stables and associated housing, including 18 housing units and a community kitchen
- most of Housekeeping Camp, including lodging units, bathrooms, and other structures
- two small employee apartment buildings in Yosemite Village
- concession headquarters (General Office)
- Residence 1 and the associated garage
- Yosemite Lodge structures: the Maple, Alder, Hemlock, and Juniper motel units, six miscellaneous structures near the Wellness Center, and three miscellaneous small structures near Dogwood Cottage
- Yosemite Creek sewage lift station
- groundwater wells near Yosemite Creek
- kennel in Lamon Orchard

Segments 3 and 4: Merced Gorge and El Portal Watershed

From the location of the former Cascades Diversion Dam downstream to the El Portal Administrative Site, the river channel is steep and confined to a narrow river gorge. In this area, the floodplain is narrow and flow velocities are very high. The Merced River channel in El Portal can shift during large floods, including movement of large boulders that define the channel. Within this area, El Portal Road and small levees alter the floodplain by restricting flow during flood events and forming a barrier to channel migration. Noted above, fill material precludes the Merced River's utilization of the floodplain area of the former Greenemeyer sand mining operation. During extreme flood events, the river has shown the capability to undermine or spill over and damage the roadway.

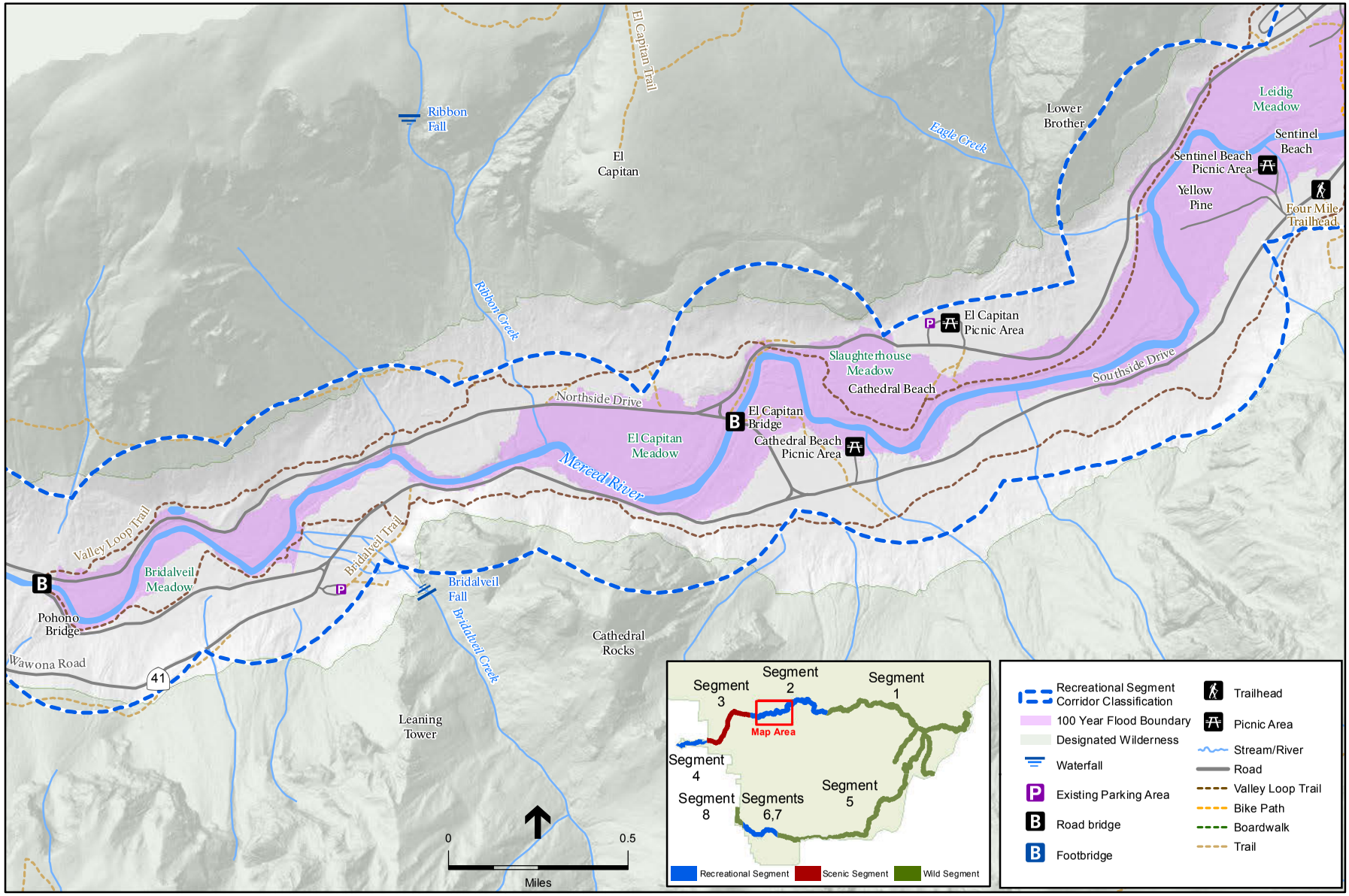


SOURCE: NPS, 2011

Merced River Comprehensive Management Plan and EIS . 210436

Figure 9-3

100-Year Flood Zone at Yosemite Valley East



SOURCE: NPS, 2011

Merced River Comprehensive Management Plan and EIS . 210436

Figure 9-4

100-Year Flood Zone at Yosemite Valley West

In El Portal, the 100-year discharge of the Merced River is estimated to be 32,800 cubic feet per second (PBS&J 2011). Hydraulic modeling of the Merced River at this location indicates that under the 100-year event, minor flooding occurs on the right (north) floodplain near the El Portal support facility. Portions of the El Portal Administrative Site parking areas and access roads are within the 100-year floodplain. Further upstream, portions of Highway 140, portions of El Portal Trailer Village and El Portal Market are all within the 100-year floodplain.

As shown in **figure 9-5**, the following facilities are located within the 100-year floodplain in Segments 3 and 4:

- El Portal Special Park Uses Trailers
- Embankment/levee between El Portal Market and gas station
- Portions of Odger's fuel transfer center
- Portions of Abbieville and Trailer Court
- NatureBridge office and dorm

Segments 5, 6, 7, and 8: South Fork Merced River

Within Wawona, the 100-year discharge of the South Fork Merced River is estimated to be 19,700 cubic feet per second (PBS&J 2011). The 100-year floodplain inundation area along Segments 5, 6, 7, and 8 is fairly limited, except in the Wawona area, because of the river corridor's steep topography. Within Wawona, most development is located outside of the 100-year floodplain.

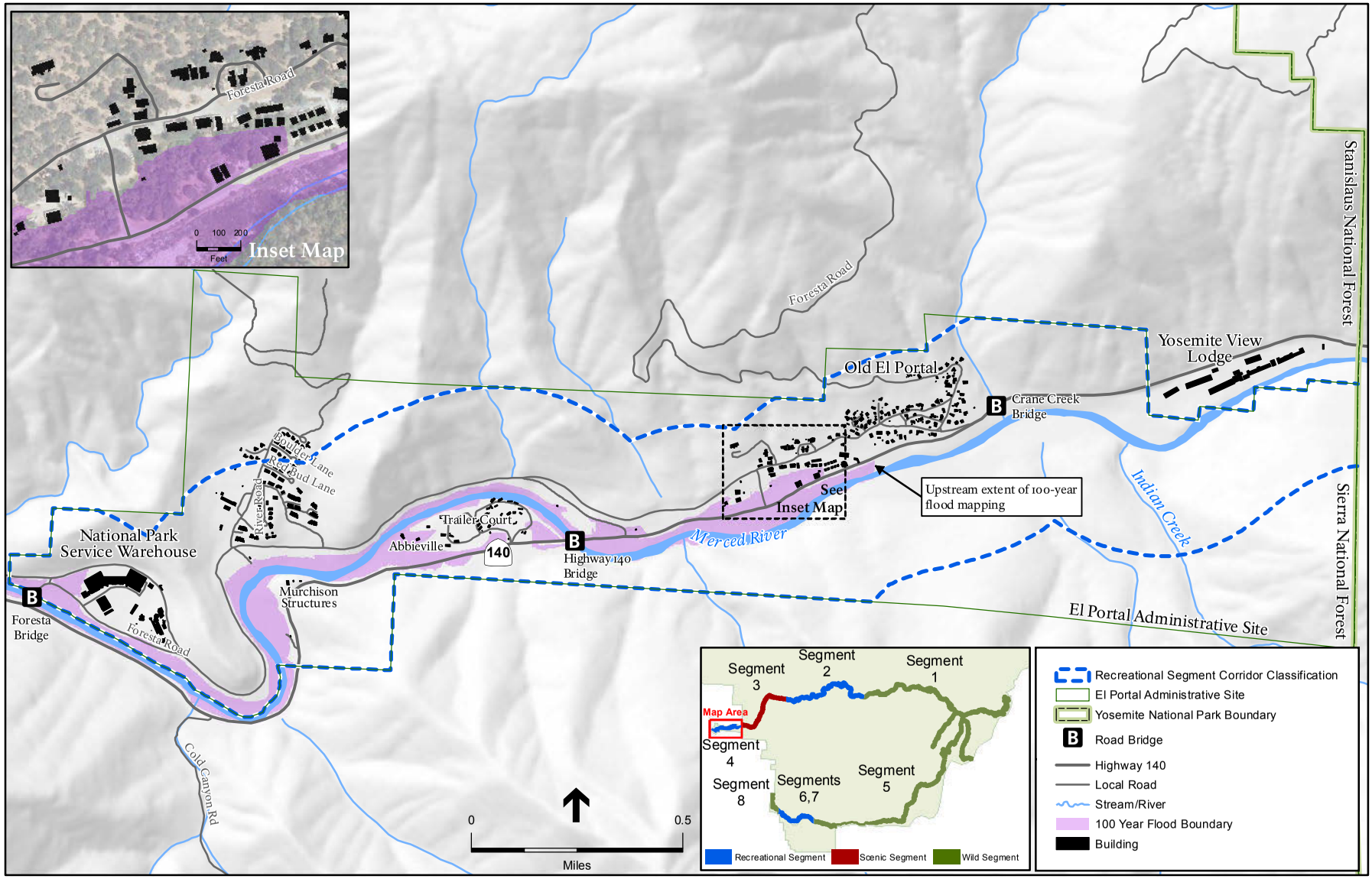
As shown in **figure 9-6**, the following facilities are located within the 100-year floodplain in Segment 7:

- portions of the Pioneer Yosemite History Center
- Wawona Covered Bridge and Wawona Road Bridge
- Portions of Wawona Campground
- South Fork Wawona Picnic Area

Environmental Consequences Methodology

Proposed management actions for each alternative are evaluated in terms of the context, intensity, and duration of the hydrologic impacts, and whether the impacts are considered beneficial or adverse to the hydrologic environment.

- **Context.** The context of the impact considers whether the impact would be local, segmentwide, parkwide, or regional. For the purposes of this analysis, local impacts would be those that occur in a specific area within a designated segment of the river (i.e., 1-8). This analysis further identifies whether there are local impacts in multiple segments. Segmentwide impacts would consist of a number of local impacts within a single segment, or larger scale impacts that would affect the segment as a whole. Parkwide impacts would extend beyond the Merced River corridor and the project area within Yosemite National Park. Regional impacts would potentially have an influence throughout the Sierra Nevada.

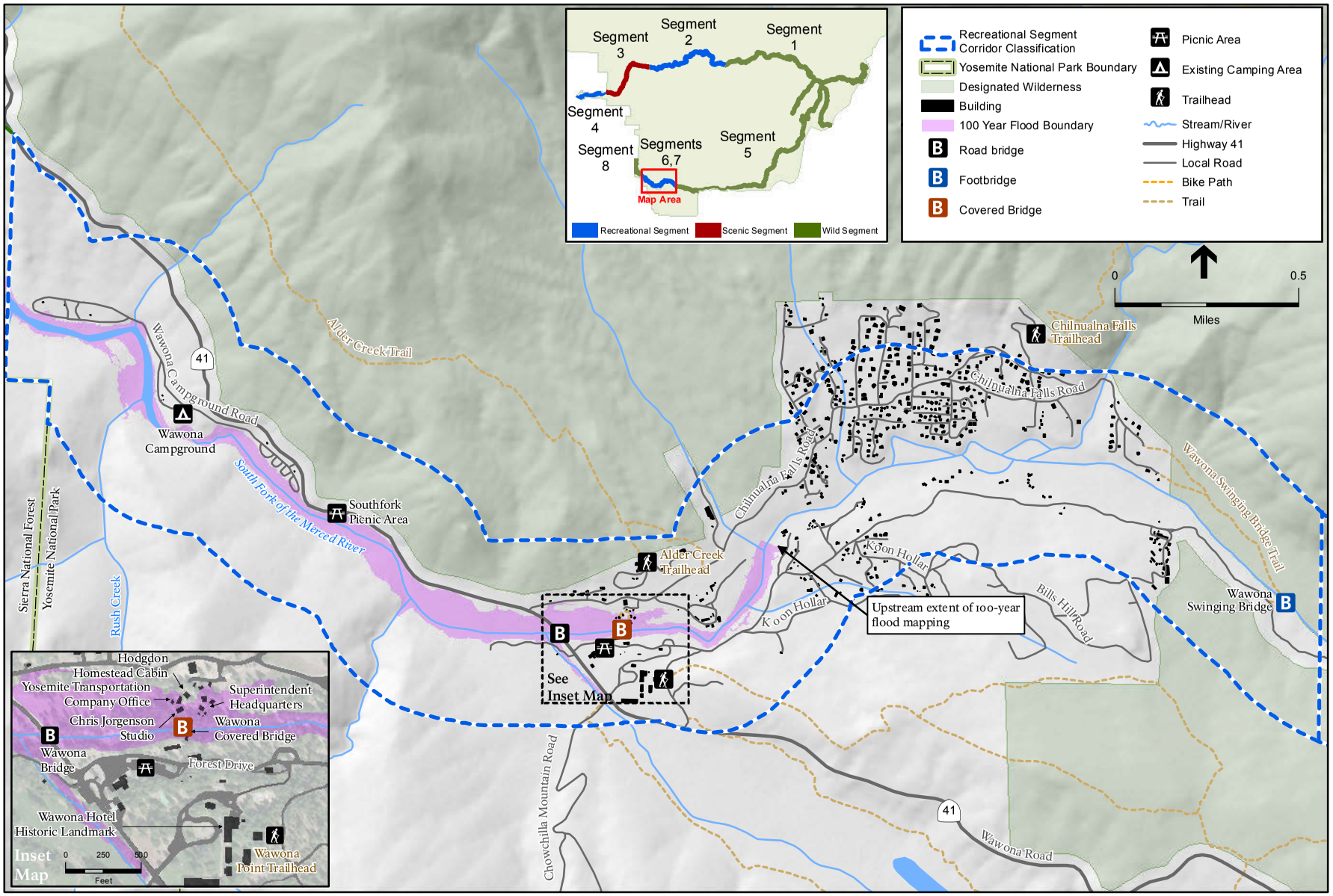


SOURCE: NPS, 2011

Merced River Comprehensive Management Plan and EIS . 210436

Figure 9-5

100-Year Flood Zone at El Portal



SOURCE: NPS, 2011

Merced River Comprehensive Management Plan and EIS . 210436

Figure 9-6

100-Year Flood Zone at Wawona

- **Intensity.** The intensity of the impact considers whether the impact would be negligible, minor, moderate, or major. Negligible impacts would not be detectable and would have no discernible effect on the hydrology of the Merced River or detectible change in water quality constituents. Minor impacts on hydrologic processes or water quality constituents would be slightly detectable, but would not be expected to have an overall effect on the character of the river, its floodplain, or water quality. Moderate impacts on hydrology would be clearly detectable, and could have an appreciable effect on hydrologic processes and the adjacent floodplain. Moderate impacts on water quality would cause a clearly detectible change in water quality constituents, but would not exceed public health or aquatic habitat thresholds. Major impacts on hydrology would have a substantial, highly noticeable influence on the hydrologic environment and could permanently alter river processes, floodplain formation, and evolution. Major impacts on water quality would cause water quality constituents to exceed public health or aquatic habitat thresholds.

- **Duration.** The duration of an impact considers whether the impact would occur in the short term or the long term. A short-term impact would be temporary in duration and would be associated with transitional activities, such as facility construction or road removal. A long-term impact would have a permanent effect on the hydrologic environment, such as altering the dynamic processes that govern the free-flowing nature of the river, floodplain formation and evolution, or the condition of water quality.

- **Type of Impact.** Impacts were evaluated in terms of whether they would be beneficial or adverse to the hydrologic environment. Beneficial impacts would sustain streamflow dynamics, allow natural processes to prevail, and protect or improve water quality. Adverse impacts would negatively alter hydrologic processes, thereby hindering natural processes and reducing protection of the river, its floodplain, and water quality.

Environmental Consequences of Alternative 1 (No Action)

The following discussion provides an overview of the impacts on hydrology (including related processes, such as stream erosion and channel migration); floodplains; and water quality that could occur within each segment of the Merced River corridor from application of Alternative 1 (No Action).

Impacts Common to Segments 1–8

Impacts of Actions to Protect and Enhance River Values (Corridorwide Actions)

Under Alternative 1, the NPS would continue maintenance and management practices that maintain existing improvements within the Merced River corridor. Specific practices are described in detail below.

Hydrology. Existing riprap interferes with natural river processes. For example, replacement of riparian vegetation with riprap generally increases flow velocities, which results in a higher frequency and intensity of erosive flows, and therefore leads to increased erosion and associated river widening. Persistence of riprap and revetment would continue to cause erosion and river widening in a detectable manner and would result in a corridorwide, long-term, minor, adverse impact on hydrology.

Abandoned infrastructure, such as underground pipelines, wastewater treatment facilities, and manholes that affect hydrology would remain. These facilities contribute to dewatering of meadows and alteration in the natural hydrologic regime of the Merced River, increasing the amount and altering the timing of runoff entering the river. Allowing abandoned infrastructure to remain would continue to affect the hydrology of the river in a detectable manner near abandoned infrastructure locations and would result in a local, long-term, minor, adverse impact on hydrology.

Large wood would continue to be removed from the river due to safety concerns and infrastructure protection, particularly in the areas around the campgrounds and areas where rafting occurs. Removal of large wood can result in a reduction in channel complexity and a reduction in natural channel processes. These would be expected to occur in a slightly detectable manner and would result in a corridorwide, long-term, minor, adverse impact on hydrology.

Informal trailing that fragments meadow habitat and alters meadow hydrology would continue. Areas that have been denuded of vegetation due to trampling would be remain, resulting in compacted soils and altered runoff characteristics. This would result an alteration of the runoff characteristics of the meadow from natural conditions, though not in a detectable manner. These actions would result in a local, long-term, negligible, adverse impact on hydrology.

The NPS would not establish an official riparian buffer to protect water quality and riparian habitat. A riparian buffer is a strip of riparian vegetation along the banks of a river that filters runoff and provides a transition zone between the river and human land use. The concept of a riparian buffer to protect river resources is well established in the scientific literature and has been applied by numerous federal, state, and local land management agencies. The effective width of a riparian buffer depends on local topography, soil, vegetation type(s), and the nature and extent of human land use.

The primary justifications for employing a riparian buffer are to protect water quality and riparian habitat. Riparian buffers help trap pollutants that could otherwise directly enter the river, improving water quality. Buffers reduce overland flow, absorb sediment, and attenuate compounds such as nitrogen and phosphorous and pathogens such as E. coli. Riparian buffer vegetation helps to stabilize riverbanks, reduce erosion, and regulate river flow by allowing surface water to infiltrate the soil. Riparian buffer vegetation provides a source of large wood to the river and adjacent floodplain. Riparian buffers enhance important habitat for birds and other wildlife by allowing establishment of new vegetation and persistence of a complex habitat structure. Buffers also protect aquatic ecosystems by providing organic nutrients, supplying woody debris, and moderating water temperatures by shading.

The lack of protection that would occur in the absence of a riparian buffer can lead to trampling of streambanks and, as a result, an alteration of natural stream processes. Visitor use would continue on sensitive banks of the Merced River. Locations include those adjacent to Lower Pines and North Pines campgrounds, Yosemite Lodge beach access, Swinging Bridge Picnic Area, Sentinel Beach Picnic Area, Cathedral Beach Picnic Area, Devil's Elbow, riverside areas between Pohono Bridge and the El Portal Road/Big Oak Flat Road intersection, and along the Valley Loop Trail. The resulting alteration of natural stream processes would result in a local, long-term, minor, adverse impact on hydrology.

Localized riverbank erosion, and scouring effects associated with bridges would remain. Erosion and scouring effects from bridges would continue to result in alteration of stream hydrology. This would result in a local, long-term, major, adverse impact on hydrology.

Water Quality. Persistence of riprap and revetment would continue to cause erosion and result in a detectable increase in fine sediment loading in the Merced River and would result in a corridorwide, long-term, minor, adverse impact on water quality.

Areas of denuded vegetation resulting from informal trailing have the potential to result in an increase in soil erosion, likely resulting in a nondetectable increase in fine sediment in the Merced River. This would have a local, long-term, negligible, adverse impact on water quality.

The lack of a riparian buffer can lead to increased soil erosion and the introduction of fine sediment to the Merced River. Lack of a riparian zone also decreases the filtering/interception capacity of riparian vegetation that would otherwise reduce and moderate sediment and nutrient inputs from upland areas. This would result in a local, long-term, minor, adverse impact on water quality.

Continued erosion due to trampling of streambanks would be expected to occur on an ongoing basis. This would contribute an in an increase in fine sediment levels in the Merced River, resulting in a local, long-term, minor, adverse impact on water quality.

Ongoing scouring due to bridges would continue in a clearly detectable manner. This would resulting in an increase in fine sediment levels in the Merced River, resulting in a local, long-term, minor, adverse impact on water quality.

Segment 1: Merced River Above Nevada Fall

Impacts of Actions to Protect and Enhance River Values

Hydrology. The continued presence of the Nevada Fall Diversion Dam, and of the diversion for the Merced Lake High Sierra Camp would minimally alter the natural processes of the Merced River, but would not have an overall affect on the character of the river. This would result in a local, long-term, negligible, adverse impact on hydrology. Informal trails at Triple Peak Fork, wetlands near Echo Valley and Merced Lake shore, mineral springs between Merced Lake and Washburn Lake, and continued administrative pack stock grazing at the Merced Lake Ranger Station Meadow have resulted in compacted soils, which can alter the runoff characteristics of the area, though not in a detectable manner. This would result in a local, long-term, negligible, adverse impact on hydrology

Water Quality. Water quality in Segment 1 would be expected to remain high, with isolated instances of minor contamination, especially after storm events, but would not be expected to exceed water quality standards. The continued presence of braided trails at Triple Peak Fork, wetlands near Echo Valley and Merced Lake shore, mineral springs between Merced Lake and Washburn Lake, and continued administrative pack stock grazing at the Merced Lake Ranger Station Meadow have the potential to cause denuded vegetation and compacted soils resulting in an increase in fine sediment concentrations in the Merced River, though not in a detectable manner. These actions would have a local, long-term, negligible, adverse impact on water quality

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. Impacts on hydrology resulting from visitor use would remain negligible due to the continuation of the wilderness trailhead quota system. Designated camping in Moraine Dome and Little Yosemite Valley would remain, resulting in a negligible amount of trampling and soil compaction. This would have a local, long-term, negligible, adverse impact on hydrology

Water Quality. Water quality would remain high in Segment 1. Designated camping in Moraine Dome and Little Yosemite Valley would remain, resulting in a negligible amount of trampling and erosion. This would have a local, long-term, negligible, adverse impact on water quality.

Merced Lake High Sierra Camp. Under Alternative 1, 22 units (60 beds) would remain at Merced Lake High Sierra Camp. The continued presence of these facilities would result in continued trampling within the existing camp area, which would result in continued local, long-term, negligible, adverse impacts with respect to water quality, due to very minor increases in erosion associated with trampled areas. Use of flush toilets under existing conditions also contributes to local, long-term, negligible, adverse effects on water quality.

Segment 1 Impact Summary: The continued presence of infrastructure and visitors within Segment 1 would have a local, long-term, negligible to minor, adverse impact on the river's hydrology and water quality.

Segment 2: Yosemite Valley

Impacts of Actions to Protect and Enhance River Values

Hydrology. Under Alternative 1 (No Action), existing bridges in this segment would remain in their current locations and configurations. Bridges would continue to constrict flow, exacerbate scour, and cause streambank erosion leading to continued impediments to hydrology and the free-flowing character of the Merced River. Flow constrictions associated with bridges would continue to create backwaters during high flows, rapid channel scour, and create excessive sediment deposition upstream and downstream. The potential for channel avulsion (rapid formation of a new channel) would continue near bridges that severely constrict flow. This would cause corridorwide, long-term, moderate, adverse impacts on hydrology. The area around Sugar Pine Bridge could experience more substantial impacts, possibly with major intensity. The bridge has been identified as severely constricting flow and increases the potential for major channel avulsion. However, because channel avulsion did not take place during the 1% chance flood that occurred in 1997, the potential for a major impact to occur is estimated to be small.

Abutments and infrastructure associated with the former bridge at Happy Isles and the gage base would remain in their current location and condition. The infrastructure associated with the Pohono Bridge gaging station would also remain in place. The continued presence of these structures would slightly alter the natural processes of the Merced River, but would not have an overall affect on the character of the river. This would result in a local, long-term, minor, adverse impact on hydrology.

The NPS has largely ceased removal of large wood from the river since the mid 1990s; however, wood continues to be removed when it threatens infrastructure or public safety. Large wood loading is expected to increase in the future due to this changed practice, leading to in a corridorwide, long-term, minor, beneficial impact on hydrology.

Withdrawals of groundwater would continue at the present rate. Observations and modeling of the surface-groundwater interactions of the Merced River and the underlying water table have concluded that the impact of groundwater pumping on streamflows in the Merced River is small (Newcomb and Fogg 2011). Continuing groundwater pumping would have a corridorwide, long-term, negligible, adverse impact on hydrology.

Human-constructed ditches, pipelines, and underground tiles would remain in meadows throughout this segment, contributing to meadow dewatering. Abandoned roadbeds would continue to disconnect meadow areas from the Merced River. Compacted soils due to informal trailing would continue to persist, reducing infiltration. Informal shoulder parking would continue to encroach on meadows, affecting the hydrologic regime by destroying native vegetation and compacting soils, resulting in less infiltration of runoff. Under Alternative 1 (No Action), local, long-term, moderate, adverse impacts on the 100-year flood regime and floodplain would continue.

Continuing these actions would slightly alter runoff characteristics in this segment, but would not be expected to affect runoff in a detectable manner, resulting in a corridorwide, long-term, negligible, adverse impact on hydrology.

Visitor use and informal parking along the river would continue to result in the use and expansion of informal trailing, riverbank erosion, and loss of riparian vegetation, leading to a corridorwide, long-term, minor, adverse impact on hydrology.

Water Quality. Water quality in Segment 2 would be expected to remain high, with isolated instances of minor contamination especially after storm events, but would not be expected to exceed water quality standards. Informal trails and informal river access would continue to cause trail and streambank erosion, resulting in suspended sediments entering the river. Riverbank widening would continue unmitigated in Segment 2. Informal parking would continue to denude vegetation, leading to an increase in erosion. This would result in a local, long-term, minor, adverse impact on water quality.

Water supply and wastewater infrastructure, including water supply wells, dump stations, and sewage lift stations, would continue to be located in the 100-year floodplain. During floods, these facilities have the potential to release contaminants to the river, resulting in a corridorwide, short-term, minor, adverse impact on water quality during storm events.

Floodplains. Roadways, structures, and visitor use areas would continue to be present in the floodplain and would be subject to flood hazards under Alternative 1 (No Action). Water supply and wastewater infrastructure, including water supply wells, dump stations, and sewage lift stations, would continue to be located in the 100-year floodplain, resulting in a local, long-term, minor, adverse impact on floodplains.

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. Visitor use of the Merced River corridor would continue to affect the hydrology of the river. Visitor use would continue to affect the adjacent floodplain by compacting soils, reducing vegetative cover, altering streambanks, and inducing erosion. Modifications to the river channel and floodplain (through soil compaction, loss of riparian vegetation, and accelerated erosion) could result in channel widening, streambank instability, loss of riparian cover, and channel erosion, which would cause an increase in fine sediment concentrations and decrease in overbank flooding. Continued concentrated visitor use on riverbanks would adversely affect floodplains in the Merced River corridor, especially in east Yosemite Valley. This effect would worsen over time as visitor use increased, and would constitute a corridorwide, long-term, minor, adverse impact on hydrology.

Where campsites were damaged and subsequently removed following the 1997 flood, these areas would be expected to continue to passively restore to natural conditions, resulting in a local, long-term, minor beneficial effect on hydrology.

Informal parking and informal trailing would continue to occur in Segment 2, causing compacted soils, denuded vegetation, and an alteration in the runoff characteristics of the area. This would result in a corridorwide, long-term, minor, adverse impact on hydrology.

Water Quality. Visitor use of the Merced River corridor would continue to slightly affect water quality, though water quality would still meet federal standards and would not be expected to occur in a detectable manner. Visitor use would continue to lead to trampling, reducing vegetative cover, altering streambanks, and inducing erosion. This would result in increased fine sediment concentrations and decreased overbank flooding. New parking areas located at Camp 6 would result in slight increases in the release of sediment and automobile related pollutants into stormwater, constituting a corridorwide, long-term, minor, adverse impact on water quality.

Floodplains. Several housing facilities, tent-style lodging, and campgrounds would continue to be partially located within the 100-year floodplain, including Housekeeping Camp, North Pines, Backpackers, Lower Pines, Tecoya concessioner employee housing area, portions of the Yosemite Lodge complex, Ahwahnee Row Housing, and various additional administrative and visitor facilities. This would present a local, long-term, minor, adverse impact on floodplains.

Curry Village & Campground. Under Alternative 1, the 400 existing lodging units in Curry Village would remain. These units contribute minimally to impervious surfaces within the area, where impervious surfaces prevent the natural infiltration of stormwater into the subsurface, resulting in elevated stormwater flows during storm events, as well as reduced hydrologic concentration time. This results in a local, long-term, negligible, adverse impact on hydrology. The existing facilities at Curry Village are located outside of the 100-year floodplain and therefore do not affect flooding in this area.

Camp 6 and Yosemite Village. Existing transportation and circulation related infrastructure would remain under Alternative 1, including roads, pedestrian walkways and crossings, intersections, and parking areas. These features contribute to the overall amount of impervious surfaces within these areas. Because impervious surfaces increase stormwater runoff and contribute to greater peak runoff flows, the continued presence of this infrastructure would contribute to a local, long-term, minor,

adverse impact on hydrology. The associated release of sediments, oils, greases, and other transportation and road related pollutants from these areas would continue to have local, long-term, minor, adverse impacts on water quality. Although select roadways and parking lots, particularly in the area of Camp 6, are located within the 100-year floodplain, these facilities generally do not include large buildings or other obstructions that could potentially interfere with flood flows. The Concessioner Garage is, however, located within the existing floodplain, and could potentially interfere with flood flows. Localized grading associated with these structures can contribute negligibly to interference with floodplain function. Therefore, the continued presence of these facilities within the floodplain would result in local, long-term, minor, and adverse impacts.

Yosemite Lodge and Camp 4. The existing pedestrian crossing west of the intersection of Northside Drive and Yosemite Lodge Drive would continue to have a local, long-term, negligible to minor, adverse impact on hydrology due to its contribution to the complex's total area of impervious surfaces. Existing facility operations (the crossing of pedestrians) and infrastructure do not noticeably contribute to stormwater quality pollution in the area. The existing facility is located outside of the floodplain, and does not contribute to flooding on site or downstream.

Segment 2 Impact Summary: The continued presence of infrastructure in the river channel and concentrated visitation along Segment 2 riverbanks would have local, long-term, minor to moderate, adverse impacts on the river's floodplain. These factors would also contribute to local, long-term, negligible to minor, adverse hydrology and water quality impacts.

Segments 3 and 4: Merced Gorge and El Portal

Impacts of Actions to Protect and Enhance River Values

Hydrology. A levee protecting infrastructure along Highway 140; riprap along the river in El Portal; and abandoned infrastructure and imported fill at Cascades Picnic Area, Abbieville, and Trailer Village would remain, slightly affecting natural river processes. This would result in a local, long-term, minor, adverse impact on hydrology.

Greenemeyer sandpit would continue to contain fill material that precludes natural flooding, causing a local, long-term, minor, adverse impact on hydrology.

Water Quality. Water quality would continue to remain high in Segments 3 and 4. Components of Alternative 1 (No Action) have the potential to release pollutants to the Merced River in a slightly detectable manner, but would not be expected to have an overall effect the river's water quality.

The off-street and roadside parking areas would continue to be located between the Merced River and Foresta Road, and underneath valley oaks. These areas have the potential to introduce minimal amounts hydrocarbons and sediment to the river, in a slightly detectable manner, resulting in a localized long-term, negligible, adverse local, impact on water quality.

A bulk storage facility for petroleum fuels and a gas station would continue to be located in El Portal, and the transportation of fuels would continue in the Merced River corridor. The risk of a fuel release would remain, but would be mitigated by compliance with standard regulatory requirements for the

transportation and storage of such materials and normal park operation and maintenance procedure, resulting in a local, long-term, negligible, adverse impact on water quality.

Segments 3 & 4 Impact Summary: The continued presence of infrastructure within Segments 3 & 4 would have a local, long-term, minor, adverse impact on hydrology. Continued use of these facilities, namely vehicle use on roads and parking areas, would contribute to local, long-term, negligible, adverse water quality impacts.

Segments 5, 6, 7, and 8: South Fork Merced River

Impacts of Actions to Protect and Enhance River Values

Hydrology. Under Alternative 1 (No Action), **t**he impoundment at Wawona would be retained, slightly affecting river processes, and would result in a local, long-term, minor, adverse impact on hydrology.

Surface water withdrawals from the South Fork Merced River in Wawona would continue and would continue to be managed by the *Wawona Water Conservation Plan*. Flows in the South Fork Merced River would not be affected to a detectable level, though a potential for adverse impacts could occur at very low flows associated with droughts (Holmquist and Waddle 2011). This would present a local, short-term, minor, adverse impact on hydrology.

Abandoned metal pipe in side channels on the South Fork Merced River would remain, dewatering the floodplain terrace, and would continue to cause a local, long-term, minor, adverse impact on hydrology.

The Wawona Store Picnic Area near Pioneer History Center would continue to experience visitor use levels during peak periods that exceed the design of the existing infrastructure. There would be no formal river access point there, resulting in the potential for streambank erosion from trampling. This would present a local, short-term, minor, adverse impact on hydrology.

Water Quality. Water quality would continue to remain high in Segments 5, 6, 7, and 8. Components of Alternative 1 have the potential to release pollutants to the South Fork Merced River in a slightly detectable manner, but would not be expected to have an overall effect on the river's water quality.

Wawona Campground would continue to be served by septic tanks and leach fields. The septic systems at Wawona Campground, which serve six restrooms, have exceeded their design life by several years, and are not part of the Wawona sewer collection system. Heavy use of the restrooms, combined with high groundwater at the campgrounds can stress the septic system and leach field, creating potential water quality impacts during peak use or wet weather. One leach field has failed and cannot be repaired in its current location and configuration. When the capacity is exceeded, or if other system failures occur or existing failures are not repaired, there would be potential for effluent to migrate into groundwater and the river. This would result in a local, short-term to long-term, moderate, adverse impact on water quality.

River access and picnicking at the Wawona Store Picnic Area, near Pioneer Yosemite History Center would continue to receive visitor use levels during peak periods that exceed the design of the existing infrastructure. There would be no formal river access point here on this steep riverbank. This would result in a local, long-term, negligible, adverse impact on water quality.

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Wawona. The Wawona campground contains 97 campsites, including 96 individual sites and one group site. The existing campground is located in close proximity to the river, and exists within the 100-year floodplain. The close proximity of the campground to the river promotes trampling of riparian vegetation and results in riverbank erosion. With continued operation of the campground at capacity, these activities will continue to have local, long-term, minor, adverse impacts on water quality due to erosion, and local, long-term, negligible, adverse impacts on floodplains due to the nominal potential for interference of existing facilities with flood flows.

Segments 5-8 Impact Summary: The continued presence of infrastructure within Segments 6 and 7 would have a local, long-term, negligible to minor, adverse impact on the river's hydrology, water quality, and flooding.

Summary of Alternative 1 (No Action) Impacts

Development and visitor use in the Merced River corridor have affected hydrologic processes, floodplains, and water quality. Under Alternative 1 (No Action), existing facilities and actions within the river corridor would continue to have short-term and long-term, minor, adverse impacts on water quality; long-term, minor to major impacts on hydrologic processes; and short-term and long-term, minor to moderate impacts on floodplains. Impacts are identified as either localized or segmentwide, while no impacts are identified as parkwide. Impacts would be most pronounced in areas with concentrated facilities and visitor use (e.g., Yosemite Valley, El Portal, Wawona). NPS administrative requirements do afford some protection to the river from future actions (e.g. ongoing water quality monitoring), but no comprehensive or unified plan exists to protect the hydrology, floodplains, and water quality of the Merced River. Under Alternative 1, the presence and continued maintenance of structures such as bridges and facilities within the floodplain, and concentrated visitor use on riverbanks would contribute to local, long-term, minor to moderate, adverse impacts on hydrology, floodplains, and water quality.

Cumulative Impacts of Alternative 1 (No Action)

The discussion of cumulative impacts on hydrology, water quality, and floodplains is based on analysis of past, present, and reasonably foreseeable actions in the Yosemite region, in combination with the potential effects of Alternative 1 (No Action). The projects identified below include those projects that have the potential to affect the watershed of the Merced River.

Past Actions

Past actions have resulted in a range of beneficial and adverse impacts. Beneficial impacts of past actions include the following: restored hydrological conditions from removal or repair of structures and restored natural drainage features; and benefits to the watershed from management plans that limit or end consumptive uses, such as grazing, formalized camping, and launch facilities for nonmotorized watercraft, and that concentrate visitor impacts. Specific examples of past projects include the following:

- ***Restored Hydrological Conditions*:** Cascades Housing Removal (including associated restoration work), Cascades Diversion Dam Removal, Cook's Meadow Ecological Restoration Happy Isles Dam Removal, Happy Isles Fen Habitat Restoration Project, Happy Isles Gauging Station Bridge Removal, and Merced River Ecological Restoration at Eagle Creek Project.

- ***Management and Planning***: *South Fork and Merced Wild and Scenic River Implementation Plan* (BLM and USFS 1991)

Adverse impacts from past actions include: modifications to hydrological conditions from the introduction of obstructions in the Merced River channel (e.g., bridges); deterioration of water quality (streambank erosion, nonpoint-source pollution); and changes to natural drainage patterns (soil compaction, loss of vegetation) from facility development. In addition, the development and improvement of roadways affects the water quality immediately adjacent to the roadway during construction; however, these projects include measures to reduce the overall, short-term impacts through the implementation of a compliance monitoring program, avoidance of sensitive habitats, erosion and sediment control measures, hazardous materials controls, and revegetation and reclamation. Specific examples of past projects include the following:

- ***Modified Hydrological Conditions*:** Previous development of bridges, riprap, dikes, flood walls, impoundments, and facilities in the Merced River channel or floodplain; widespread removal of large wood from the river channel from early park management until the 1990s

- ***Rehabilitation of Roadways*:** El Portal Road Improvement Projects, Yosemite Valley Loop Road Rehabilitation, Wawona Road Rehabilitation Project

- ***Facility Development*:** Curry Village development, Yosemite Valley Lost Arrow Temporary Employee Housing and Yosemite Valley Ahwahnee Temporary Employee Housing

Present Actions

Present actions contribute to similar beneficial and adverse impacts, as described for past actions, above.

Beneficial impacts from present actions are similar to those discussed for past actions. Specific examples of present projects include the following:

- ***Restored Hydrological Conditions*:** General Ecological Restoration

- ***Management and Planning*:** Grazing restrictions contained in Commercial Use Authorizations for commercial pack stock operators, *Vegetation Management Plan*

Adverse impacts from present actions are similar to those discussed for past actions. Specific examples of present projects include the following:

- ***Facility Development*:** *East Yosemite Valley Utilities Improvement Plan/EA*, Wahhoga Indian Cultural Center

- ***Large Wood Management*:** Removal of large wood and debris from the channel in Segment 2

Reasonably Foreseeable Future Actions

Impacts from future actions are similar to those discussed for past and present actions. A specific example of a future project with beneficial impacts is the forthcoming *Yosemite Wilderness Stewardship Plan/EIS*, while the Concessioner Parking Lot Restoration Project could result in adverse impacts similar to past and present roadway rehabilitation projects

Overall Cumulative Impact

Overall development and recreational uses within the Merced River watershed have resulted in local, long-term, moderate, adverse impacts on natural hydrology, water quality, and floodplains throughout the Yosemite region. A number of past, present, and future projects have benefited the river through planning or restored hydrological conditions, though the overall impact remains adverse. Under Alternative 1 (No Action), the presence and continued maintenance of structures such as bridges and facilities within the floodplain, and concentrated visitor use on riverbanks, would contribute to local, long-term, moderate, adverse impacts on hydrologic values, floodplains, and water quality. In a cumulative context in conjunction with other actions in the Yosemite region, the impact on hydrologic processes would be long-term, minor, and adverse.

Environmental Consequences of Actions Common to Alternatives 2–6

All River Segments

Impacts of Actions to Protect and Enhance River Values

Hydrology. Under Alternatives 2–6, restoration activities would cause local, long-term, minor to moderate, beneficial impacts on hydrology. Abandoned infrastructure, such as underground pipelines, wastewater treatment facilities, and manholes that affect hydrology would be removed. (These facilities contribute to dewatering of meadows and alteration in the natural hydrologic regime of the river, increasing the amount and altering the timing of runoff entering the Merced River.) Removing infrastructure that affects hydrology would have a local, long-term, minor, beneficial impact on hydrology.

Six miles of informal trailing on meadows and near archeological sites, including at El Capitan, Cooks, and Sentinel Meadows, would be removed and restored to natural conditions. Areas that have been

denuded of vegetation due to trampling would be decompacted and replanted with native species. Fencing and signage would be used near the El Capitan and Swinging Bridges to direct traffic to less sensitive areas that can accommodate some use without compromising meadow and riparian ecosystem health. Restored trail areas with compacted soils would be decompacted; soils and ruts would be filled with native soils. Conifer seedlings and saplings would be removed from Royal Arches, Ahwahnee, and other valley meadows and low-intensity, high-frequency fire would be restored as an ecological process. The riparian zone would be protected from new development within 150 feet from the ordinary high-water mark. These actions would restore the ability of soils to infiltrate runoff and promote a more natural hydrologic regime. These actions would have a corridor-wide, long-term, moderate, beneficial impact on hydrology.

The riparian zone would be protected from new development within 150 feet of the ordinary high-water mark, and all campsites would be relocated at least 100 feet away from the ordinary high-water mark. Areas susceptible to erosion, such as steep riverbanks and areas of trampled or denuded vegetation, would be closed and restored using bioengineering and revegetation. Large wood, engineered log jams, and brush layering would be used in the vicinity of bridges to decrease bed scouring and streambank instability. Riprap would be removed where possible and replaced with native riparian vegetation, using bioengineering techniques. Large wood and constructed log jams can deflect erosive flows away from bridge abutments and other structures, and also promote desirable sediment deposition. Use of constructed logjams could, however, require ongoing maintenance by the NPS in order to maintain their efficacy, such as following major storm events which could result in logjam washout or alteration. In the event that such actions do not improve conditions, bridge redesign or removal could be reconsidered. These actions would increase the integrity of hydrologic processes and would have a corridor-wide, long-term, moderate, beneficial impact on hydrology.

Constructed logjams would be installed in the river and large wood would be managed according to a large wood management plan. Large wood that does not compromise visitor safety or infrastructure would be allowed to remain in the Merced River. Large wood would be incorporated into riverbanks to provide structure for eroded riverbanks. In developed areas, where hazard trees must be removed for safety, they would be felled into the river rather than cut and removed. Constructed logjams would be installed into the river in severely widened reaches, improving hydrologic function. An increase in the wood load of the river would promote more complex morphology of the Merced River and reduce river widening. These actions would have a corridor-wide, long-term, moderate, beneficial impact on hydrology.

Under Alternatives 2–6, 3,400 feet of riprap would be removed and revegetated with riparian species as needed. An additional 2,300 feet of riprap would be removed and replaced with bioengineered riverbank stabilization. Riprap hardens riverbanks preventing channel erosion and other natural stream processes such as lateral migration and point bar formation. Riprap also reduces flow velocity dissipation that would be provided by riparian vegetation, thereby impacting areas downstream. Removal of riprap and replacing it with natural vegetation or biostabilization would partially restore hydrologic processes in a detectable manner, and would have corridorwide, long-term, minor, beneficial impact on hydrology.

Water Quality. Under Alternatives 2–6, restoration actions, including those described above for Hydrology, would cause corridor-wide long-term, minor, beneficial impacts and corridor-wide, short-term, minor, adverse impacts on water quality. Restoration of meadows in the areas of informal trails and revegetation of floodplains and streambanks would reduce the amount of erosion and fine sediment entering the stream. Visitor use would be limited in unstable areas and directed to more resilient access points; constructed logjams would be installed to protect erosive areas; and riprap would be removed and replaced with native riparian vegetation, using bioengineering techniques. These actions would have corridor-wide, beneficial, long-term, minor impacts on water quality.

Restoring low-intensity, high-frequency fire to the Merced River corridor would temporarily remove vegetation that stabilizes fine sediment and prevents erosion. This would have the potential to increase the generation of fine sediment that enters the river over the short term, until vegetation can regenerate to restabilize soils. Such effects would be limited, however, during most prescribed burning, because most prescribed fires would be small and generally located on flat terrain. This action would have a local, short-term, minor, adverse impact on water quality.

Eroded riverbanks would be stabilized using bioengineering techniques, such as brush layering of willow cuttings. Visitor use would be directed away from vulnerable riverbanks and to more resilient access points, such as sandy beaches and low-angle slopes, through delineated trails, signs, maps, and brochures. Signage and fencing would be established to protect vulnerable riverbanks. These actions would reduce instability of riverbanks and reduce erosion and the amount of fine sediment entering the Merced River. These actions would have a corridor-wide, long-term, moderate, beneficial impact on water quality.

The riparian zone would be protected from new development within 150 feet of the ordinary high-water mark, and all campsites would be relocated at least 100 feet away from the ordinary high-water mark. Areas susceptible to erosion, such as steep riverbanks and areas of trampled or denuded vegetation, would be closed and restored using bioengineering and revegetation techniques. Large wood, constructed logjams, and brush layering would be used in the vicinity of bridges to decrease bed scouring and streambank instability. Large wood and constructed logjams can deflect erosive flows away from bridge abutments and promote sediment deposition near bridges. Riprap would be removed where possible and replaced with native riparian vegetation, using bioengineering techniques. These actions would promote local streambank stability, which would reduce the amount of fine sediment entering the river, leading to a corridor-wide, long-term, minor, beneficial impact on water quality.

Constructed logjams would be installed in the Merced River and large wood would be managed according to a large wood management plan. Large wood that does not compromise visitor safety or infrastructure would be allowed to remain in the river. Large wood would be incorporated into riverbanks to provide structure for eroded riverbanks. In developed areas where hazard trees must be removed for safety, they would be felled into the river rather than cut and removed. Constructed logjams would be installed into the river in severely widened reaches, improving hydrologic function. Use of constructed logjams could, however, require ongoing maintenance by the NPS in order to maintain their efficacy, such as following major storm events which could result in logjam washout or alteration. In the event that such actions do not improve conditions, bridge redesign or removal could

be reconsidered. Constructed logjams would decrease channel widening and increase channel resistance to erosion, leading to a corridor-wide, long-term, minor, beneficial impact on water quality.

Floodplains. Under Alternatives 2–6, restoration activities, including those described above for Hydrology, would cause corridor-wide, long-term, minor to moderate, beneficial impacts on floodplains. The riparian zone would be protected from new development within 150 feet from the ordinary high-water mark. This action would reconnect the river to its floodplain in some areas where it has been affected by development. These actions would have a corridor-wide, long-term, beneficial, moderate impact on floodplains.

Constructed logjams would be installed in the Merced River and large wood would be managed according to a large wood management plan. Large wood that does not compromise visitor safety or infrastructure would be allowed to remain in the river. Large wood would be incorporated into riverbanks to provide structure for eroded riverbanks. In developed areas, where hazard trees must be removed for safety, they would be felled into the Merced River instead of cut and removed. Constructed logjams would be installed into the river in severely widened reaches, improving hydrologic function. An increase in the wood load of the river would promote more complex morphology and increase shallow overbank flooding. These actions would have a corridor-wide, long-term, minor, beneficial impact on high-frequency floodplains. An increase in the wood regime and installation of constructed logjams would slightly increase the roughness of the river, thereby increasing water surface elevations during low-frequency events such as the 100-year storm event, though not in a manner that is expected to be detectable. This would result in a corridor-wide, long-term, negligible, beneficial impact on floodplains.

Hydrologic/Geologic Resource Actions. Under Alternatives 2–6, 3,400 feet of riprap would be removed and revegetated with riparian species, as needed. An additional 2,300 feet of riprap would be removed and replaced with bioengineered riverbank stabilization. Riprap hardens riverbanks, preventing channel erosion, but can accelerate channel velocity and result in downstream impacts. Removing riprap and replacing it with natural vegetation or biostabilization would lead to more stable banks. Riprap would be removed using a track-mounted excavator. Operators would pick up boulders with the bucket of the excavator and either stockpile the rocks on adjacent terraces or load them directly into a dump truck. Bioengineering techniques would include hydrodrilling, brush layering, and wood incorporation. Willow wattles and anchoring logs could be used to accrete sediment. Willow cuttings would be taken from established plants and placed deeply into the soil to promote regeneration and prevent them from washing away during high-water events. Rocky or compacted riverbanks would most effectively and efficiently be planted using a hydraulic excavator. In fine sediment, a hydro-drill (a pump with a high-powered stream of water) would create deep holes into which cuttings would be placed. Willows could also be bundled into wattles and partially buried and anchored along riverbanks. Large wood could also be used to provide structure when repairing highly eroded riverbanks or after riprap removal. Earth-moving activities during construction have the potential to mobilize fine sediment, which would result in a local, short-term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce this impact to negligible. After construction, this action would improve water quality in a detectable manner by reducing incidence of erosion and bank failure, and would have a segmentwide, long-term, minor, beneficial impact on water quality.

Segment 1: Merced River Above Nevada Fall

Impacts of Actions to Protect and Enhance River Values

Hydrology. In Segment 1, informal trails in Merced Lake Shore Meadow, adjacent the Merced Lake High Sierra Camp have fragmented meadow habitat and stunted vegetation lining the lakeshore. Compacted soils are less able to infiltrate runoff than noncompacted soils, altering the hydrologic regime. Under Alternatives 2–6, informal trails would be removed, soils would be decompacted, and ruts would be filled with native soils. Denuded areas would be planted with native species. These actions would promote infiltration of runoff and would result in a local, long-term, minor, beneficial impact on hydrology.

Water Quality. Pack stock used for administrative purposes would no longer graze on meadow vegetation near the Merced Lake Ranger Station. This would help protect meadow vegetation, which in turn would help to stabilize soils in the area. This would result in a local, long-term, negligible, beneficial impact on water quality.

In Segment 1, informal trails in the meadow adjacent the Merced Lake High Sierra Camp, have the potential to increase fine sediment delivery. Compacted soils are less able to infiltrate runoff than noncompacted soils, altering the hydrologic regime and increasing the intensity of runoff. In addition denuded areas have less vegetation to stabilize sediments, increasing the potential for erosion from informal trails. Under Alternatives 2–6, informal trails would be removed, soils would be decompacted, and ruts would be filled with native soils. Denuded areas would be planted with native species. These actions would reduce the intensity of runoff and reduce fine sediment delivery to the Merced River. This would result in a local, long-term, minor, beneficial impact on water quality.

Segment 1 Impact Summary: Actions to protect and enhance river values would have a local, long-term, negligible to minor, beneficial hydrology and water quality impacts.

Segment 2: Yosemite Valley

Impacts of Actions to Protect and Enhance River Values

Hydrology. In Segment 2, roads over meadows and paved bicycle paths have disconnected the floodplain from the Merced River, creating a negligible impediment to the free-flowing condition of the river during high flows. Large portions of the floodplain become disconnected from the river, disrupting the ecological function of the meadows. Under Alternatives 2–6, road and bicycle path improvements over meadows would use wide box culverts or other design components such as rolling dips, permeable subgrade, etc., to improve water flow. This would have a segment-wide, long-term, negligible, beneficial impact on hydrology.

Under Alternatives 2–6, large wood, constructed logjams, and brush layering would be used from El Capitan Moraine to the Sentinel Picnic Area, and in the vicinity of Clark's Bridge, Housekeeping Camp footbridge, Happy Isles Bridge, Sentinel Bridge, and Swinging Bridge to decrease bed scouring and streambank instability in the vicinity of these bridges. At Housekeeping Camp Bridge, the channel downstream has widened beyond its historic width, contributing to streambank failure. Large wood

and constructed logjams can enhance channel complexity and deflect erosive flows away from bridge abutments and promote sediment deposition near bridges. Use of constructed logjams could, however, require ongoing maintenance by the NPS in order to maintain their efficacy, such as following major storm events which could result in logjam washout or alteration. In the event that such actions do not improve conditions, bridge redesign or removal could be reconsidered. These actions would promote local streambank stability, leading to a local, long-term, minor, beneficial impact on the free-flowing nature of the Merced River.

Under Alternatives 2–6, restoration activities in meadow areas would result in minor to negligible, beneficial impacts on the free-flowing nature and hydrology of the Merced River. Informal trails in the vicinity of Leidig Meadow and Sentinel Meadow have fragmented meadows and compacted soils. Soil compaction reduces the infiltration rate and affects river hydrology. Meadow disconnection creates a negligible impact on the free-flowing nature of the river. Under Alternatives 2–6, informal trails in these areas would be removed, decompacted, and restored to native meadow vegetation. This would result in a local, long-term, minor, beneficial impact on hydrology due to restoration of soil infiltration and a local, long-term, negligible, beneficial impact on the free-flowing nature of the river by reconnecting meadow areas.

Abandoned roadbeds exist adjacent to Ahwahnee Meadow, Bridalveil Meadow, in the vicinity Cook's Meadow, and near Royal Arches Meadow, causing a disconnection of meadow areas and a reduction of the infiltration capacity of the soil. Under Alternatives 2–6, former roadbeds in these areas would be removed, and the soils decompacted and replanted with native species, resulting in a local, long-term, beneficial, negligible impact on the free-flowing nature of the Merced River and a local, long-term, minor, beneficial impact on hydrology.

Abandoned underground tiles and pipes exist adjacent to Bridalveil Meadow, Eagle Creek Meadow, near the former Rocky Point Sewage Plant, and Royal Arches Meadow. These tiles and pipes contribute to dewatering of meadows and affect the natural hydrologic regime of the river, increasing the amount and timing of runoff entering the river. Under Alternatives 2–6, abandoned underground infrastructure would be removed, resulting in a segment-wide, long-term, minor, beneficial impact on hydrology.

Adjacent to Bridalveil Meadow, a deep headcut in the meadow from a former ditch is causing meadow dewatering and downstream erosion. Willows were once removed from the meadow and have not been present for over 100 years, potentially increasing the rate of erosion around the headcut. Under Alternatives 2–6, this area would be treated by inserting live willow cuttings into the headcut area, the riverbank, and the adjacent meadow, thereby stabilizing the area and arresting future erosion. This would prevent dewatering of the meadow, resulting in a local, long-term, minor, beneficial impact on hydrology.

At Ahwahnee Meadow, several topographic modifications and impervious areas affect the hydrologic function of the meadow, including ditching, fill material at the former golf course, and the tennis courts. Under Alternatives 2–6, the Ahwahnee Meadow would be restored by removing tennis courts, restoring topography, removing abandoned irrigation lines and fill, filling ditches, and revegetating with native meadow vegetation. This would restore the hydrologic regime of 5.65 acres of meadow, resulting in a local, long-term, minor, beneficial impact on hydrology.

Informal shoulder parking is encroaching on Cook's Meadow at Sentinel Drive and Northside Drive. The footprint of this area is estimated to be up to 25 feet, reducing the meadow extent and causing a minor impact on the hydrologic regime by destroying native vegetation and compacting soils, which leads to less infiltration of runoff. Under Alternatives 2–6, roadside parking along Cook's Meadow would be removed and the area would be restored to meadow conditions, creating a local, long-term, minor, beneficial impact on hydrology.

The western portion of Lower Pines Campground and the former Yosemite Lodge cabin area and volunteer center were affected by the 1997 flood and subsequently abandoned. Remaining areas of roadbeds, fill, and compacted soils are still present, causing a reduction of the infiltration capacity of the soil. Under Alternatives 2–6, 20 acres of floodplain adjacent to Lower Pines Campground, as well as 13.2 acres of riparian area near the former Yosemite Lodge cabin area and volunteer center, would be restored and decompacted, resulting in a local, long-term, minor, beneficial impact on hydrology.

Restoration actions in Eagle Creek would restore its natural braided morphology. Channelization of the creek affects the natural hydrology of the Merced River by altering the timing and velocity of runoff. Under Alternatives 2–6, the berm and parking lot abutting Eagle Creek would be removed and culverts would be added to allow more dispersed water delivery to Eagle Creek Meadow and the Merced River. The restored areas would be revegetated with native upland species, resulting in a local, long-term, minor, beneficial impact on hydrology.

High visitor use along sensitive riverbanks near El Capitan Bridge; Swinging Bridge Designated Picnic Area; Sentinel Beach Designated Picnic Area, between Happy Isles and the Mist Trail; Devil's Elbow; and in Yosemite Valley campgrounds is causing vegetation trampling and soil compaction, resulting in riparian vegetation loss, riverbank erosion, and decreased soil infiltration. Under Alternatives 2–6, visitors would be redirected to access the river at resilient sandbar points through signage, campground maps, and brochures. Picnic areas would be delineated by fencing, and river terraces would be revegetated with native species. Vulnerable steep slopes would be fenced off to prevent further bank erosion. These actions would result in a local, long-term, minor, beneficial impact on hydrology by restoring native soil infiltration and runoff characteristics.

Cultural restoration activities would result in local, long-term, minor, beneficial impacts on hydrology. Informal trails near archeological sites would be removed and restored, resulting in restored vegetation and decompacted soils, which in turn would restore the hydrologic regime to natural conditions. This would result in a local, long-term, minor, beneficial impact on hydrology.

Overflow day parking has developed along the road shoulder of Sentinel Drive, resulting in vegetation being trampled and destroyed. Under Alternatives 2–6, roadside parking along Sentinel Drive would be removed and restored to natural conditions. This would restore the hydrologic regime in this area, resulting in a local, long-term, minor, beneficial impact on hydrology.

Unnecessary infrastructure at the former Happy Isles footbridge (including old Happy Isles Bridge Abutments and the abandoned gaging station base) that restrict the free-flowing nature of the Merced River would be removed under Alternatives 2–6. The Pohono Bridge gaging station, which is currently located within the bed and banks of the Merced River, would be relocated north of Northside Drive, out of the river channel, and connected to the river via conduits under the road. Footings and other

structures would be removed from the bed and banks of the river, and denuded vegetation would be restored, resulting in a local, long-term, minor, beneficial impact on the free-flowing nature of the river.

Under Alternatives 2–6, parking and traffic circulation at the Ahwahnee and Wilderness-related parking areas (i.e., hotel parking and also formal parking areas for access to wilderness areas) would be rehabilitated to include proper drainage and stormwater best management practices. Drainage improvements would include swales, bioretention areas, or infiltration areas, which would reduce stormwater peak flows and reduce the velocity of runoff entering the Merced River. These would have a beneficial, minor, long-term effect on hydrology.

The western portion of Lower Pines Campground was affected by the 1997 flood and most infrastructure was subsequently removed. Remaining areas of roadbeds, fill, and compacted soils are still present, causing a reduction of the infiltration capacity of the soil, and precludes riparian vegetation growth. Under Alternatives 2–6, 20 acres of floodplain adjacent to Lower Pines Campground, as well as 13.2 acres of riparian area near the former Yosemite Lodge cabin area and volunteer center, would be restored and decompacted, resulting in a local, long-term, minor, beneficial impact on hydrology.

Water Quality. Under Alternatives 2–6, restoration activities in meadow areas would result in local, long-term, minor, beneficial impacts on water quality. Methods for meadow and riparian restoration would include asphalt removal, recontouring, ditch removal, and decompaction. Asphalt surfaces would be broken using heavy equipment. Asphalt would then be loaded into dump trucks, using a loader to be moved off-site. Small asphalt pieces may be manually collected and removed. Recontouring would involve use of a skid steer, loader, excavator, dozer, and dump truck to remove excavated material from the site. An excavator or dozer may be used to excavate depressions, cut-off channels, and oxbows. On steep riverbanks, an excavator or dozer may push soils and material down the slope of the bank to create a gentler slope, which would increase revegetation success. Whenever possible, native fill would be used from the restoration site. Where possible, ditches would be contoured and leveled using fill material already present in associated berms. Soil decompaction would involve breaking up soils either manually, by using special decompaction tools, or with heavy equipment that can support ripping tines, such as excavators, skid steer, and dozers. Small pockets of fill would at times be blended into the soil, as decompaction occurs, using an excavator or a dozer with winged rippers. Earth-moving activities during construction have the potential to mobilize fine sediment, which would result in a local, short-term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce this impact to negligible.

Informal trails in the vicinity of Leidig Meadow and Sentinel Meadow have denuded vegetation, which can contribute to fine sediment entering runoff. Under Alternatives 2–6, informal trails in these areas would be removed, decompacted, and restored to native meadow vegetation. This would result in a local, long-term, minor, beneficial impact on water quality due to reducing the amount of fine sediment entering the Merced River.

The area located adjacent to Bridalveil Meadow would be treated by inserting live willow cuttings into the headcut area, the riverbank, and the adjacent meadow, thereby stabilizing the area and arresting

future erosion. This would result in a local, long-term, minor, beneficial impact on water quality due to reducing the amount of fine sediment entering the Merced River.

Informal shoulder parking is encroaching on Cook's Meadow at Sentinel Drive and Northside Drive. The footprint of this area is estimated to be up to 25 feet, reducing the meadow extent and causing a minor impact on water quality by removing vegetation that can stabilizes soils, which leads to an increased chance of fine sediment being mobilized in stormwater. Under Alternatives 2–6, roadside parking along Cook's Meadow would be removed and the area would be restored to meadow conditions, creating a local, long-term, minor, beneficial impact on water quality by reducing the amount of fine sediment entering the Merced River.

The western portion of Lower Pines Campground and the former Yosemite Lodge cabin area and volunteer center were affected by the 1997 flood and subsequently removed. Remaining areas of roadbeds, fill, and compacted soils are still present, causing a potential source of fine sediment. Under Alternatives 2–6, 20 acres of floodplain adjacent to Lower Pines Campground, as well as 13.2 acres of riparian area near the former Yosemite Lodge cabin area and volunteer center, would be restored resulting in a local, long-term, minor, beneficial impact on water quality.

Restoration actions in Eagle Creek would restore its natural braided morphology. Channelization of the creek affects the natural hydrology of the Merced River by altering the timing and velocity of runoff, thus increasing the potential for erosion. Under Alternatives 2–6, the berm and parking lot abutting Eagle Creek would be removed and culverts would be added to allow more dispersed water delivery to Eagle Creek Meadow and the Merced River. The restored areas would be revegetated with native upland species, thereby reducing erosion and resulting in a local, long-term, minor, beneficial impact on water quality.

High visitor use along sensitive riverbanks near El Capitan Bridge; Swinging Bridge Designated Picnic Area; Sentinel Beach Designated Picnic Area, between Happy Isles and the Mist Trail; Devil's Elbow; and in Valley campgrounds is causing vegetation trampling, resulting in riparian vegetation loss, river bank erosion, and a potential for erosion of fine sediment. Under Alternatives 2–6, visitors would be redirected to accessing the Merced River to resilient sandbar points through signage, campground maps, and brochures. Picnic areas would be delineated by fencing, and river terraces would be revegetated with native species. Vulnerable steep slopes would be fenced off to prevent further bank erosion. These actions would result in a segment-wide, long-term, minor beneficial impact on water quality by reducing the potential for erosion.

Informal trails near archeological sites contribute to vegetation denudation and can contribute to erosion and fine sediment entering the river. Informal trails near archeological sites would be removed and restored, resulting in restored vegetation and a reduction in fine sediment entering the river, resulting in a local, long-term, minor, beneficial impact on water quality.

Biological Resource Actions. Biological resources actions common to Alternatives 2-6 and located in Segment 2 include restoration of 5.65 acres of Ahwahnee Meadow to natural conditions; installation of 150 feet of boardwalk at Sentinel Meadow; restoration and removal of non-native species and encroaching conifers at Stoneman Meadow; formalization of parking and river access areas from Pohono Bridge to Diversion Dam, including soil decompaction and riparian revegetation; removal of

all campsites within 100 feet of the bed and banks of the river, including removal of asphalt parking, decompacting of soils, revegetation and recontouring; rerouting of trails, removal of informal trails, replacement of culverts, and installation of new culverts at El Capitan Meadow; relocation of parking and removal of informal trails at Devil's Elbow; restore riverbank with brush layering and restrict visitor access at Housekeeping Camp riparian and river access areas; designate river access points, reestablish riparian vegetation, remove parking from the riparian zone, decompact soils, remove infrastructure (toilets, parking, picnic tables) from the 10-year floodplain at Cathedral Beach Picnic Area; fill 2,155 feet of ditches not serving current operational needs along Valley meadows.

Restoration of meadows and other areas located outside of the floodplain could contribute to increased stormwater infiltration capacity and increased storm event hydrologic concentration times. Decompaction of soils and restoration of riparian vegetation would have similar effects. Restoration of riparian vegetation would generally slow floodwaters in the vicinity of the restored area, more closely mimicking natural conditions, resulting in a segment-wide, long-term, negligible, beneficial impact to hydrology.

Removal of all campsites, existing infrastructure, and other facilities as discussed above from within 100 feet of the river bed and banks would reduce existing constraints on the natural floodplain of the river. Reductions in these constraints would support the free-flowing condition of the river, and would reduce existing interference within the floodplain. Therefore, this is considered a segment-wide, long-term, minor, beneficial impact with respect to flooding.

Extending the permeable road base across the entire segment of Northside Drive through El Capitan Meadow and adding more box culverts beneath Northside Drive, with bottom elevations equal to the meadow surface elevation, would support drainage at El Capitan Meadow. Installation of culverts would alleviate or reduce localized flooding during storm events, which is considered a local, long-term, minor, beneficial impact to flooding.

Construction of the proposed biological resources actions could result in temporary disturbance to surface sediments and vegetation. Disturbance would result primarily from the use of heavy machinery. Heavy machinery would be used for soil decompaction, removal and relocation of asphalt parking lots including those located within 150 feet of the bed and banks of the river, recontouring of topography, rerouting of trails, removal of informal trails, replacement or installation of culverts, removal of infrastructure from the 10-year floodplain, and removal of fill as noted previously. Minimal additional disturbance could occur during restoration activities and installation of the 150 foot boardwalk, due to localized disturbance. Additionally, construction related use of heavy machinery could result in accidental release of construction related fluids, oils, fuels, greases, hydraulic fluid, and other potential construction related water quality pollutants, during the construction process. Adhering to the proposed mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce these potential impacts to local, short-term, minor, and adverse.

Increases in riparian and floodplain vegetation associated with the proposed restoration activities, as noted above, would result in increased coverage of such vegetation along the river. Increases in riparian and floodplain vegetation coverage would result in reductions in sediment and other pollutant

levels in stormwater that drains into the Merced River. Therefore, the proposed restoration activities would result in a segment-wide, long-term, negligible, beneficial impact on water quality.

Hydrologic/Geologic Resource Actions. Hydrologic resources actions common to Alternatives 2-6 and Segment 2 include removal of abandoned gauging station infrastructure located at Pohono Bridge, and restoration of the riparian buffer to natural conditions; removal of the Happy Isles former footbridge remnant footings, along with the river gauge base, and revegetate denuded informal trails; comprehensive restoration within the river reach between Clark's and Sentinel bridges, construction of eight engineered log jams plus revegetation to repair localized erosion.

With respect to hydrology, the existing structures located along the Merced River, including abandoned gauging infrastructure at Pohono Bridge and at the Happy Isles former footbridge, and remnant footings for the Happy Isles former footbridge, contribute to altered hydrology along the river by restricting the free-flowing condition of the river. Removal of these structures would alleviate the hydrologic restrictions, resulting in a local, long-term, negligible, beneficial impact on hydrology

Between Clark's and Sentinel Bridges, the river is more than twice its historic width, shallower than its historic depth, and lacks complexity. Installation of the eight proposed constructed logjams is expected to reduce the intensity and extent of this condition, by adding complexity to the river channel and reducing existing channel width. Potential uncertainty regarding the long-term efficacy of the proposed logjams is noted, which could potentially be subject to washout or other hydrologic processes. However, considering the anticipated reduction of channel width to a more natural state, this action would result in a local, long-term, moderate, beneficial impact on hydrology.

With respect to flooding, removal of the remnant infrastructure, as noted above, would reduce existing obstructions to the free-flowing condition of the river. Revegetation of informal trails and riparian areas would result in increased complexity and roughness within the river floodplain, and installation of the proposed constructed logjams would also result in increased roughness and complexity within the system. The anticipated increased roughness would contribute to a slowing of floodwaters during a flood event, but any changes in flood height or extent are expected to be non-detectible. Therefore, these actions would result in a local, long-term, negligible, beneficial impact with respect to flooding.

During construction for each of the proposed resource actions noted above, potential water quality degradation could occur as a result of the proposed activities involving facility removal and installation. Specifically, removal of abandoned gauging station infrastructure, removal of remnant footings, construction and installation of log jams, and restoration activities could require the use of heavy construction equipment. Equipment used may include excavators, backhoes, bulldozers, semi-trucks, and other construction equipment. Use of such machinery during construction could result in disturbance to surface sediments and soils, and temporary disturbance to existing vegetation. As a result, increased sediment loading could occur during storm events, which could result affect natural waters in the Merced River. Additionally, use of heavy machinery could result in the accidental release of construction related fluids, oils, fuels, greases, hydraulic fluid, and other potential construction related water quality pollutants. These potential impacts would be limited to the construction period. Adhering to the proposed mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce these potential water quality impacts to local, short-term, minor, and adverse.

Increases in riparian and floodplain vegetation associated with the proposed restoration activities, as noted above, would result in increased coverage of such vegetation along the river. Increases in riparian and floodplain vegetation coverage could result in reductions in sediment and other pollutant levels in stormwater that drains into the Merced River. Therefore, the proposed restoration activities would result in a segment-wide, long-term, negligible, beneficial impact on water quality.

Cultural Resource Actions. Cultural resource actions in Segment 2 common to Alternatives 2-6 would include the removal of campsite 208 from the Upper Pines campground, including the existing bear box, and footpath to restroom facilities. Under existing conditions, the campsite is located in close proximity to pounding rocks/bedrock mortars, which are being degraded due to campground use. Removal of this campsite would not remove or add any impervious surfaces, would not remove or create any major structures that could impede flood flows, and would not result construction of facilities or other actions that could result in a detectable change in stormwater quality. For these reasons, no detectable impacts, adverse or beneficial, on hydrologic resources would occur.

Scenic Resource Actions. A suite of scenic resource actions would occur within Segment 2 under Alternatives 2-6. Briefly, these would include at several locations within Segment 2: removal and selective thinning of encroaching conifers and other vegetation; and monitoring and maintenance of distant views; restoration of grassland and oak habitat. Specific actions relevant to hydrology and water quality include burning of undergrowth in the vicinity of Sentinel Bridge; repair of riverbank erosion at Clark's Bridge.

Riverbank erosion at Clark's Bridge contributes to impacted hydrologic processes along the Merced River. Repair of existing riverbank erosion in this area would alleviate the existing impacted condition, resulting in a local, long-term, negligible, and beneficial impact on water quality.

Conifer and other tree/shrub thinning or removal could involve limited use of heavy machinery during the thinning or removal process. Restoration activities could also involve the limited use of heavy machinery. Use of heavy machinery could result in the accidental release of construction related fluids, oils, fuels, greases, hydraulic fluid, sediment, and other potential construction related water quality pollutants. These potential impacts would be limited to the construction period, and would be limited in extent due to the limited use of such equipment. Adhering to the proposed mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce these potential water quality impacts to local, short-term, negligible, and adverse.

Immediately following selective burning, elevated levels of nutrients, sediment, and other potential water quality pollutants may be present in stormwater inclement on burned areas. Selective burning associated with the proposed scenic resource actions evaluated here would be used in limited areas that would generally not be located immediately adjacent to the Merced River. Therefore, potential impacts of selective burning on water quality are considered local, short-term, negligible, and adverse.

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. To educate visitors on natural river processes and protection and stewardship of river-related resources, an interpretive walk through Lower River Campground would be developed. It would emphasize river-related natural processes, the NPS's ecological restoration work, and what

visitors can do to protect the river. Increased visitor awareness of ways to protect the river would lead to protection of streambanks and floodplain areas, resulting in a local, long-term, minor, beneficial impact on hydrology.

Water Quality. The area adjacent to Bridalveil Meadow would be treated, under Alternatives 2-6, by inserting live willow cuttings into the headcut area, the riverbank, and the adjacent meadow, thereby stabilizing the area and arresting future erosion. This would result in a local, long-term, minor, beneficial impact on water quality due to reducing the amount of fine sediment entering the Merced River.

Camp 6 and Yosemite Village. Actions common to Alternatives 2-6 proposed for the Yosemite Village area include removal the existing Concessioner General Office with relocation of essential functions to the Concessioner Maintenance and Warehouse building; relocation of the Concessioner Garage to the Government Utility Building, with Camp 6 parking being expanded into the existing garage service area footprint; removal of the pool and tennis courts from The Ahwahnee complex, removal of the Arts and Activities Center (Bank Building) and informal parking overflow from the Camp 6 day use area; repurposing of the Village Sport Shop as a visitor contact station; and construction of a new maintenance building near the Government Utility Building, and of pathways leading from the Camp 6 parking lot to the existing Village Sport Shop building.

Removal of the Concessioner General Office, the Concessioner Garage building, the pool and tennis courts, and the Arts and Activities Center would result in a net reduction in the total area of impervious surfaces within the complex. Impervious surfaces prevent the infiltration of stormwater into the soil, causing increased discharges of stormwater into receiving waters and a shortened hydrologic concentration time, as compared to existing conditions. Additionally, removal of the existing informal parking area near Camp 6 would result in the restoration of soils that have become partially compacted due to vehicle usage. Compacted surfaces reduce stormwater infiltration capacity and, similar to impervious surfaces, result in a net increase in stormwater runoff and a reduction in hydrologic concentration times. Removal of impervious and partially compacted areas within the complex would therefore help to restore natural stormwater infiltration. Construction of the proposed maintenance building and the expansion of Camp 6 parking would partially, but not entirely, offset the reduction in impervious surfaces associated with facility removal. The expanded parking lot would, however, include the installation of bioswales to help manage stormwater and stormwater quality. Repurposing of the existing Sport Shop would not alter existing impervious surfaces or cause other changes that would affect stormwater hydrology. In total, these actions would contribute to an approximately 0.68 acre reduction in existing impervious surfaces, would move select existing infrastructure further from the river, and would support updating of existing drainage infrastructure, and would result of the installation of bioswales at parking lots. Therefore, these proposed actions would cause in a net reduction in total impervious surfaces on site, resulting in a local, long-term, minor, beneficial impact on hydrology.

Demolition of existing facilities slated for removal, as well as construction of the proposed buildings and parking lots discussed above, could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. Additionally, the use of heavy construction related equipment would also disturb surface sediments, and could result in the

accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants into stormwater. These activities would result in a local, short-term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

The existing Concessioner Garage is located in an area that is subject to inundation during a 100-year flood. The garage is used to service shuttles, tour buses, and visitor and concessioner vehicles. During a major flood event, if the facility were to become inundated, potential automotive related water quality pollutants could be released into flood waters. Inundation is anticipated to occur infrequently. Therefore, removal of the Concessioner Garage from the 100-year floodplain would result in a local, long-term, negligible, beneficial impact on water quality.

The existing informal parking area near Camp 6 is located within the 100-year floodplain. The existing Concessioner Garage is also located in the river corridor, within the 100-year floodplain. The proposed expansion of the Camp 6 parking lot would be located within the 100-year floodplain. Removal and restoration of the existing informal parking areas near Camp 6 would result in negligible changes to existing topography, and would not result in the installation or removal of any structures, berms, or other facilities that could interfere with or alter flood flows. Removal of the existing Concessioner Garage would result in the removal of a building that, under existing conditions, could interfere with flood flows. Replacement of the Concessioner Garage with additional parking area would therefore result in a net reduction in the level of potential flood-flow interference that would result from facilities in this area. Therefore, these actions would have a local, long-term, minor, beneficial floodplain impact.

Yosemite Lodge and Camp 4. Actions at Yosemite Lodge and immediately surrounding areas that would occur across Alternatives 2-6 include removal of the NPS Volunteer Office, post office, swimming pool, snack stand, and old and temporary housing at Highland Court; removal and replacement of Yosemite Lodge employee housing (Thousand Cabins) with new facilities; relocation of the Yosemite Lodge maintenance and housekeeping facilities; and re-purposing of the convenience and nature shops.

Removal of the NPS volunteer office, post office, swimming pool, snack stand, and housing would result in a net reduction in the total area of impervious surfaces located within the complex. In total, assuming that relocation of existing facilities would result in no net change in impervious surfaces, approximately 0.45 acres (net) of existing impervious surface area would be removed. Relocation of the existing Yosemite Lodge employee housing and maintenance/housekeeping facilities would change the location, but not the amount of impervious surface area. Repurposing of the existing convenience and nature shops would not result in the addition or removal of impervious surface areas. Therefore, implementation of the actions proposed for the Yosemite Lodge and its vicinity would result in a net reduction in total impervious surface area of 0.45 acres. Because impervious surfaces prevent the infiltration of stormwater and result in elevated peak flows and reduced hydrologic concentration times, a reduction in impervious surface coverage would result in a beneficial effect on hydrology. For these reasons, the proposed actions would result in a local, long-term, minor, beneficial impact on hydrology.

Water quality could be affected by construction of the proposed facilities. Construction activities would involve the demolition and removal of select facilities located on site, as well as construction of new facilities within the previously developed area. Construction activities associated with these actions would require the use of heavy equipment, which could loosen surface soils and sediments, creating increased potential for erosion. Use of heavy construction equipment can also result in the accidental release of oils, greases, antifreeze, hydraulic fluid, and other potential water quality pollutants. Additionally, demolition of the existing facilities could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. Therefore, construction activities would result in a local, short-term, minor, adverse impact on water quality. However, implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the impact intensity to negligible.

With respect to flooding, two of the existing Yosemite Lodge employee housing (Thousands Cabins) cabins are located in the 100-year floodplain. However, replacement facilities would be located outside of the existing 100-year floodplain, in areas adjacent to the other Thousands Cabins site. Other proposed facilities in this area would be located outside of the 100-year floodplain. Replacement of existing facilities which are currently located within the 100-year floodplain, with facilities that are located outside of the 100-year floodplain would result in a local, long-term, minor, beneficial impact on floodplains.

Bridalveil and West Valley: Actions at Bridalveil/West Valley would include paving and formalization of five roadside pull-outs to support river access, installation of curbing along pull-outs along El Portal Road, removal of one pull-out that is not protective of resources, decompaction of soil and revegetation in areas that require restoration following parking and river access formalization.

Formalization/paving of pull-outs and associated facilities would minimally increase the area of impervious surfaces within this area. Decompaction of soils and revegetation would promote infiltration in restored areas, which would in part offset increased impervious surfaces. This would result in a local, long-term, negligible, adverse impact on hydrology.

Water quality could be affected by construction of the proposed facilities. Construction activities would involve the installation of pavement and the removal of select informal pull-outs. Construction activities associated with these actions would require the use of heavy equipment, which could loosen surface soils and sediments, creating increased potential for erosion. Use of heavy construction equipment can also result in the accidental release of oils, greases, antifreeze, hydraulic fluid, and other potential water quality pollutants. Additionally, demolition of the existing facilities could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. Therefore, construction activities would result in a local, short-term, minor, adverse impact on water quality. However, implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the impact intensity to negligible.

With respect to flooding, installation of pavement would not involve the installation of large structures that could impede flood flows. While the proposed extent of the new parking lots would be limited, flood flows over smooth pavement can result in increased flood velocities in comparison to unpaved areas due to reduced roughness. Increased flood velocities can support increased erosion potential

and other deleterious hydrodynamic effects downstream. Therefore, installation of these relatively small facilities would result in a local, long-term, negligible, adverse impact on floodplains.

Segment 2 Impact Summary: Actions to protect and enhance river values within Segment 2 would have local, long-term, moderate, beneficial, hydrology, water quality, and floodplain impacts. Actions to manage user capacities, land use, and facilities would result in local, long-term, minor, beneficial impacts on hydrology and water quality.

Segments 3 and 4: Merced Gorge and El Portal

Impacts of Actions to Protect and Enhance River Values

Hydrology. Removal of abandoned infrastructure and imported fill at Cascades Picnic Area, Abbieville, and Trailer Village would restore natural runoff processes in this area, resulting in a local, long-term, negligible, beneficial impact on hydrology.

Under Alternatives 2–6, a set of best management practices would be developed for revetment construction and repair throughout the Merced River corridor. Practices would include use of vertical retaining walls, where possible, to limit impacts on the Merced River channel. This would improve the ability of the river to undergo natural hydrologic processes, resulting in a local, long-term, minor, beneficial impact on hydrology.

Water Quality. The off-street and roadside parking areas at the maintenance and administrative complex would be paved to formalize and maximize visitor and employee parking within the existing footprint. Informal parking sites would be restored between Foresta Road and the Merced River. These actions would reduce the likelihood of petroleum hydrocarbons and sediment reaching the river, though not in a detectable manner, resulting in a local, long-term, negligible, beneficial impact on water quality.

Biological Resource Actions. Actions relevant to Alternatives 2-6 that would be located in Segment 4 include removal of asphalt and imported fill, recontouring, and planting of native vegetation within the 150 foot riparian buffer at Abbieville and the Trailer Village.

Removal of imported fill, removal of asphalt, and recontouring would remove these obstructions from the Abbieville/Trailer Village Areas. These obstructions are currently located within 150 feet of the riverbanks, and contribute altered floodplain hydrology along this segment of the Merced River. Removal of these existing obstructions would reduce existing interference of the facilities with the floodplain. This would result in a local, long-term, minor, beneficial impact to flooding.

Construction of the proposed biological resources actions could result in temporary disturbance to surface sediments and vegetation. Disturbance would result primarily from the use of heavy machinery for removal of imported fill and asphalt, and recontouring, and could result in increased levels of sediment reaching the Merced River. Additionally, construction related use of heavy machinery could result in accidental release of construction related fluids, oils, fuels, greases, hydraulic fluid, and other potential construction related water quality pollutants, during the construction process. Adhering to

the proposed mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce these potential impacts to local, short-term, minor, and adverse.

Increases in riparian and floodplain vegetation associated with the proposed restoration activities at Abbieville and the Trailer Village, would result in increased coverage of such vegetation along the river. Increases in riparian and floodplain vegetation coverage would reduce sediment and other pollutant levels in stormwater that filters through these areas and drains into the Merced River. Therefore, the proposed restoration activities would result in a local, long-term, negligible, beneficial impact on water quality.

Scenic Resource Actions. Scenic resources actions relevant to Alternatives 2-6 that would be located along Segment 3 include selective removal of conifers at the Cascade Falls viewpoint. Selective removal of conifers in this area would not affect or alter hydrology, flooding, or water quality of the Merced River or other natural waterways.

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. Asphalt and imported fill would be removed at Abbieville and El Portal Trailer Court housing. The area would be recontoured and planted with native riparian species and oaks within the 150-foot riparian buffer. This would restore natural runoff characteristics to the area, resulting in a local, long-term, negligible, beneficial impact on hydrology.

Segments 3 & 4 Impact Summary: Actions to protect and enhance river values within Segments 3 & 4 would have local, long-term, negligible to minor, beneficial, hydrology, water quality, and floodplain impacts. Actions to manage user capacities, land use, and facilities would result in local, long-term, negligible, beneficial impacts on hydrology.

Segments 5, 6, 7, and 8: South Fork Merced River

Impacts of Actions to Protect and Enhance River Values

Hydrology. The removal of informal trails and informal parking in Segments 5, 6, 7, and 8, near archeology sites, picnic areas, riverbanks, and abandoned underground infrastructure, would slightly restore natural runoff processes, and thus would result in a local, long-term, negligible, beneficial impact on hydrology.

Under Alternatives 2–6, surface water withdrawals would continue at the Wawona Impoundment and would continue to be subject to the *1987 Wawona Water Conservation Plan*. Diversions would continue at the present rate of 0.59 cubic feet per second. When discharge in the South Fork Merced River is less than 6 cubic feet per second, diversions would be limited to 10% of the discharge in the South Fork Merced River to limit negative effects on aquatic life. This would result in a segment-wide, long-term, negligible, adverse impact on hydrology.

Seven campsites would be removed from the Wawona Campground because they could result in adverse affects on cultural resources. Campsite removal would decrease foot-traffic in this area,

leading to a potential recovery of vegetation. This would help to restore the hydrologic regime in the area, resulting in a local, long-term, negligible, beneficial impact on hydrology.

The Wawona maintenance yard consists of areas of denuded vegetation, compacted soils, and a parking lot, which alter the ability of the area to infiltrate runoff. Under Alternatives 2–6, areas of denuded vegetation, compacted soils, and portions of the parking lot that are located within 150 feet of the river would be removed. This would lead to increased infiltration and a more natural hydrologic regime, resulting in a local, long-term, minor, beneficial impact on hydrology.

Water Quality. The removal of informal trails and informal parking in Segments 5, 6, 7, and 8, near archeology sites, picnic areas, riverbanks, and abandoned underground infrastructure, would slightly decrease soil erosion. This, in turn, would result in a local, long-term, negligible, beneficial impact on water quality.

Development of a wastewater collection system at the Wawona Campground would include the building of a pump station above the Wawona Campground, to connect the facility to the existing wastewater treatment plant. This would alleviate existing issues related to old septic systems and associated infrastructure located on site, and would reduce the potential for effluent to migrate into the groundwater and the South Fork Merced River during times of heavy use. This would result in a local, long-term, moderate, beneficial impact on water quality.

Relocation of the Wawona dump station away from the South Fork Merced River would reduce the potential for pollutants to migrate to the river, resulting in a local, long-term, negligible, beneficial impact on water quality.

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. Actions to remove roadside parking and to formalize South Fork Merced River access in Segments 5, 6, 7, and 8 would reduce trampling and soil compaction, resulting in a recovery of runoff processes. This would result in a local, long-term, minor, beneficial impact on hydrology.

Water Quality. Actions to remove roadside parking and to formalize South Fork Merced River access in Segments 5, 6, 7, and 8 would reduce trampling and erosion. In turn, this would reduce fine sediment loads in the river, though not in a detectable manner. This would result in a local, long-term, negligible, beneficial, impact on water quality.

Hydrologic/Geologic Resource Actions. Hydrologic/geologic resource actions relevant to Alternatives 2-6 that would be located in Segment 7 include implementation of the water conservation plan at the Wawona surface water withdrawal site in order to adhere to the minimum flow analysis for the South Fork Merced River and the associated conservation plan.

Surface water withdrawals and the existing impoundment affect the free-flowing condition of the river, and minimally reduce the volume of water delivered downstream. Excessive water withdrawals can, however, adversely affect aquatic life. Implementation of the aforementioned conservation plan would reduce the volume of water withdrawn at Wawona, which would result in a segment-wide, long-term, minor, beneficial impact to hydrology downstream of the diversion point.

Wawona. Redesign of the proposed bus stop would result in negligible effects on hydrologic resources. During construction, minimal areas of the existing pavement and minimal roadside areas that are currently covered by grasses and low vegetation would be disturbed. Use of heavy equipment during construction would be limited, and the effects of heavy equipment use on water quality, including increases in releases of sediment and equipment-related pollutants, would be avoided through implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C). Therefore, this action would result in a local, short-term, negligible, adverse impact on water quality.

Installation of the proposed seating and sun cover would result in the installation of negligible areas of new impervious surfaces. Impervious surfaces can alter hydrology by reducing the volume of stormwater that is infiltrated, and increasing the volume of runoff, from a given area. However, given the very limited extent of the proposed facility, this area of new impervious surfaces would contribute to local, long-term, negligible, adverse impact on hydrology.

The proposed bus stop improvements are located outside of the 100-year floodplain. Therefore no effects on floodplains would occur.

Segments 5-8 Impact Summary: Actions to protect and enhance river values within Segments 5-8 would have local, long-term, negligible, beneficial, hydrology, water quality, and floodplain impacts. Actions to manage user capacities, land use, and facilities would result in local, short-term and long-term, negligible to minor, beneficial and adverse impacts on the river's hydrology and water quality.

Summary of Impacts Common to Alternatives 2–6

Hydrology. Actions common to Alternatives 2–6 would have long-term, minor to moderate, beneficial impacts on hydrology. Restoration actions associated with Alternatives 2–6 would decompact soil and restore meadow and riparian areas. Actions associated with the removal of impervious surfaces would increase infiltration and partially restore the natural hydrologic regime in a detectable manner. Actions associated with in-river restoration would add roughness and complexity to the Merced River, thereby restoring hydrologic processes in a detectable manner.

Water Quality. Actions common to Alternatives 2–6 would have long-term, minor, beneficial impacts on water quality. Restoration actions associated with Alternatives 2–6 would restore denuded vegetation and limit informal trails, leading to a reduction in erosion. Actions associated with in-river restoration would help to stabilize eroded areas, thereby reducing fine sediment in a detectable manner. Construction activities associated with restoration have the potential to adversely affect water quality over the short term, but would be mitigated to a negligible level by instituting mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C).

Floodplains. Actions common to Alternatives 2–6 would have long-term, beneficial impacts on floodplains, ranging from negligible to minor. Restoration actions associated with Alternatives 2–6 would reconnect the Merced River and its floodplain in a detectable manner. Actions associated with in-river restoration would add roughness and complexity to the river, partially reconnecting the river to its floodplain, and creating a nondetectable long-term, negligible, beneficial impact on 100-year floodplains.

Environmental Consequences of Alternative 2: Self-Reliant Visitor Experiences and Extensive Floodplain Restoration

Segment 1: Merced River Above Nevada Fall

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. Pack stock used for administrative purposes would no longer graze on meadow vegetation near the Merced Lake Ranger Station. All administrative pack stock passing through the area would instead be required to carry pellet feed. This would help protect meadow vegetation, which in turn would produce a more natural hydrologic regime. This would result in a local, long-term, negligible, beneficial impact on hydrology.

Overnight capacities for both Little Yosemite Valley and Merced Lake would be reduced in Alternative 2, promoting dispersed camping. Concentrated camping areas would be converted to dispersed camping. This would reduce the potential for informal trails and vegetation trampling, and in turn reduced vegetation trampling would lead to an increase in the ability of the soil to infiltrate runoff. This action would not be expected to create a measurable change in hydrology in the Merced River and would result in a local, long-term, negligible, beneficial impact on hydrology.

Water Quality. The reduction of overnight capacities for Little Yosemite Valley and Merced Lake would reduce the potential for informal trails and vegetation trampling. In turn, this would reduce erosion but would not be expected to cause detectible change in Merced River water quality. Thus, reduced overnight capacities would result in a local, long-term, negligible, beneficial impact on water quality.

Merced Lake High Sierra Camp. Under Alternative 2, the Merced Lake High Sierra Camp would be closed and all facilities removed. In its place, dispersed camping at Merced Lake Backpackers Camping Area would expand into the High Sierra Camp footprint. The area of the former High Sierra Camp would be converted to designated wilderness.

With respect to hydrologic resources, removal of the Camp facilities and expansion of dispersed camping could result in the cutting of new trails and informal campsites. These activities could generate very localized and temporary increases in erosion and sedimentation in affected areas. However, these effects would be minimal to negligible in extent. With implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), potential water quality related impacts would be a local, short-term, negligible adverse impact on water quality.

Removal of the High Sierra Camp and expansion of camping into the areas would lessen impacts on water quality, hydrology, and flooding as compared to those of Alternative 1 (No Action). Impervious surfaces would be reduced, as would potential sources of water quality pollutants, and no potential floodplain obstructions would be installed. The resulting impacts would be local, long-term, negligible, and beneficial.

Segment 1 Impact Summary: Actions to manage user capacities, land use, and facilities within Segment 1 would result in a local, long-term, negligible, beneficial impact on hydrology.

Segment 2: Yosemite Valley

Impacts of Actions to Protect and Enhance River Values

Hydrology. Under Alternative 2, the Stoneman, Sugar Pine, and Ahwahnee bridges and associated berms would be removed and restored to natural conditions. The multi-use trail on Sugar Pine and Ahwahnee bridges would be rerouted along the north bank of the Merced River. This action would have an appreciable effect on streamflow dynamics, allowing natural processes to prevail. Backwaters, rapid scour, and excessive sediment deposition upstream and downstream of bridges would be reduced. The removal of hard points associated with these bridges would promote channel migration and partially restore natural channel evolution. This action would improve hydrology in a clearly detectable manner and result in a local, long-term, major, beneficial impact on hydrology.

Under Alternative 2, all campsites, tent-style lodging, and associated infrastructure within the 100-year floodplain would be removed and restored to natural conditions. This would include campsites at Backpackers Camp, North Pines Campground, Upper Pines and Lower Pines campgrounds, Yellow Pines Campground, and tent-style lodging at Housekeeping Camp. Other facilities that would be removed from the 100-year floodplain include select Yosemite Lodge infrastructure. Existing facilities located between the Village Store and Ahwahnee Meadow, including Ahwahnee Row housing and the Tecoya Dorms, would also be removed. Meadow restoration would take place at Ahwahnee, El Capitan, and Stoneman meadows. The amount of impervious surface in restored areas would be reduced, increasing infiltration of runoff and restoring a more natural hydrologic regime. Removing infrastructure, including road prisms and ditches, would reconnect surface and groundwater within each meadow. Replanting restored areas with native vegetation would restore the natural runoff regime. In total, Alternative 2 would result in 337 acres of ecological restoration, corridorwide. These actions would be expected to have a measurable effect on hydrology in the Merced River, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, long-term, moderate to major, beneficial impact on hydrology.

Temporary housing in the Lost Arrow parking lot would be removed and administrative parking would be reinstated, resulting in no net change in impervious surface area. This action would not affect hydrology.

Under Alternative 2, Merced River access would be more formalized, leading to a reduction in streambank erosion and soil compaction. Visitors would be directed to more stable river access points throughout Segment 2, and areas of compacted soils would be decompacted and restored. This would improve bank stability at river access points and restore natural runoff processes. This would be expected to have a measurable effect on hydrology in the river, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, long-term, minor, beneficial impact on hydrology.

Water Quality. Under Alternative 2, the Stoneman, Sugar Pine, and Ahwahnee bridges and associated berms would be removed and restored to natural conditions. The multi-use trail on Sugar Pine and Ahwahnee bridges would be rerouted along the north bank of the Merced River. These sites would have reduced scour and more stable riverbanks, which would reduce the amount of fine sediment in

the river. This would not be expected to have a measurable effect on water quality and would result in a local, long-term, negligible, beneficial impact on water quality.

Under Alternative 2, all campsites and associated infrastructure within the 100-year floodplain would be removed and restored to natural conditions. This would include campsites at Backpackers Camp, North Pines Campground, Upper Pines and Lower Pines campgrounds, Yellow Pines Campground, and tent-style lodging at Housekeeping Camp. Other facilities that would be removed from the 100-year floodplain include select Yosemite Lodge infrastructure. Existing facilities located between the Village Store and Ahwahnee Meadow, including Ahwahnee Row housing and the Tecoya Dorms, would also be removed. Meadow restoration would take place at Ahwahnee, El Capitan, and Stoneman meadows. Methods for restoration would include recontouring, ditch removal, and decompaction. Recontouring would involve use of a skid steer, loader, excavator, dozer, and dump truck to remove excavated material from the site. An excavator or dozer could be used to excavate depressions, cut-off channels, and oxbows. On steep riverbanks, an excavator or dozer could push soils and material down the slope of the bank to create a gentler slope, which would increase revegetation success. Whenever possible, native fill would be used from the restoration site. Where possible, ditches would be contoured and leveled using fill material already present in associated berms. Soil decompaction would involve breaking up soils either manually, by using special decompaction tools, or with heavy equipment that can support ripping tines, such as excavators, skid steer, and dozers. Small pockets of fill would at times be blended into the soil, as decompaction occurs, using an excavator or a dozer with winged rippers. Earth-moving activities during construction have the potential to mobilize fine sediment, which would result in a local, short-term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would result in this impact being characterized as short-term, local, negligible, and adverse. After construction, restored areas would result in established vegetation that would be less likely to erode, thus reducing fine sediment loads. This would not be expected to have a measurable effect on water quality and would result in a local, long-term, minor, beneficial impact on water quality.

Under Alternative 2, Merced River access would be more formalized, leading to a reduction in streambank erosion and soil compaction. Visitors would be directed to more stable river access points throughout the segment, and areas of compacted soils would be decompacted and restored. This would improve bank stability at river access points, thereby reducing erosion, though not to a measurable extent. This would result in a local, long-term, negligible, beneficial impact on water quality.

Floodplains. Removal of the Stoneman, Sugar Pine and Ahwahnee bridges and associated berms would reduce constrictions in the Merced River and reduce water surface elevations during floods, thereby resulting in a local, long-term, minor, beneficial impact on floodplains.

Restoration of areas within the 100-year floodplain would occur, including locations at Backpackers Camp, North Pines Campground, Upper Pines and Lower Pines campgrounds, Yellow Pines Campgrounds, former Upper River and Lower River campgrounds, Housekeeping Camp, and Yosemite Lodge. Existing facilities located between the Village Store and Ahwahnee Meadow, including Ahwahnee Row housing and the Tecoya Dorms, would also be removed. Meadow restoration would take place at Ahwahnee, El Capitan, and Stoneman meadows, which would increase

connectivity between the Merced River and its floodplain in a detectable manner. This would result in a local, long-term, moderate, beneficial impact on floodplains.

Biological Resource Actions. Proposed biological resource actions associated with Alternative 2 that would be deployed along Segment 2 include rerouting and consolidation of 350 feet of trail near Housekeeping Camp and Housekeeping Footbridge; removal of 900 feet of Northside Drive, relocation of the bike path, and vegetation restoration at Ahwahnee Meadow; restoration 1,335 feet of Southside Drive and road realignment at Stoneman Meadow, and application of engineering solutions to promote water flow at the Orchard Parking Lot, with installation of up to 275 feet of boardwalk at Curry Village; restoration of 35.6 acres of 10-year floodplain including decompaction of soils and removal of asphalt, former roads, and campsites, removal of the Lower River amphitheater structure and fill; removal of campsites within 100 feet of the river bed and banks with restoration of 25.1 acres of floodplain and riparian habitat at Valley Campgrounds; removal of informal trails and reduction of roadside parking at El Capitan meadow; restoration of 10.9 acres of riparian ecosystem at the site of the former Yosemite Lodge units and cabins (those that were damaged after the 1997 flood and subsequently removed), remove fill, decompact soils, and plant riparian plant species.

Rerouting and consolidation of trails, restoration of road areas and meadows, restoration of floodplain, decompaction, and removal of informal trails could contribute to increased stormwater infiltration capacity and increased storm event hydrologic concentration times. Restoration of riparian and floodplain vegetation would generally slow floodwaters in the vicinity of the restored area, more closely mimicking natural conditions, resulting in a local, long-term, minor, beneficial impact to hydrology and flooding.

Relocation and removal of facilities located in floodplain areas, including removal of existing amphitheater structure and fill, removal of campsites, removal of informal trails, relocation of paths, road realignments, and other proposed facility realignments would reduce existing constraints on the natural floodplain of the river. Reductions in these constraints would support the free-flowing condition of the river, and would reduce existing interference within the floodplain. Therefore, this is considered a segment-wide, long-term, minor, beneficial impact with respect to flooding.

Implementation of engineering solutions to promote water flow at the Orchard Parking Lot would alleviate existing stormwater/flood related constrictions at the parking lot. This would result in a local, long-term, minor, beneficial impact on flooding.

Construction of the proposed biological resources actions could result in temporary disturbance to surface sediments and vegetation. Disturbance would result primarily from the use of heavy machinery. Heavy machinery would be used for soil decompaction, removal and relocation of asphalt areas, recontouring of topography, rerouting of trails, removal of informal trails, and removal of other infrastructure as noted previously. Minimal additional disturbance could occur during restoration activities and boardwalk installation, due to localized disturbance. Additionally, construction related use of heavy machinery could result in accidental release of construction related fluids, oils, fuels, greases, hydraulic fluid, and other potential construction related water quality pollutants, during the construction process. Adhering to the proposed mitigation measures MM-HYD-1 through

MM-HYD-5, as appropriate (see Appendix C), would reduce these potential impacts to local, short-term, minor, and adverse.

Increases in riparian and floodplain vegetation associated with the proposed restoration activities, as noted above, would result in increased coverage of such vegetation along the river. Increases in riparian and floodplain vegetation coverage would result in reductions in sediment and other pollutant levels in stormwater that drains into the Merced River. Therefore, the proposed restoration activities would result in a segment-wide, long-term, negligible, beneficial impact on water quality.

Hydrologic/Geologic Resource Actions. Hydrologic/geologic resource actions that would occur under Alternative 2 along Segment 2 include movement of the unimproved parking area at Camp 6 north and closer to the Village Center, and rerouting of Northside Drive to outside of the 10-year floodplain, with removal of fill and restoration of meadow and floodplain ecosystems; and removal of three bridges including Stoneman Bridge, Sugar Pine Bridge, Ahwahnee Bridge and the associated road berms, including rerouting of trails and utilities, and redesign of affected roadways and intersections.

The three bridges that would be removed – Stoneman Bridge, Sugar Pine Bridge, and Ahwahnee Bridge – currently cause hydrologic constrictions along the Merced River. During moderate flow conditions, constrictions associated with these bridges interferes with natural hydrologic processes along the river, including reduction of channel migration, alteration of scour, and other hydrologic alterations. During high and flood flows, the bridges constrict flood flows, resulting in backup of flows behind the bridges, increases in flow velocity and scour in the vicinity of the bridges, and reduction in flows downstream of the bridges, in comparison to natural conditions. Therefore, removal of these three bridges would alleviate these conditions, resulting in a local, long-term, major, beneficial impact on hydrology and flooding.

Removal of the unimproved parking area at Camp 6 and rerouting of Northside Drive to outside of the 10-year floodplain, along with associated fill removal, would result in the removal of existing structures that interfere with floodplain function. Removal of these structures would thereby reduce existing obstructions within the floodplain, and would thereby result in a net local, long-term, minor, beneficial impact on flooding.

Removal of the various trails, berms, roadways, and intersections associated with the proposed bridge removals and the Camp 6 actions would represent the removal of existing obstructions within the floodway corridor of the Merced River. Removal of these features would contribute to a return towards natural flood stage hydrologic processes in the vicinity of these existing features, by removing floodplain obstructions from the 10-year floodplain. Therefore, these proposed actions would result in a local, long-term, minor, beneficial impact on flooding.

With respect to water quality, during construction, removal of the three bridges and other infrastructure from the Merced River and its floodplain, and associated restoration activities, would result in temporary construction related impacts to water quality. These could include incidental releases of sediment into natural waterways and the Merced River. Additionally, the use of heavy construction equipment during removal of bridges and other facilities could result in accidental release of construction related fluids, oils, fuels, greases, hydraulic fluid, and other potential construction related water quality pollutants during the construction period. Adhering to the

proposed mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce these potential impacts to local, temporary, minor, and adverse.

Increases in riparian and floodplain vegetation associated with the proposed restoration activities, as noted above, would result in increased coverage of such vegetation along the river. Increases in riparian and floodplain vegetation coverage would result in reductions in sediment and other pollutant levels in stormwater that drains into the Merced River. Therefore, the proposed restoration activities would result in a segment-wide, long-term, negligible, beneficial impact on water quality.

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. Under Alternative 2, visitor-serving facilities and overall use would be reduced, including in riverside areas, thereby decreasing trampling, informal trail development, and riverbank erosion. The number of employee housing units, campsites, and lodging units would decrease. In addition, informal parking would also be reduced. These actions would have a net reduction in total impervious surface area, allowing soils and vegetation to recover, and lead to increased infiltration of runoff, reduced riverbank erosion, and increased streamflow dynamics. This would be expected to have a measurable effect on hydrology, but would not be expected to have an overall effect on the character of the Merced River, thus resulting in a segmentwide, long-term, minor, beneficial impact on hydrology.

Removal of trails and formalizing picnic areas would increase infiltration of runoff, restore riparian vegetation, and restore a more natural hydrologic regime. Formalizing Merced River access points and trails would reduce vegetation trampling. This would be expected to have a measurable effect on hydrology in the river, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, long-term, minor, beneficial impact on hydrology.

Water Quality. Under Alternative 2, total visitation, residential and visitor serving facilities, and parking within the Valley would be reduced. These actions would reduce trampling of riparian vegetation, informal trail development, and riverbank erosion. Removal of facilities and informal parking would reduce impervious surfaces, allow soils and vegetation to recover, and improve infiltration. With the number vehicles entering the Valley reduced, the concentration of vehicle-associated pollutants in stormwater runoff would also decrease. These actions would be expected to lead to a detectable reduction in fine sediment and pollutants entering the Merced River, resulting in a segmentwide, long-term, minor, beneficial impact on water quality.

New parking areas located at the West of Yosemite Lodge parking and parking areas moved at Camp 6 would generate discharges of sediment and automobile related pollutants into stormwater. Release of these pollutants could result in negligible degradation of water quality downstream, and these actions constitute a local, long-term, negligible, adverse impact on water quality.

Removal of trails and formalizing picnic areas would restore riparian vegetation and reduce erosion. Formalizing Merced River access points and trails would reduce vegetation trampling and help to stabilize riverbanks. This would be expected to result in a local, long-term, negligible, beneficial impact on water quality.

Curry Village & Campgrounds. Actions to manage user capacities, land use, and facilities in this area would include an increase in total units from 400 existing units to 433 units. Total lodging within this area would consist of 290 tent-style lodging units retained in Curry Village, 78 newly constructed hard-sided units in Boys Town, 18 units retained at Stoneman House, and 47 cabin-with-bath units retained in Curry Village.

Installation of the new units in Boys Town would require the addition of new impervious surfaces, and a net increase in total impervious surface area would be anticipated within this area. As noted previously, impervious surfaces prevent the infiltration of stormwater into the subsurface, causing increased discharges of stormwater and a shortened hydrologic concentration time, as compared with those of under existing conditions. New impervious surfaces would be limited to facilities footprints, and some additional access areas. Because new impervious surface areas would be limited in extent, the proposed projects would result in a local, long-term, negligible, adverse impact on hydrology.

Construction of the proposed new units could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. The use of heavy construction equipment would also disturb surface sediments, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants into stormwater. These activities would result in a local, short term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

Floodplains. Under Alternative 2, existing development would be removed from the floodplain in several areas (see *Impacts of Actions to Protect and Enhance River Values*, above), no new development would occur within these areas, and the park would undertake active (e.g., Yellow Pines Campground) and passive (e.g., Upper and Lower Rivers Campgrounds) restoration actions. These actions would have a local, long-term, minor, beneficial impact on Segment 2 floodplains.

Camp 6 and Yosemite Village. Actions to manage user capacities, land use, and facilities within this area of Segment 2 primarily concern transportation improvements. Proposed projects would involve improvements to intersection function at Village Drive and Northside Drive near Camp 6; relocation and redevelopment of the existing overflow parking area west of Yosemite Lodge to provide 150 additional overnight parking spaces; relocation of the Camp 6 day use parking area outside of the 10-year floodplain; and the rerouting of Northside Drive to south of the parking area. The Camp 6/ Village Center parking area would be increased to 550 units by redeveloping part of the current administrative footprint in that area. One hundred parking spaces would be added to the Yosemite Village parking area.

Installation of new parking areas and roadways would require the construction of new impervious surfaces. Net increases in impervious surface area would be largely offset by the removal of select existing parking facilities and roadways, as noted above, as well as improvements in drainage facilities associated with the new structures, and the addition of bioswales in parking areas. However, based on the anticipated increase in parking and road area, a net increase in impervious surfaces is anticipated. As noted elsewhere, impervious surfaces cause increased discharges of stormwater and shorten

hydrologic concentration time. The proposed actions would therefore result in a local, long-term, minor, adverse impact on stormwater hydrology.

Demolition of existing parking areas and roadways slated for removal, as well as construction of new parking areas and roads discussed above, could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. Additionally, the use of heavy construction related equipment would also disturb surface sediments, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants. These activities would result in a local, short term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would be required, and would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

The use of the proposed new parking areas would serve to consolidate existing parking activities into formalized areas, reducing reliance on informal parking areas. Therefore, the anticipated increase in formalized parking spaces is not expected to result in increased use, but would accommodate existing use that currently relies on other facilities. Therefore, no net change in water quality pollutants related to parking lots is anticipated, because existing effects would be consolidated into formalized parking areas.

The existing Camp 6 day use parking area is located within the 10-year floodplain. Parking lots do not generally constitute major obstructions to flood flows, and so their presence within a floodplain is generally less obstructive than other vertical development; although minor effects, such as localized interference with flood flows, could still occur during a flooding event. A parking lot in the floodplain does, however, remove floodplain vegetation and soils. This rougher natural surface slows floodwaters, filters suspended sediment, and buffers the impacts of flooding. Therefore, removal of the existing facility to outside of the 10-year floodplain would reduce the frequency of inundation, and would reduce existing pressures on the existing floodplain area. Other facilities would not appreciably affect floodplain areas. These actions would result in a local, long-term, minor to moderate, beneficial impact with respect to flooding.

Yosemite Lodge and Camp 4. Actions to manage user capacities, land use, and facilities within this area of Segment 2 are limited to removal of the existing on-grade pedestrian crossing located west of the intersection of Northside Drive and Yosemite Lodge Drive. This action would be completed in order to alleviate pedestrian/vehicle conflicts. The crossing would be moved to west of the existing intersection.

The impervious surfaces associated with this crossing would be removed from their existing location, and moved west, to a new location. Therefore, this action is not expected to result in a noticeable increase or decrease in impervious surfaces or other features that would affect stormwater flows, and therefore would not affect on site hydrology.

Demolition of the existing pedestrian crossing, as well as construction of the proposed relocated crossing, could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. The use of heavy construction related equipment would also disturb surface sediments within affected areas, and could result in the accidental release of fuels,

oils, greases, antifreeze, and other potential construction-related water quality pollutants into stormwater. These activities would result in a local, short term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

The facilities in question would be located outside of the existing floodplain, and therefore would not affect flooding.

Segment 2 Impact Summary: Actions to protect and enhance river values within Segment 2 would have local, long-term, beneficial impacts on hydrology, water quality, and floodplains, ranging from minor to moderate. Actions to manage user capacities, land use, and facilities would have local and segmentwide, long-term, minor to moderate, beneficial impacts on hydrology, water quality, and floodplains.

Segments 3 and 4: Merced Gorge and El Portal

Impacts of Actions to Protect and Enhance River Values

Hydrology. Oak protection, removal of fill, and decompaction of soils in the Odger's fuel storage area would promote infiltration in the area, but would not have a discernible effect on the hydrology of the river, thus resulting in a local, long-term, negligible, beneficial impact on hydrology.

Impacts of Actions to Manage User Capacity, Land Use, and Facilities

Hydrology. Construction of new housing in the Rancheria Flatt and Abbieville areas of El Portal would involve vegetation removal, soils compaction, and increased areas of impervious surfaces outside the 100-year floodplain. These actions would have a local, long-term, minor, adverse impact on hydrology.

Water Quality. Construction of new housing and parking lots, as described above, could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. Additionally, the use of heavy construction related equipment would also disturb surface sediments, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants into stormwater. These activities would result in a local, short-term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

Segments 3 & 4 Impact Summary: Actions to protect and enhance river values within Segment 4 would have local, long-term, negligible, beneficial impact on the river's hydrology and water quality. Actions to manage visitor capacity, land use, and facilities would have a long-term, minor, adverse impact on hydrology.

Segments 5, 6, 7, and 8: South Fork Merced River

Impacts of Actions to Protect and Enhance River Values

Hydrology. The removal and restoration of campsites either within the 100-year floodplain or in culturally sensitive areas, and removal of the Wawona Golf Course would result in reduced trampling, increased area of natural vegetative cover, and an increase in soil infiltration. Impervious surfaces would be reduced, leading to an increase in the infiltration capacity of the area, thereby restoring the hydrologic regime. This would be expected to have local and segmentwide, long-term, moderate, beneficial impacts on hydrology.

Water Quality. The removal and restoration of campsites either within the 100-year floodplain or in culturally sensitive areas, and removal of the Wawona Golf Course would result in reduced trampling and greater cover of native vegetation that would be less likely to erode and would reduce stormwater runoff through improved infiltration. The work would require the use of heavy equipment, which could cause short-term, adverse impacts to water quality. With implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), such local impacts would be reduced to short-term, negligible to minor, and adverse. Over the long-term, the impacts on water quality would be segmentwide, minor, and beneficial.

Floodplains. The removal and restoration of campsites either within the 100-year floodplain or in culturally sensitive areas would increase connectivity between the South Fork Merced River and its floodplain in a detectable manner. This would result in a local, long-term, minor, beneficial impact on floodplains.

Biological Resource Actions. Along Segment 7 under Alternative 2, relocation of two stock use campground sites from sensitive biological resource areas to Wawona Stables would result in long-term, localized, negligible, beneficial impacts to river or floodplain hydrology. Minor construction activities associated with relocation of these facilities could result in potential construction related water quality impacts – primarily the temporary release of elevated sediment levels into stormwater during construction activities, but to a lesser extent, potential release of oils, greases, fuels, and other construction related water quality pollutants associated with the use of heavy equipment. Adhering to the proposed mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce these potential impacts to local, short-term, negligible, and adverse.

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. Under Alternative 2, visitor use would be reduced in Segments 5, 6, 7, and 8, including use in riverside areas. This would result in a decrease in trampling, informal trail development, and riverbank erosion. This also would lead to increased infiltration of runoff, reduced riverbank erosion, and increased streamflow dynamics. These results would be expected to have a measurable effect on hydrology, but would not be expected to have an overall effect on the character of the South Fork Merced River, thus resulting in a segmentwide, long–term, minor, beneficial impact on hydrology.

The removal of facilities under Alternative 2 would reduce the amount of impervious surfaces within Segments 5, 6, 7, and 8, leading to a more natural hydrologic regime, though not to a measurable extent. This would result in a local, long-term, negligible, beneficial, impact on hydrology.

Water Quality. Under Alternative 2, visitor use would be reduced Segments 5, 6, 7, and 8, including use in riverside areas. This would result in a decrease in trampling, informal trail development, and riverbank erosion. While vehicles can contribute hydrocarbons, oil and grease, and metals to stormwater runoff, these actions would reduce the number of vehicles entering the South Fork Merced River corridor and thus result in a corresponding reduction in vehicle-associated pollutants. These actions would be expected to lead to in detectable reduction in fine sediment and pollutants, thereby resulting in a segmentwide, long-term, minor, beneficial impact on water quality.

Wawona. Removal of 32 campsites from areas located within the 100-year floodplain would reduce existing effects of trampling on riverbank areas, and would support reduced erosion rates within the area. This would result in a local, long-term, minor, beneficial impact on water quality due to reduced erosion rates. Similarly, removal of 32 campsites from within the existing floodplain would result in a net reduction in floodplain area that is impacted by existing facilities. Removal of these sites would result in a local, long-term, negligible, beneficial impact on floodplains and flooding. Finally, removal of the existing facilities would involve minimal demolition related activities, which could include the use of heavy machinery, as well as other minor restoration activities. These construction activities would require implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), which would ensure that potential water quality impacts would be local, short-term, negligible, and adverse.

Segments 5-8 Impact Summary: Actions to protect and enhance river values within Segments 5-8 would have local and segmentwide, long-term, negligible to minor, beneficial impacts on hydrology, water quality, and floodplains. Actions to manage user capacities, land use, and facilities would have local and segmentwide, long-term, negligible to minor, beneficial impacts on hydrology, water quality, and floodplains.

Summary of Impacts from Alternative 2: Self-Reliant Visitor Experiences and Extensive Floodplain Restoration

Hydrology. Actions associated with Alternative 2 would have long-term, minor to major, beneficial, impacts on hydrology. Restoration actions associated with all alternatives would decompact soil and restore meadow and riparian areas. Actions associated with the removal of impervious surfaces would increase infiltration and partially restore the natural hydrologic regime in a detectable manner. Actions associated with in-river restoration would add roughness and complexity to the Merced River, thereby restoring hydrologic processes in a detectable manner. Actions associated with bridge removal would restore lost hydrologic processes in a clearly detectable manner and would have a long-term, moderate to major, beneficial impact on hydrology.

Water Quality. Actions associated with Alternative 2 would have long-term, minor, beneficial impacts on water quality. Restoration actions associated with Alternatives 2–6 would restore denuded vegetation and limit informal trails, leading to a reduction in erosion. Actions associated with in-river

restoration would help to stabilize eroded areas, thereby reducing fine sediment in a detectable manner. Construction activities associated with restoration have the potential to adversely affect water quality over the short term, but would be mitigated to a negligible level by instituting mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C).

Floodplains. Actions associated with Alternative 2 would have long-term, negligible to moderate, beneficial and adverse impacts on floodplains. Restoration actions associated with Alternatives 2–6 would reconnect the Merced River and its floodplain in a detectable manner. Actions associated with in-river restoration would add roughness and complexity to the river, partially reconnecting the river to its floodplain, combined with restoration of areas within the 100-year floodplain would combine to create a long-term, moderate, beneficial impact on 100-year floodplains.

Cumulative Impacts from Alternative 2: Self-Reliant Visitor Experiences and Extensive Floodplain Restoration

The cumulative impacts analysis for Alternative 2 reflects the historic timeframe for installation of the various past, present, and reasonably foreseeable future actions listed below. The spatial dimension for the cumulative impacts analysis encompasses the portion of the Merced River watershed that is located within the park. The cumulatively considerable projects for Alternative 2 would be the same as those presented in Alternative 1.

Overall Cumulative Impact Common for Alternative 2: Self-Reliant Visitor Experiences and Extensive Floodplain Restoration

Under Alternative 2, removal of riprap, removal of three bridges and unnecessary infrastructure, restoration of meadow hydrology, and improvements to wastewater collection would result in increased alluvial processes, reconnection of the Merced River to its floodplain, and enhanced water quality. This would contribute to local, long-term, moderate to major, beneficial cumulative impacts on hydrology, and floodplains, and a local, long-term, minor to moderate, beneficial cumulative impact on water quality.

Environmental Consequences of Alternative 3: Dispersed Visitor Experiences and Extensive Riverbank Restoration

Segment 1: Merced River Above Nevada Fall

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. Pack stock used for administrative purposes would graze on meadow vegetation near the Merced Lake Ranger Station in accordance with established grazing capacities. This would help protect meadow vegetation, which in turn would produce a more natural hydrologic regime. This would result in a local, long-term, negligible, beneficial impact on hydrology.

Overnight capacities for both Little Yosemite Valley and Merced Lake would be reduced under Alternative 3, thereby promoting dispersed camping. Concentrated camping areas would be converted

to dispersed camping. This would reduce the potential for informal trails and vegetation trampling, thereby leading to an increase in the ability of the soil to infiltrate runoff. This action would not be expected to create a measurable change in hydrology in the Merced River and would result in a local, long-term, negligible, beneficial impact on hydrology.

Water Quality. The reduction of overnight capacities for Little Yosemite Valley and Merced Lake would reduce the potential for informal trails and vegetation trampling. In turn, this would reduce erosion but would not be expected to cause detectible change in Merced River water quality. Thus, reduced overnight capacities would result in a local, long-term, negligible, beneficial, impact on water quality.

Merced Lake High Sierra Camp. Under Alternative 3 the Merced Lake High Sierra Camp would be closed, all existing permanent infrastructure removed, and the area converted into a temporary pack camp with a maximum of 15 people allowed. The area would be converted to designated wilderness.

With respect to hydrologic resources, removal of existing facilities would result in a negligible net reduction in impervious surfaces on site. This would provide a negligible benefit to hydrology, because impervious surfaces contribute to increased stormwater runoff and other effects on hydrology. Total impervious surfaces removed would be less than half an acre. Therefore, potential impacts on hydrology associated with this action are considered to be local, long-term, negligible, and beneficial.

Removal of existing facilities and conversion to a temporary pack camp in the same vicinity could result in negligible disturbance during facility removal and the establishment of pack camp sites. These activities could generate very local and temporary increases in erosion and sedimentation in affected areas. However, these effects would be limited to the construction period, and would be negligible in extent. With implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), potential water quality related impacts would have a local, temporary, negligible, adverse impact on water quality.

Removal of the High Sierra Camp and conversion to a temporary stock camp would lessen impacts on water quality, hydrology, and flooding as compared to those of Alternative 1 (No Action). Impervious surfaces would be reduced, as would potential sources of water quality pollutants, and no potential floodplain obstructions would be installed. The resulting impacts would be local, long-term, negligible, and beneficial.

Segment 1 Impact Summary: Actions to manage user capacities, land use, and facilities within Segment 1 would result in a local, long-term, negligible, beneficial impact on hydrology.

Segment 2: Yosemite Valley

Impacts of Actions to Protect and Enhance River Values

Hydrology. Under Alternative 3, the Stoneman, Sugar Pine, and Ahwahnee bridges and associated berms would be removed and restored to natural conditions. The multi-use trail on Sugar Pine and Ahwahnee bridges would be rerouted along the north bank of the Merced River. This action would have an appreciable effect on streamflow dynamics, allowing natural processes to prevail. Backwaters,

rapid scour, and excessive sediment deposition upstream and downstream of bridges would be reduced. The removal of hard points associated with these bridges would promote channel migration and partially restore natural channel evolution. This action would improve hydrology in a clearly detectable manner and result in a local, long-term, major, beneficial impact on hydrology.

Under Alternative 3, campsites and associated infrastructure located within 150 feet of the Merced River would be removed and restored to natural conditions. This would include campsites at Backpackers Camp, North Pines Campground, Upper Pines and Lower Pines campgrounds, and Yellow Pines Campground. All tent-style lodging at Housekeeping Camp would be removed and the area would be repurposed as river access. Restoration actions would result in the restoration of approximately 230 acres of meadow, riparian, and other habitat types.

Meadow restoration would take place at Ahwahnee, El Capitan, and Stoneman meadows. The amount of impervious surface in restored areas would be reduced, increasing infiltration of runoff and restoring a more natural hydrologic regime. Removing infrastructure, including road prisms and ditches, would reconnect surface and groundwater within each meadow. Replanting restored areas with native vegetation would restore the natural runoff regime. These actions would be expected to have a measurable effect on hydrology in the Merced River, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, long-term, moderate, beneficial impact on hydrology.

Under Alternative 3, Merced River access would be more formalized, leading to a reduction in streambank erosion and soil compaction. Visitors would be directed to more stable river access points throughout Segment 2, and areas of compacted soils would be decompacted and restored. This would improve bank stability at Merced River access points, and restore natural runoff processes. This would be expected to have a measurable effect on hydrology in the river, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, long–term, minor, beneficial impact on hydrology.

Water Quality. Under Alternative 3, the Stoneman, Sugar Pine and Ahwahnee bridges and associated berms would be removed and restored to natural conditions. The multi-use trail on Sugar Pine and Ahwahnee bridges would be rerouted along the north bank of the Merced River. These sites would have reduced scour and more stable riverbanks, thus reducing the amount of fine sediment in the river. This would not be expected to have a measurable effect on water quality and would result in a local, long-term, negligible, beneficial impact on water quality.

Under Alternative 3, campsites and associated infrastructure located within 150 feet of the Merced River would be removed and restored to natural conditions. This would include campsites at Backpackers Camp, North Pines Campground, Upper Pines and Lower Pines campgrounds, and Yellow Pines Campgrounds. All tent-style lodging at Housekeeping Camp would be removed and the area would be repurposed as river access. Methods for restoration would include recontouring, ditch removal, and decompaction. Recontouring would involve use of a skid steer, loader, excavator, dozer, and dump truck to remove excavated material from the site. An excavator or dozer could be used to excavate depressions, cut-off channels, and oxbows. On steep riverbanks, an excavator or dozer could push soils and material down the slope of the bank to create a gentler slope, which would increase

revegetation success. Whenever possible, native fill would be used from the restoration site. Where possible, ditches would be contoured and leveled using fill material already present in associated berms. Soil decompaction would involve breaking up soils either manually, by using special decompaction tools, or with heavy equipment that can support ripping tines, such as excavators, skid steer, and dozers. Small pockets of fill would at times be blended into the soil, as decompaction occurs, with an excavator or dozer with winged rippers. Earth-moving activities during construction have the potential to mobilize fine sediment, which would result in a local, short-term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce this impact to negligible. After construction, restored areas would result in established vegetation that would be less likely to erode, thus reducing fine sediment loads. This would not be expected to have a measurable effect on water quality and would result in a local, long-term, negligible, beneficial impact on water quality.

Under Alternative 3, river access would be more formalized, leading to a reduction in streambank erosion and soil compaction. Visitors would be directed to more stable Merced River access points throughout the segment, and areas of compacted soils would be decompacted and restored. This would improve bank stability at river access points, thereby reducing erosion, though not to a measurable extent. This would result in a local, long-term, negligible, beneficial impact on water quality.

Floodplains. Removal of the Sugar Pine and Ahwahnee bridges and associated berms would reduce constrictions in the Merced River and would reduce water surface elevations during floods, resulting in a local, long-term, minor, beneficial impact on floodplains.

Restoration of areas within the 150-foot river buffer would include locations at Backpackers Camp, North Pines Campground, Upper Pines and Lower Pines campgrounds, Yellow Pines Campground, former Upper River and Lower River campgrounds, Housekeeping Camp, the Curry Orchard parking lot, and Yosemite Lodge. Meadow restoration would take place at Ahwahnee, El Capitan, and Stoneman meadows, which would increase connectivity between the Merced River and its floodplain in a detectable manner. This would result in a local, long-term, minor, beneficial impact on floodplains.

Biological Resource Actions. Proposed biological resource actions associated with Alternative 3 that would be deployed along Segment 2 include rerouting and consolidation of 350 feet of trail near Housekeeping Camp and Housekeeping Footbridge; removal of 900 feet of Northside Drive, relocation of the bike path, and vegetation restoration at Ahwahnee Meadow; restoration 1,335 feet of Southside Drive and road realignment at Stoneman Meadow, and application of engineering solutions to promote water flow at the Orchard Parking Lot, with installation of up to 275 feet of boardwalk at Curry Village; restoration of 30 acres of 10-year floodplain including decompaction of soils and removal of asphalt, former roads, and campsites, removal of the Lower River amphitheater structure and fill; restoration of 12 acres of riparian habitat at North Pines Campgrounds; removal of select informal trails at El Capitan meadow; restoration of 10.9 acres of riparian ecosystem at the site of the former Yosemite Lodge units and cabins (those that were damaged after the 1997 flood and subsequently removed), remove fill, decompact soils, and plant riparian plant species.

Rerouting and consolidation of trails, restoration of road areas and meadows, restoration of floodplain, decompaction, and removal of informal trails could contribute to increased stormwater infiltration capacity and increased storm event hydrologic concentration times. Restoration of riparian and floodplain vegetation would generally slow floodwaters in the vicinity of the restored area, more closely mimicking natural conditions, resulting in a local, long-term, minor, beneficial impact to hydrology and flooding.

Relocation and removal of facilities located in floodplain areas, including removal of existing amphitheater structure and fill, removal of campsites, removal of informal trails, relocation of paths, road realignments, and other proposed facility realignments would reduce existing constraints on the natural floodplain of the river. Reductions in these constraints would support the free-flowing condition of the river, and would reduce existing interference within the floodplain. Therefore, this is considered a segment-wide, long-term, minor, beneficial impact with respect to flooding.

Implementation of engineering solutions to promote water flow at the Orchard Parking Lot would alleviate existing stormwater/flood related constrictions at the parking lot. This would result in a local, long-term, minor, beneficial impact on flooding.

Construction of the proposed biological resources actions could result in temporary disturbance to surface sediments and vegetation. Disturbance would result primarily from the use of heavy machinery. Heavy machinery would be used for soil decompaction, removal and relocation of asphalt areas, recontouring of topography, rerouting of trails, removal of informal trails, and removal of other infrastructure as noted previously. Minimal additional disturbance could occur during restoration activities and boardwalk installation, due to localized disturbance. Additionally, construction related use of heavy machinery could result in accidental release of construction related fluids, oils, fuels, greases, hydraulic fluid, and other potential construction related water quality pollutants, during the construction process. Adhering to the proposed mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce these potential impacts to local, short-term, minor, and adverse.

Increases in riparian and floodplain vegetation associated with the proposed restoration activities, as noted above, would result in increased coverage of such vegetation along the river. Increases in riparian and floodplain vegetation coverage would result in reductions in sediment and other pollutant levels in stormwater that drains into the Merced River. Therefore, the proposed restoration activities would result in a segment-wide, long-term, negligible, beneficial impact on water quality.

Hydrologic/Geologic Resource Actions. Hydrologic/geologic resource actions that would occur under Alternative 3 along Segment 2 would be the same as those that would occur under Alternative 2 along Segment 2. Potential impacts associated with these activities under Alternative 3 would be the same as those discussed for Alternative 2. Please refer to the prior discussion for impacts on hydrology, floodplains, and water quality for Alternative 2, Segment 2.

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. Under Alternative 3, visitor-serving facilities and overall use would be reduced, including in riverside areas, thereby decreasing trampling, informal trail development, and riverbank erosion. While

number of campsites would increase slightly, employee housing and overnight lodging would decrease. In addition, informal parking would also be reduced. These actions would have a net reduction in total impervious surface area, allowing soils and vegetation to recover, and lead to increased infiltration of runoff, reduced riverbank erosion, and increased streamflow dynamics. This would be expected to have a measurable effect on hydrology, but would not be expected to have an overall effect on the character of the Merced River, thus resulting in a segmentwide, long-term, minor, beneficial impact on hydrology.

Temporary housing in the Lost Arrow parking lot would be removed and administrative parking would be reinstated, resulting in no net change in impervious surface area. This action would not affect hydrology.

Removal of trails and formalizing picnic areas would increase infiltration of runoff, restore riparian vegetation, and restore a more natural hydrologic regime. Formalizing river access points and trails would reduce vegetation trampling. This would be expected to have a measurable effect on hydrology in the Merced River, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, long–term, minor impact on hydrology.

Water Quality. Under Alternative 3, total visitation, residential and visitor serving facilities, and parking within the Valley would be reduced. These actions would reduce trampling of riparian vegetation, informal trail development, and riverbank erosion. Removal of facilities and informal parking would reduce impervious surface area, allow soils and vegetation to recover, and improve infiltration. With the number vehicles entering the Valley reduced, the concentration of vehicle-associated pollutants in stormwater runoff would also decrease. This would be expected to lead to a detectable reduction in fine sediment and pollutants, thereby resulting in a segmentwide, long-term, minor, beneficial impact on water quality.

New parking areas located at the West of Yosemite Lodge parking and parking areas moved at Camp 6 would generate discharges of sediment and automobile related pollutants into stormwater. Release of these pollutants could result in negligible degradation of water quality downstream, and these actions constitute a local, long-term, minor, adverse negligible impact on water quality.

Removal of trails would restore riparian vegetation and reduce erosion. Formalizing picnic areas, Merced River access points and trails would reduce vegetation trampling and help to stabilize riverbanks. This would be expected to result in a local, long-term, negligible, beneficial impact on water quality.

Floodplains. Under Alternative 3, existing development would be removed from the floodplain in several areas (see *Impacts of Actions to Protect and Enhance River Values*, above). No new development would occur within these areas, and the park would provide for passive restoration of previously disturbed areas (e.g., Upper and Lower Rivers Campgrounds). These actions would have a local, long-term, negligible, beneficial impact on Segment 2 floodplains.

Curry Village & Campground. Actions to manage user capacities, land use, and facilities in this area would include a reduction in total units from 400 existing units to 355 units. Total lodging within this area would include 290 tent-style lodging units retained in Curry Village, 18 units retained at

Stoneman House, and 47 cabin-with-bath units retained in Curry Village. At Boys Town, Southside Drive would be re-routed and restored.

Removal of approximately 45 existing units would result in negligible reductions in impervious surfaces associated with existing facilities and access areas. Re-routing of Southside Drive would result in essentially no net change in total impervious surface area. Impervious surfaces can increase volumes of stormwater runoff and reduce hydrologic concentration time. Therefore, a local, long-term, negligible, beneficial impact to hydrology would result from these actions.

Removal of the existing units and rerouting/construction associated with Southside Drive could result in minimal and temporary release of debris, sediment, and other potential water quality pollutants into stormwater. The use of heavy construction related equipment, as warranted, would also disturb surface sediments, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants into stormwater. These activities would result in a local, short-term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

The existing and proposed facilities would be located outside of the 100-year floodplain and therefore would not interfere with floodplain characteristics or flood flows.

Camp 6 and Yosemite Village. Actions to manage user capacities, land use, and facilities within this area of Segment 2 primarily concern transportation improvements. Proposed projects would involve improvements to intersection function at Village Drive and Northside Drive near Camp 6; relocation and redevelopment of the existing overflow parking area west of Yosemite Lodge to provide 150 additional parking spaces; relocation of the Camp 6 day use parking area outside of the 10-year floodplain; and the rerouting of Northside Drive. The Camp 6/Village Center parking area would be increased to 550 units by redeveloping part of the current administrative footprint in that area. One hundred parking spaces would be added to the Yosemite Village parking area. The existing tour bus drop off area would be relocated to the Highland Court area, in order to provide 3 additional bus loading/unloading spaces. The Highland Court area is currently used for the placement of temporary housing in the existing parking lot, following the 1997 flood.

Installation of new parking areas and roadways would require the construction of new impervious surfaces. Net increases in impervious surface area would be largely offset by the removal of select existing parking facilities and roadways, as noted above, as well as improvements in drainage facilities associated with the new structures, and the addition of bioswales in parking areas. However, based on the anticipated increase in parking and road area, a net increase in impervious surfaces is anticipated. As noted elsewhere, impervious surfaces cause increased discharges of stormwater and shorten hydrologic concentration time. This would result in a local, long-term, minor, adverse impact on stormwater hydrology. Relocation of the bus drop-off area and additional bus loading and unloading spaces would not result in a change in impervious surfaces, because the affected areas are already impervious.

Demolition of existing parking areas and roadways slated for removal, as well as construction of new parking areas and roads and other activities discussed above, could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff.

Additionally, the use of heavy construction related equipment would also disturb surface sediments, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants. These activities would result in a local, short term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

The use of the proposed new parking areas would serve to consolidate existing parking activities into formalized areas, reducing reliance on informal parking areas. Therefore, the anticipated increase in formalized parking spaces is not expected to result in increased use, but would accommodate existing use that currently relies on other facilities. Similarly, moving the existing bus stop to a new location would not represent a new or increased intensity of use. Therefore, no net change in water quality pollutants related to parking lots is anticipated, because existing effects would be consolidated into formalized parking areas.

The existing Camp 6 day use parking area is located within the 10-year floodplain. Parking lots do not generally constitute major obstructions to flood flows, and so their presence within a floodplain is generally less obstructive than other vertical development; although minor effects, such as localized interference with flood flows, could still occur during a flooding event. A parking lot in the floodplain does, however, remove floodplain vegetation and soils. The rougher natural surfaces of vegetation and soils slow floodwaters, filter suspended sediment, and buffer the impacts of flooding. Therefore, removal of the existing facility to outside of the 10-year floodplain would reduce the frequency of inundation, and would reduce existing pressures on the existing floodplain area. Other facilities would not appreciably affect floodplain areas. These actions would result in a local, long-term, minor to moderate, beneficial impact with respect to flooding.

Yosemite Lodge and Camp 4. Actions to manage user capacities, land use, and facilities within this area of Segment 2 are limited to removal of the existing on-grade pedestrian crossing located west of the intersection of Northside Drive and Yosemite Lodge Drive. This action would be completed in order to alleviate pedestrian/vehicle conflicts. The crossing would be moved to west of the existing intersection.

The impervious surfaces associated with this crossing would be removed from their existing location, and moved west, to a new location. Therefore, this action is not expected to result in a noticeable increase or decrease in impervious surfaces or other features that would affect stormwater flows, and therefore would not affect on site hydrology.

Demolition of the existing pedestrian crossing, as well as construction of the proposed relocated crossing, could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. The use of heavy construction related equipment would also disturb surface sediments within affected areas, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants into stormwater. These activities would result in a local, short term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate

(see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

The facilities in question would be located outside of the existing floodplain, and therefore would not affect flooding.

Segment 2 Impact Summary: Actions to protect and enhance river values within Segment 2 would have local, long-term, minor to moderate, beneficial impacts on hydrology, water quality, and floodplains. Actions to manage user capacities, land use, and facilities would have local and segmentwide, long-term, negligible to minor, beneficial impacts on hydrology, water quality, and floodplains.

Segments 3 and 4: Merced Gorge and El Portal

Impacts of Actions to Protect and Enhance River Values

Hydrology. Oak protection, removal of fill, and decompaction of soils in the Odger's fuel storage area would promote infiltration in the area, but would not have a discernible effect on the hydrology of the Merced River, thus resulting in a local, long-term, negligible, beneficial impact on hydrology.

Water Quality. Parking restrictions in the Odger's fuel storage area would result in established vegetation that would be less likely to erode, thereby reducing fine sediment loads. This would not be expected to have a measurable effect on water quality and would result in a local, long-term, negligible, beneficial impact on water quality.

Impacts of Actions to Manage User Capacity, Land Use, and Facilities

Hydrology. Construction of new housing in the Rancheria Flatt area of El Portal would involve vegetation removal, soils compaction, and increased areas of impervious surfaces outside the 100-year floodplain. These actions would have a local, long-term, minor, adverse impact on hydrology.

Water Quality. Construction of new housing and parking lots, as described above, could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. Additionally, the use of heavy construction related equipment would also disturb surface sediments, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants into stormwater. These activities would result in a local, short-term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1, through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

Segments 3 & 4 Impact Summary: Actions to protect and enhance river values within Segment 4 would have local, long-term, negligible, beneficial impact on the river's hydrology and water quality. Actions to manage visitor capacity, land use, and facilities would have a long-term, minor, adverse impact on hydrology.

Segments 5, 6, 7, and 8: South Fork Merced River

Impacts of Actions to Protect and Enhance River Values

Hydrology. The removal and restoration of campsites either within the 100-year floodplain or in culturally sensitive areas, and removal of the Wawona Golf Course would result in reduced trampling, increased area of natural vegetative cover, and an increase in soil infiltration. Impervious surfaces would be reduced, leading to an increase in the infiltration capacity of the area, thereby restoring the hydrologic regime. This would be expected to have local and segmentwide, long-term, moderate, beneficial impacts on hydrology

Water Quality. The removal and restoration of campsites either within the 100-year floodplain or in culturally sensitive areas, and removal of the Wawona Golf Course would result in reduced trampling and greater cover of native vegetation that would be less likely to erode and would reduce stormwater runoff through improved infiltration. The work would require the use of heavy equipment, which could cause short-term, adverse impacts to water quality. With implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), such local impacts would be reduced to short-term, negligible to minor, and adverse. Over the long-term, the impacts on water quality would be segmentwide, minor, and beneficial.

Floodplains. The removal and restoration of campsites either within the 100-year floodplain or in culturally sensitive areas would increase connectivity between the South Fork Merced River and its floodplain in a detectable manner. This would result in a local, long-term, minor, beneficial impact on floodplains.

Biological Resource Actions. Along Segment 7 under Alternative 3, relocation of two stock use campground sites from sensitive biological resource areas to Wawona Stables would be the same as described for Alternative 2, and therefore would incur the same impacts as discussed for Alternative 2. Please refer to the discussion for Alternative 2.

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. The removal of facilities under Alternative 3 would reduce the amount of impervious surfaces within Segments 5, 6, 7, and 8, leading to a more natural hydrologic regime, though not to a measurable extent. This would result in a local, long-term, negligible, beneficial impact on hydrology.

Wawona. Removal of 27 campsites from areas located within 150 feet of the river would reduce existing effects of trampling on riverbank areas, and would support reduced erosion rates within the area. This would result in a local, long-term, minor, beneficial impact on water quality due to reduced erosion rates. Similarly, removal of 27 campsites from within the existing floodplain would result in a net reduction in floodplain area that is impacted by existing facilities. Removal of these sites would result in a local, long-term, negligible, beneficial impact on floodplains and flooding. Finally, removal of the existing facilities would involve minimal demolition related activities, which could include the use of heavy machinery, as well as other minor restoration activities. These construction activities would require implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as

appropriate (see Appendix C), which would ensure that potential water quality impacts would be local, short-term, negligible, and adverse.

Segments 5-8 Impact Summary: Actions to protect and enhance river values within Segments 5-8 would have local, long-term, negligible to minor, beneficial impacts on hydrology, water quality, and floodplains. Actions to manage user capacities, land use, and facilities would have local and segmentwide, long-term, negligible to minor, beneficial impacts on hydrology, water quality, and floodplains.

Summary of Impacts of Alternative 3: Dispersed Visitor Experiences and Extensive Riverbank Restoration

Hydrology. Actions associated with Alternative 3 would have long-term, moderate to major, beneficial impacts on hydrology. Restoration actions associated with Alternative 3 would decompact soil and restore meadow and riparian areas. Actions associated with the removal of impervious surfaces would increase infiltration and partially restore the natural hydrologic regime in a detectable manner. Actions associated with in-river restoration would add roughness and complexity to the Merced River, thereby restoring hydrologic processes in a detectable manner.

Water Quality. Actions associated with Alternative 3 would have long-term, minor, beneficial impacts on water quality. Restoration actions associated with Alternative 3 would restore denuded vegetation and limit informal trails, leading to a reduction in erosions. Actions associated with in-river restoration would help to stabilize eroded areas, thereby reducing fine sediment in a detectable manner. Construction activities associated with restoration have the potential to adversely affect water quality over the short term, but would be mitigated to a negligible level by instituting measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C).

Floodplains. Actions associated with Alternative 3 would have negligible to minor, beneficial and adverse, long-term impacts on floodplains. Restoration actions associated with Alternative 3 would reconnect the Merced River and its floodplain in a detectable manner. Actions associated with in-river restoration would add roughness and complexity to the Merced River, partially reconnecting the river to its floodplain and creating a long-term, minor, beneficial impact on 100-year floodplains.

Cumulative Impacts from Alternative 3: Dispersed Visitor Experiences and Extensive Riverbank Restoration

The cumulative impacts analysis for Alternative 3 reflects the historic timeframe for installation of the various past, present, and reasonably foreseeable future actions listed below. The spatial dimension for the cumulative impacts analysis encompasses the portion of the Merced River watershed that is located within the Park. The cumulatively considerable projects for Alternative 3 would be the same as those presented in Alternative 1.

Overall Cumulative Impact Common for Alternative 3: Dispersed Visitor Experiences and Extensive Riverbank Restoration

Under Alternative 3, removal of riprap, removal of three bridges and unnecessary infrastructure, restoration of meadow hydrology, and improvements to wastewater collection would result in increased alluvial processes, reconnection of the Merced River to its floodplain, and enhanced water quality. This would contribute to local, long-term, moderate to major, beneficial cumulative impacts on hydrology and floodplains, and a local, long-term, minor to moderate, beneficial cumulative impact on water quality.

Environmental Consequences of Alternative 4: Resource-based Visitor Experiences and Targeted Riverbank Restoration

Segment 1: Merced River Above Nevada Fall

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. Pack stock used for administrative purposes would no longer graze on meadow vegetation near the Merced Lake Ranger Station. All administrative pack stock passing through the area would instead be required to carry pellet feed. This would help protect meadow vegetation, which in turn would produce a more natural hydrologic regime. This would result in a local, long-term, negligible, beneficial impact on hydrology.

Overnight capacities for both Little Yosemite Valley and Merced Lake would be reduced under Alternative 4, thereby promoting dispersed camping. Concentrated camping areas would be converted to dispersed camping. This would reduce the potential for informal trails and vegetation trampling. In turn, this would lead to an increase in the ability of the soil to infiltrate runoff. This action would not be expected to create a measurable change in hydrology in the Merced River and would result in a local, long-term, negligible, beneficial impact on hydrology.

Water Quality. The reduction of overnight capacities for Little Yosemite Valley and Merced Lake would reduce the potential for informal trails and vegetation trampling. In turn, this would reduce erosion but would not be expected to cause detectible change in Merced River water quality. Thus, reduced overnight capacities would result in a local, long-term, negligible, beneficial impact on water quality.

Merced Lake High Sierra Camp. Under Alternative 4, the Merced Lake High Sierra Camp would be closed and the area restored to natural conditions, as designated wilderness.

With respect to hydrologic resources, removal of existing facilities would result in a negligible net reduction in impervious surfaces on site. This would provide a negligible benefit to hydrology, because impervious surfaces increase stormwater runoff, among other effects on hydrology. Total impervious surfaces removed would be less than half an acre. Therefore, potential impacts on hydrology associated with this action are considered to be local, long-term, negligible, and beneficial.

Removal of existing facilities and restoration to natural conditions could result in negligible disturbance during facility removal and the establishment of restored vegetation. These activities could generate very local and temporary increases in erosion and sedimentation in affected areas. However, these effects would be limited to the construction period, and would be minimal to negligible in extent. With implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), potential water quality related impacts would be a local, temporary, negligible adverse impact on water quality.

Removal of the High Sierra Camp and conversion to a temporary stock camp would lessen impacts on water quality, hydrology, and flooding as compared to those of Alternative 1 (No Action). Following construction, the area would experience reduced trampling, which could result in negligible reductions in erosion on site. Impervious surfaces would be reduced and no potential floodplain obstructions would be installed. The resulting impacts would be local, long-term, negligible, and beneficial.

Segment 1 Impact Summary: Actions to manage user capacities, land use, and facilities within Segment 1 would result in a local, long-term, negligible, beneficial impact on hydrology.

Segment 2: Yosemite Valley

Impacts of Actions to Protect and Enhance River Values

Hydrology. Under Alternative 4, the Sugar Pine and Ahwahnee bridges and associated berms would be removed and restored to natural conditions. The multi-use trail on Sugar Pine and Ahwahnee bridges would be rerouted along the north bank of the Merced River. This action would have an appreciable effect on streamflow dynamics, allowing natural processes to prevail. Backwaters, rapid scour, and excessive sediment deposition upstream and downstream of bridges would be reduced. The removal of hard points associated with these bridges would promote channel migration and partially restore natural channel evolution. This action would improve hydrology in a clearly detectable manner and result in a local, long–term, moderate to major, beneficial impact on hydrology.

The placement of large wood (including large trees with root wads) near Stoneman Bridge would add complexity by creating scour around the large wood area and deflecting flows. Depths would be deeper in the reduced area of the Merced River channel. This would have a slightly detectable impact on river dynamics, but would not be expected to have an overall effect on the character of the Merced River, thus resulting in a local, long-term, minor, beneficial impact on hydrology.

Under Alternative 4, all campsites and associated infrastructure within 150 feet of the Merced River would be removed and restored to natural conditions. This would include campsites at Backpackers Camp, North Pines Campground, Upper Pines and Lower Pines campground, Yellow Pines Campground, and tent-style lodging at Housekeeping Camp. Other facilities that would be removed from the 100-year floodplain include the select Yosemite Lodge infrastructure. Meadow restoration would take place at Ahwahnee, El Capitan, and Stoneman meadows.

Restoration actions would result in the restoration of approximately 194 acres of meadow, riparian, and other habitat types. The amount of impervious surface in restored areas would be reduced,

increasing infiltration of runoff and restoring a more natural hydrologic regime. Removing infrastructure, including road prisms and ditches, would reconnect surface and groundwater within each meadow. Replanting restored areas with native vegetation would restore the natural runoff regime. These actions would be expected to have a measurable effect on hydrology in the Merced River, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, long-term, moderate to major, beneficial impact on hydrology.

Under Alternative 4, river access would be more formalized, leading to a reduction in streambank erosion and soil compaction. Visitors would be directed to more stable Merced River access points throughout Segment 2, and areas of compacted soils would be decompacted and restored. This would improve bank stability at river access points, and restore natural runoff processes. This would be expected to have a measurable effect on hydrology in the river, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, long-term minor, beneficial impact on hydrology.

Water Quality. Under Alternative 4, the Sugar Pine and Ahwahnee bridges and associated berms would be removed and restored to natural conditions. The multi-use trail on Sugar Pine and Ahwahnee bridges would be rerouted along the north bank of the Merced River. These sites would have reduced scour and more stable riverbanks, thus reducing the amount of fine sediment in the river. This would not be expected to have a measurable effect on water quality and would result in a local, long-term, negligible, beneficial impact on water quality.

Under Alternative 4, all campsites and associated infrastructure within the 100-year floodplain would be removed and restored to natural conditions. This would include campsites at Backpackers Camp, North Pines Campground, Upper Pines and Lower Pines campgrounds, Yellow Pines Campground, and tent-style lodging at Housekeeping Camp. Other facilities that would be removed from the 100-year floodplain include the select Yosemite Lodge infrastructure. Meadow restoration would take place at Ahwahnee, El Capitan, and Stoneman meadows. Methods for restoration would include recontouring, ditch removal, and decompaction. Recontouring would involve use of a skid steer, loader, excavator, dozer, and dump truck to remove excavated material from the site. An excavator or dozer could be used to excavate depressions, cut-off channels, and oxbows. On steep riverbanks, an excavator or dozer could push soils and material down the slope of the bank to create a gentler slope, which would increase revegetation success. Whenever possible, native fill would be used from the restoration site. Where possible, ditches would be contoured and leveled using fill material already present in associated berms. Soil decompaction would involve breaking up soils either manually, by using special decompaction tools, or with heavy equipment that can support ripping tines, such as excavators, skid steer, and dozers. Small pockets of fill would at times be blended into the soil, as decompaction occurs, with an excavator or dozer with winged rippers. Earth-moving activities during construction have the potential to mobilize fine sediment, which would result in a local, short-term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce this impact to negligible. After construction, restored areas would result in established vegetation that would be less likely to erode, thereby reducing fine sediment loads. This would not be expected to have a measurable effect on water quality and would result in a local, long–term, negligible, beneficial impact on water quality.

Under Alternative 4, Merced River access would be more formalized, leading to a reduction in streambank erosion and soil compaction. Visitors would be directed to more stable river access points throughout Segment 2, and areas of compacted soils would be decompacted and restored. This would improve bank stability at river access points, reducing erosion, though not to a measurable extent. This would result in a local, long-term, negligible, beneficial impact on water quality.

Floodplains. Removal of the Sugar Pine and Ahwahnee bridges and associated berms would reduce constrictions in the Merced River and would reduce water surface elevations during floods, resulting in a local, long-term, minor, beneficial impact on floodplains.

Restoration. Restoration of areas within the 100-year floodplain, including locations at Backpackers Camp, North Pines Campground, Upper Pines and Lower Pines campgrounds, Yellow Pines Campground, former Upper River and Lower River campgrounds, Housekeeping Camp, and Yosemite Lodge. Meadow restoration would take place at Ahwahnee, El Capitan, and Stoneman meadows, which would increase connectivity between the Merced River and its floodplain in a detectable manner. This would result in a local, long-term, minor, beneficial impact on floodplains.

Biological Resource Actions. Proposed biological resource actions associated with Alternative 4 that would be deployed along Segment 2 include removal or realignment of Northside Drive and bike path would not occur, improve hydrologic connectivity along both sides of the road, and remove fill and replace with a boardwalk at Ahwahnee Meadow; restoration 1,335 feet of Southside Drive and road realignment at Stoneman Meadow, and application of engineering solutions to promote water flow at the Orchard Parking Lot, with installation of up to 275 feet of boardwalk at Curry Village; restoration of 16.5 acres of floodplain including decompaction of soils and removal of asphalt, former roads, and campsites, re-establishment of filled channels, placement of large box culverts under road to all water flow, close riparian zone to prevent trampling at former Upper and Lower Rivers Campground; restoration of 12 acres of riparian habitat at North Pines Campgrounds; designate access points using boardwalks and viewing platforms, restore informal trails at El Capitan meadow; restoration of 10.9 acres of riparian ecosystem at the site of the former Yosemite Lodge units and cabins (those that were damaged after the 1997 flood and subsequently removed), remove fill, decompact soils, and plant riparian plant species.

Rerouting and consolidation of trails, restoration of road areas and meadows, restoration of floodplain, decompaction, and removal of informal trails could contribute to increased stormwater infiltration capacity and increased storm event hydrologic concentration times. Restoration of riparian and floodplain vegetation would generally slow floodwaters in the vicinity of the restored area, more closely mimicking natural conditions, resulting in a local, long-term, minor, beneficial impact to hydrology and flooding.

Relocation and removal of facilities located in floodplain areas, including removal of existing fill, removal of campsites, removal of informal trails, relocation of paths, and other proposed facility realignments would reduce existing constraints on the natural floodplain of the river. Reductions in these constraints would reduce existing interference within the floodplain. Installation of large box culverts and restoration of filled channels would also support floodplain function Therefore, this is considered a segment-wide, long-term, minor, beneficial impact with respect to flooding.

Implementation of engineering solutions to promote water flow at the Orchard Parking Lot would alleviate existing stormwater/flood related constrictions at the parking lot. This would result in a local, long-term, minor, beneficial impact on flooding.

Construction of the proposed biological resources actions could result in temporary disturbance to surface sediments and vegetation. Disturbance would result primarily from the use of heavy machinery. Heavy machinery would be used for soil decompaction, removal and relocation of asphalt areas, recontouring of topography, rerouting of trails, removal of informal trails, and removal of other infrastructure as noted previously. Minimal additional disturbance could occur during restoration activities and boardwalk installation, due to localized disturbance. Additionally, construction related use of heavy machinery could result in accidental release of construction related fluids, oils, fuels, greases, hydraulic fluid, and other potential construction related water quality pollutants, during the construction process. Adhering to the proposed mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce these potential impacts to local, short-term, minor, and adverse.

Increases in riparian and floodplain vegetation associated with the proposed restoration activities, as noted above, would result in increased coverage of such vegetation along the river. Increases in riparian and floodplain vegetation coverage would result in reductions in sediment and other pollutant levels in stormwater that drains into the Merced River. Therefore, the proposed restoration activities would result in a segment-wide, long-term, negligible, beneficial impact on water quality.

Hydrologic/Geologic Resource Actions. Hydrologic/geologic resource actions that would occur under Alternative 4 along Segment 2 include movement of the unimproved parking area at Camp 6 north by approximately 150 feet away from the ordinary high water mark, and restore riparian habitat along the river; removal of two bridges including Sugar Pine Bridge and Ahwahnee Bridge and the associated road berms, including rerouting of trails and utilities, and redesign of affected roadways and intersections; placement of large wood, brush layering, and an engineered log jam so as to reduce the effects of Stoneman Bridge on hydrology and flooding characteristics of the river; install culverts along Northside Drive to improve drainage.

Stoneman Bridge, Sugar Pine Bridge, and Ahwahnee Bridge currently cause hydrologic constrictions along the Merced River. During moderate flow conditions, constrictions associated with these bridges interferes with natural hydrologic processes along the river, including reduction of channel migration, alteration of scour, and other hydrologic alterations. During high and flood flows, the bridges constrict flood flows, resulting in backup of flows behind the bridges, increases in flow velocity and scour in the vicinity of the bridges, and reduction in flows downstream of the bridges, in comparison to natural conditions. Therefore, removal of the Sugar Pine and Ahwahnee Bridges would alleviate these conditions in localized areas. Installation of the proposed large wood, brush layering, and engineered log jam would reduce the deleterious effects of Stoneman Bridge on the hydrology and flooding characteristics of the Merced River in its vicinity, but would not completely alleviate the existing constriction. Therefore, implementation of these actions would result in a local, long-term, moderate, beneficial impact on hydrology and flooding.

Installation of the proposed culverts along Northside Drive would reduce existing stormwater drainage issues in that area, thereby reducing localized flooding conditions during major storm events. This would result in a net improvement with respect to flooding, and is considered a local, long-term, minor, beneficial impact on flooding.

Moving the unimproved parking area at Camp 6 north and away from the ordinary high water mark of the river would result in the removal of existing structures that interfere with floodplain function. Removal of these structures would thereby reduce existing obstructions within the floodplain, and would thereby result in a net local, long-term, minor, beneficial impact on flooding.

Removal of the various trails, berms, roadways, and intersections associated with the proposed bridge removals and the Camp 6 actions would represent the removal of existing obstructions within the floodway corridor of the Merced River. Removal of these features would contribute to a return towards natural flood stage hydrologic processes in the vicinity of these existing features, by removing floodplain obstructions from the 10-year floodplain. Therefore, these proposed actions would result in a local, long-term, minor, beneficial impact on flooding.

With respect to water quality, during construction, removal of the two bridges and other infrastructure from the Merced River and its floodplain, placement of logjams and other infrastructure near Stoneman Bridge, and associated restoration activities, would result in temporary construction related impacts to water quality. These could include incidental releases of sediment into natural waterways and the Merced River. Additionally, the use of heavy construction equipment during bridge removal could result in accidental release of construction related fluids, oils, fuels, greases, hydraulic fluid, and other potential construction related water quality pollutants during the construction period. Adhering to the proposed mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce these potential impacts to local, temporary, minor, and adverse.

Increases in riparian and floodplain vegetation associated with the proposed restoration activities, as noted above, would result in increased coverage of such vegetation along the river. Increases in riparian and floodplain vegetation coverage would result in reductions in sediment and other pollutant levels in stormwater that drains into the Merced River. Therefore, the proposed restoration activities would result in a segment-wide, long-term, negligible, beneficial impact on water quality.

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. Under Alternative 4, visitor-serving facilities and overall use would be reduced, including in riverside areas, thereby decreasing trampling, informal trail development, and riverbank erosion. While number of campsites would increase, employee housing and overnight lodging would decrease. In addition, informal parking would also be reduced. These actions would have a net reduction in total impervious surface area, allowing soils and vegetation to recover, and lead to increased infiltration of runoff, reduced riverbank erosion, and increased streamflow dynamics. This would be expected to have a measurable effect on hydrology, but would not be expected to have an overall effect on the character of the Merced River, thus resulting in a segmentwide, long term, minor, beneficial impact on hydrology.

Temporary housing in the Lost Arrow parking lot would be removed and permanent housing constructed, resulting in no net change in impervious surface area. This action would not affect hydrology.

Removal of trails and formalizing picnic areas would increase infiltration of runoff, restore riparian vegetation, and restore a more natural hydrologic regime. Formalizing Merced River access points and trails would reduce vegetation trampling. This would be expected to have a measurable effect on hydrology in the river, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, long-term, minor, beneficial impact on hydrology.

Water Quality. Under Alternative 4, total visitation, residential and visitor serving facilities, and parking within the Valley would be reduced. These actions would reduce trampling of riparian vegetation, informal trail development, and riverbank erosion. Despite the increase in campsites, the overall reduction in facilities and informal parking would reduce impervious surface area, allow soils and vegetation to recover, and improve infiltration. With the number vehicles entering the Valley reduced, the concentration of vehicle-associated pollutants in stormwater runoff would also decrease. This would be expected to lead to a detectable reduction in fine sediment and pollutants, resulting in a segmentwide, long-term, minor, beneficial impact on water quality.

New parking areas located at the West of Yosemite Lodge parking and parking areas moved at Camp 6 would generate discharges of sediment and automobile related pollutants into stormwater. Release of these pollutants could result in negligible degradation of water quality downstream, and these actions constitute a local, long-term, negligible, adverse impact on water quality.

Removal of trails and formalizing picnic areas would restore riparian vegetation and reduce erosion. Formalizing Merced River access points and trails would also reduce vegetation trampling and help to stabilize riverbanks. This would be expected to result in a local, long-term, negligible, beneficial impact on water quality.

Floodplains. Under Alternative 4, existing development would be removed from the floodplain in several areas (see *Impacts of Actions to Protect and Enhance River Values*, above). The park would construct new campgrounds at the former Upper and Lower Rivers campgrounds, Upper Pines Campground, and install new RV camping facilities west of Yosemite Lodge. While these facilities would be constructed more than 150 feet from the river's ordinary high water mark, they would remain within the 100-year floodplain. The presence of such facilities would not be expected to substantially impact flood flows. Nonetheless, the presence of these campgrounds within the 100-year floodplain would make them susceptible to periodic flooding. The resulting floodplain impact would be local, long-term, negligible, and adverse.

Curry Village & Campground. Actions to manage user capacities, land use, and facilities in this area would include a reduction in total units from 400 existing units to 355 units. Total lodging within this area would consist of 290 tent-style lodging units retained in Curry Village, 18 units retained at Stoneman House, and 47 cabin-with-bath units retained in Curry Village. At Boys Town, Southside Drive would be re-routed and a 40-site campground would be constructed.

Removal of approximately 45 existing units and installation of new campgrounds would result in negligible increases in impervious surfaces associated with facilities and access areas. The re-routing of Southside Drive would result in essentially no net change in total impervious surface area. Impervious surfaces increase stormwater discharge volumes and shorten hydrologic concentration time. Therefore, a local, long-term, negligible, adverse impact to hydrology would result from these actions.

Removal of the existing units, installation of new units, and rerouting/construction associated with Southside Drive could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. The use of heavy construction related equipment, as warranted, would also disturb surface sediments, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants. These activities would result in a local, short term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

The existing and proposed facilities would be located outside of the 100-year floodplain and therefore would not interfere with floodplain characteristics or flood flows.

Camp 6 and Yosemite Village. Actions to manage user capacities, land use, and facilities within this area of Segment 2 primarily concern transportation improvements. Proposed projects would involve improvements to intersection function at Village Drive and Northside Drive near Camp 6, including construction of a pedestrian underpass to alleviate traffic congestion; installation of a three-way intersection at Sentinel Drive and the entrance to the parking area; relocation and redevelopment of the existing overflow parking area west of Yosemite Lodge to provide 150 additional parking spaces; and relocation of Camp 6 day use parking area north by 150 feet in order to facilitate riparian restoration (restoration actions evaluated above). The Camp 6/Village Center parking area would be increased to 750 units by redeveloping part of the current administrative footprint in that area. One hundred parking spaces would be added to the Yosemite Village parking area. The existing tour bus drop off area would be relocated to the Highland Court area, in order to provide 3 additional loading and unloading spaces. The Highland Court area is currently used for the placement of temporary housing in the existing parking lot, following the 1997 flood.

Installation of new parking areas, roadways, intersection, and the pedestrian underpass would require the construction of new impervious surfaces. Net increases in impervious surface area would be largely offset by the removal of select existing parking facilities and roadways, as noted above, as well as improvements in drainage facilities associated with the new structures, and the addition of bioswales in parking areas. However, based on the anticipated increase in parking and road area, a net increase in impervious surfaces is anticipated. As noted elsewhere, impervious surfaces cause increased stormwater discharge and shorten hydrologic concentration time. This would result in a local, long-term, minor, adverse impact on stormwater hydrology. Relocation of the bus drop-off area and additional bus loading and unloading spaces would not result in a change in impervious surfaces, because the affected areas are already impervious.

Demolition of existing parking areas and roadways slated for removal, as well as construction of new parking areas, roads, and the pedestrian underpass and other activities discussed above, could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. Additionally, the use of heavy construction related equipment would also disturb surface sediments, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants. These activities would result in a local, short term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

The use of the proposed new parking areas would serve to consolidate existing parking activities into formalized areas, reducing reliance on informal parking areas. Therefore, the anticipated increase in formalized parking spaces is not expected to result in increased use, but would accommodate existing use that currently relies on other facilities. Similarly, moving the existing bus stop to a new location would not represent a new or increased intensity of use. Therefore, no net change in water quality pollutants related to parking lots is anticipated, because existing effects would be consolidated into formalized parking areas.

The existing Camp 6 day use parking area is located within the 10-year floodplain. Parking lots do not generally constitute major obstructions to flood flows, and so their presence within a floodplain is generally less obstructive than other vertical development; although minor effects, such as localized interference with flood flows, could still occur during a flooding event. A parking lot in the floodplain does, however, remove floodplain vegetation and soils. This rougher natural surface slows floodwaters, filters suspended sediment, and buffers the impacts of flooding. Moving the existing facility by up to 150 feet could result in a negligible reduction in the area of parking lot that is located within the 10-year floodplain. However, the parking lot would remain within the 100-year floodplain and therefore continue to have a local, long-term, minor, adverse impact with respect to flooding.

Yosemite Lodge and Camp 4. Actions to manage user capacities, land use, and facilities within this area of Segment 2 are limited to the replacement of the existing on-grade pedestrian crossing located west of the intersection of Northside Drive and Yosemite Lodge Drive with a pedestrian underpass. This action would be completed in order to alleviate pedestrian/vehicle conflicts.

Installation of an underpass would result in a slight expansion of the area of impervious facilities located on site, as compared to existing conditions. Because impervious surfaces increase stormwater runoff and peak runoff flows, the anticipated net increase in impervious surfaces would result in a local, long-term, negligible, adverse impact on hydrology.

Construction of the proposed underpass, could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. The use of heavy excavation and construction related equipment would also disturb surface sediments within affected areas, could require stockpiling of spoils, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants. These activities would result in a local, short term, minor, adverse impact on water quality. Implementation of mitigation

measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

The facilities in question would be located outside of the existing floodplain, and therefore would not affect flooding.

Segment 2 Impact Summary: Actions to protect and enhance river values within Segment 2 would have local, long-term, minor to moderate, beneficial impacts on hydrology, water quality, and floodplains. Actions to manage user capacities, land use, and facilities would have local and segmentwide, long-term, negligible to minor, beneficial impacts on hydrology and water quality, and a local, long-term, negligible, adverse impact on floodplains.

Segments 3 and 4: Merced Gorge and El Portal

Impacts of Actions to Protect and Enhance River Values

Hydrology. Oak protection, removal of fill, and decompaction of soils in the Odger's fuel storage area would promote infiltration in the area, but would not have a discernible effect on the hydrology of the river, thus resulting in a local, long-term, negligible, beneficial impact on hydrology.

Water Quality. Parking restrictions in the Odger's fuel storage area would result in established vegetation that would be less likely to erode, thereby reducing fine sediment loads. This would not be expected to have a measurable effect on water quality and would result in a local, long–term, negligible, beneficial impact on water quality.

Impacts of Actions to Manage User Capacity, Land Use, and Facilities

Hydrology. Construction of new housing in the Rancheria Flatt area of El Portal would involve vegetation removal, soils compaction, and increased areas of impervious surfaces outside the 100-year floodplain. These actions would have a local, long-term, minor, adverse impact on hydrology.

Water Quality. Construction of new housing and parking lots, as described above, could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. Additionally, the use of heavy construction related equipment would also disturb surface sediments, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants into stormwater. These activities would result in a local, short-term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

Segments 3 & 4 Impact Summary: Actions to protect and enhance river values within Segment 4 would have local, long-term, negligible, beneficial impact on the river's hydrology and water quality. Actions to manage visitor capacity, land use, and facilities would have a long-term, minor, adverse impact on hydrology.

Segments 5, 6, 7, and 8: South Fork Merced River

Impacts of Actions to Protect and Enhance River Values

Hydrology. The removal and restoration of campsites either within the 100-year floodplain or in culturally sensitive areas would result in a decrease of trampling and an increase in soil infiltration. Impervious surfaces would be reduced, leading to an increase in the infiltration capacity of the area, thereby restoring the hydrologic regime. This would be expected to have a measurable effect on hydrology in the South Fork Merced River, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, long-term, minor, beneficial impact on hydrology.

Water Quality. The removal and restoration of campsites either within the 100-year floodplain or in culturally sensitive areas would result in reduced trampling and established vegetation that would be less likely to erode, thereby reducing fine sediment loads. This would not be expected to have a measurable effect on water quality and would result in a local, long-term, negligible, beneficial impact on water quality.

Floodplains. The removal and restoration of campsites either within the 100-year floodplain or in culturally sensitive areas would increase connectivity between the South Fork Merced River and its floodplain in a detectable manner. This would result in a local, long-term, minor, beneficial impact on floodplains.

Biological Resource Actions. Along Segment 7 under Alternative 4, relocation of two stock use campground sites from sensitive biological resource areas to Wawona Stables would be the same as described for Alternative 2, and therefore would incur the same impacts as discussed for Alternative 2. Please refer to the discussion for Alternative 2.

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. The removal of facilities under Alternative 4 would reduce the amount of impervious surfaces within the Segments 5, 6, 7, and 8, thereby leading to a more natural hydrologic regime, though not to a measurable extent. This would result in a local, long-term, negligible, beneficial impact on hydrology.

Wawona. Removal of 27 campsites from areas located within 150 feet of the river would reduce existing effects of trampling on riverbank areas, and would support reduced erosion rates within the area. This would result in a local, long-term, minor, beneficial impact on water quality due to reduced erosion rates. Similarly, removal of 27 campsites from within the existing floodplain would result in a net reduction in floodplain area that is impacted by existing facilities. Removal of these sites would result in a local, long-term, negligible, beneficial impact on floodplains and flooding. Finally, removal of the existing facilities would involve minimal demolition related activities, which could include the use of heavy machinery, as well as other minor restoration activities. These construction activities would require implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), which would ensure that potential water quality impacts would be local, short-term, negligible, and adverse.

Segments 5-8 Impact Summary: Actions to protect and enhance river values within Segments 5-8 would have local, long-term, negligible to minor, beneficial impacts on hydrology, water quality, and floodplains. Actions to manage user capacities, land use, and facilities would have local and segmentwide, long-term, negligible to minor, beneficial impacts on hydrology, water quality, and floodplains.

Summary of Impacts from Alternative 4: Resource-based Visitor Experiences and Targeted Riverbank Restoration

Hydrology. Actions associated with Alternative 4 would have long-term, minor to moderate, beneficial impacts on hydrology. Restoration actions associated with Alternative 4 would decompact soil and restore meadow and riparian areas. Actions associated with the removal of impervious surfaces would increase infiltration and partially restore the natural hydrologic regime in a detectable manner. Actions associated with in-river restoration would add roughness and complexity to the Merced River, thereby restoring hydrologic processes in a detectable manner.

Water Quality. Actions associated with Alternative 4 would have long-term, minor, beneficial impacts on water quality. Restoration actions associated with Alternatives 4 would restore denuded vegetation and limit informal trails, leading to a reduction in erosions. Actions associated with in-river restoration would help to stabilize eroded areas, thereby reducing fine sediment in a detectable manner. Construction activities associated with restoration have the potential to adversely affect water quality over the short term, but would be mitigated to a negligible level by instituting measure MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C).

Floodplains. Actions associated with Alternative 4 would have long-term, negligible to minor, beneficial and adverse impacts on floodplains. Restoration actions associated with Alternative 4 would reconnect the Merced River and its floodplain in a detectable manner. Actions associated with in-river restoration would add roughness and complexity to the river, partially reconnecting the river to its floodplain, and creating a long-term, negligible, beneficial impact on 100-year floodplains.

Cumulative Impacts from Alternative 4: Resource-based Visitor Experiences and Targeted Riverbank Restoration

The cumulative impacts analysis for Alternative 2 reflects the historic timeframe for installation of the various past, present, and reasonably foreseeable future actions listed below. The spatial dimension for the cumulative impacts analysis encompasses the portion of the Merced River watershed that is located within the park. The cumulatively considerable projects for Alternative 2 would be the same as those presented in Alternative 1.

Overall Cumulative Impact Common for Alternative 4: Resource-based Visitor Experiences and Targeted Riverbank Restoration

Under this alternative, removal of riprap, removal of two bridges and unnecessary infrastructure, restoration of meadow hydrology, and improvements to wastewater collection would result in increased alluvial processes, reconnection of the Merced River to its floodplain, and enhanced water

quality. This would contribute to local, long-term, moderate, beneficial cumulative impacts on hydrology and floodplains, and local, long-term, minor to moderate, beneficial impacts on water quality.

Environmental Consequences of Alternative 5: Enhanced Visitor Experiences and Essential Riverbank Restoration

Segment 1: Merced River Above Nevada Fall

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. Pack stock used for administrative purposes would graze on meadow vegetation near the Merced Lake Ranger Station in accordance with established grazing capacities. This would help protect meadow vegetation, which in turn would produce a more natural hydrologic regime. This would result in a local, long-term, negligible, beneficial impact on hydrology.

The reduction in capacity at Merced Lake High Sierra Camp would slightly reduce the amount of localized vegetation trampling, leading to an increase in the ability of the soil to infiltrate runoff. This action would not be expected to create a measurable change in hydrology in the Merced River and would result in a local, long-term, negligible, beneficial impact on hydrology.

Water Quality. The reduction in capacity at Merced Lake High Sierra Camp would slightly reduce the amount of localized vegetation trampling, leading to a decrease in erosion. This action would not be expected to create a measurable change in hydrology in the Merced River and would result in a local, long-term, negligible, beneficial impact on water quality.

Merced Lake High Sierra Camp. Under alternative 5, the Merced Lake High Sierra Camp would be reduced in size to 11 units (42 beds), and existing flush toilets would be replaced with composting toilets.

With respect to hydrologic resources, removal of select existing facilities would result in a negligible net reduction in impervious surfaces on site. This would provide a negligible benefit to hydrology, because impervious surfaces prevent the natural infiltration of stormwater during storm events, resulting in increased runoff and other effects on stormwater hydrology. Total impervious surfaces removed would be less than one quarter of an acre. Therefore, potential impacts on hydrology associated with this action are considered to be local, long-term, negligible, and beneficial.

Removal of existing facilities and restoration of the area to natural conditions could result in negligible disturbance during facility removal. These activities could generate very localized and temporary increases in erosion and sedimentation in affected areas. However, these effects would be limited to the construction period, and would be minimal to negligible in extent. With implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), potential water quality related impacts would be a local, temporary, negligible, and adverse.

Removal of 11 High Sierra Camp units would lessen impacts on water quality, hydrology, and flooding as compared to those of Alternative 1 (No Action). Impervious surfaces would be reduced, as would potential sources of water quality pollutants, and no potential floodplain obstructions would be installed. The resulting impacts would be local, long-term, negligible, and beneficial.

Segment 1 Impact Summary: Actions to manage user capacities, land use, and facilities within Segment 1 would result in a local, short-term and long-term, negligible, beneficial impact on hydrology.

Segment 2: Yosemite Valley

Impacts of Actions to Protect and Enhance River Values

Hydrology. Under Alternative 5, the Sugar Pine Bridge would be removed and restored to natural conditions. This action would have an appreciable effect on streamflow dynamics, allowing natural processes to prevail. Backwaters, rapid scour, and excessive sediment deposition upstream and downstream of bridges would be reduced. The removal of hard points associated with these bridges would promote channel migration and partially restore natural channel evolution. This action would improve hydrology in a clearly detectable manner and result in a local, long-term, moderate to major, beneficial impact on hydrology.

The placement of large wood and constructed logjams (including large trees with root wads) to mitigate the effects of the Stoneman and Ahwahnee bridges would add complexity by creating scour around the large wood area and deflecting flows. Depths would be deeper in the reduced area of the Merced River channel. This would have a slightly detectable impact on river dynamics, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, long–term, minor, beneficial impact on hydrology.

Under Alternative 5, all campsites and associated infrastructure within 100 feet of the ordinary high-water mark of the Merced River would be removed and restored to natural conditions. This would include campsites at Backpackers Camp, North Pines Campground, Upper Pines and Lower Pines campgrounds, Yellow Pines Campground, and tent-style lodging units at Housekeeping Camp. Meadow restoration would take place at Ahwahnee, El Capitan, and Stoneman meadows. Restoration actions would result in the restoration of approximately 182 acres of meadow, riparian, and other habitat types. The amount of impervious surface in restored areas would be reduced, increasing infiltration of runoff and restoring a more natural hydrologic regime. Removing infrastructure, including road prisms and ditches, would reconnect surface and groundwater within each meadow. Replanting restored areas with native vegetation would restore the natural runoff regime. These actions would be expected to have a measurable effect on hydrology in the Merced River, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, moderate to major, long-term, beneficial impact on hydrology.

Under Alternative 5, river access would be more formalized, leading to a reduction in streambank erosion and soil compaction. Visitors would be directed to more stable Merced River access points throughout the segment, and areas of compacted soils would be decompacted and restored. These

actions would improve bank stability at river access points, and restore natural runoff processes. This would be expected to have a measurable effect on hydrology in the river, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, long-term, minor, beneficial impact on hydrology.

Water Quality. Under Alternative 5, the Sugar Pine Bridge would be removed and restored to natural conditions. The multi-use trail on Sugar Pine and Ahwahnee bridges would be rerouted along the north bank of the Merced River. These sites would have reduced scour and more stable riverbanks, thus reducing the amount of fine sediment in the river. This would not be expected to have a measurable effect on water quality and would result in a local, long–term, negligible, beneficial impact on water quality.

Under Alternative 5, all campsites and associated infrastructure within 100 feet of the ordinary high-water mark of the Merced River would be removed and restored to natural conditions. This would include campsites at Backpackers Camp, North Pines Campground, Upper Pines and Lower Pines campgrounds, Yellow Pines Campground, and tent-style lodging units at Housekeeping Camp. Meadow restoration would take place at Ahwahnee, El Capitan, and Stoneman meadows. Methods for restoration would include recontouring, ditch removal, and decompaction. Recontouring would involve use of a skid steer, loader, excavator, dozer, and dump truck to remove excavated material from the site. An excavator or dozer could be used to excavate depressions, cut-off channels, and oxbows. On steep riverbanks, an excavator or dozer could push soils and material down the slope of the bank to create a gentler slope, which would increase revegetation success. Whenever possible, native fill would be used from the restoration site. Where possible, ditches would be contoured and leveled using fill material already present in associated berms. Soil decompaction would involve breaking up soils either manually, by using special decompaction tools, or with heavy equipment that can support ripping tines, such as excavators, skid steer, and dozers. Small pockets of fill would at times be blended into the soil as decompaction occurs, using an excavator or dozer with winged rippers. Earth-moving activities during construction have the potential to mobilize fine sediment, which would result in a local, short-term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce this impact to negligible. After construction, restored areas would result in established vegetation that would be less likely to erode, thereby reducing fine sediment loads. This would not be expected to have a measurable effect on water quality and would result in a local, long-term, negligible, beneficial impact on water quality.

Under Alternative 5, Merced River access would be more formalized, leading to a reduction in streambank erosion and soil compaction. Visitors would be directed to more stable river access points throughout Segment 2, and areas of compacted soils would be decompacted and restored. This would improve bank stability at Merced River access points, thus reducing erosion, though not to a measurable extent. This would result in a local, long-term, negligible, beneficial impact on water quality.

Floodplains. Removal of the Sugar Pine Bridge would reduce constrictions in the Merced River and would reduce water surface elevations during floods, resulting in a local, long-term, minor, beneficial impact on floodplains.

The placement of large wood and constructed logjams (including large trees with root wads) at the bases of Ahwahnee and Stoneman bridges would increase roughness in the Merced River, allowing it to reconnect to its floodplain during moderate flows, though not in a manner that would have a substantial effect on the character of the river. This would result in a local, long-term, minor, beneficial impact on floodplains. During higher flows, this action could increase 100-year water surface elevations, though in a manner that would be minimally detectable, and would result in a local, long–term, minor, beneficial impact on floodplains and infrastructure located in floodplains.

Restoration of areas within the 150-foot Merced River buffer, including locations at Backpackers Camp, North Pines Campground, Upper Pines and Lower Pines campgrounds, Yellow Pines Campground, former Upper River and Lower River campgrounds, Housekeeping Camp, the Curry Orchard parking lot, and Yosemite Lodge. Meadow restoration would take place at Ahwahnee, El Capitan, and Stoneman meadows, which would increase connectivity between the Merced River and its floodplain in a detectable manner. This would result in a local, long–term, minor, beneficial impact on floodplains.

Biological Resource Actions. Proposed biological resource actions associated with Alternative 5 that would be deployed along Segment 2 include replacement of a trail with boardwalk, removal or realignment of Northside Drive and bike path would not occur, improve hydrologic connectivity along both sides of the road by installing culverts, and remove fill and replace with a boardwalk at Ahwahnee Meadow; and application of redesign and engineering solutions to promote water flow at the Orchard Parking Lot, with installation of up to 275 feet of boardwalk at Curry Village; restoration of 16.5 acres of floodplain including decompaction of soils and removal of asphalt, former roads, and campsites, re-establishment of filled channels, placement of large box culverts under road to all water flow, close riparian zone to prevent trampling at former Upper and Lower Rivers Campground; removal of all campsites and infrastructure within a 100 foot buffer of the river along Valley campgrounds with restoration of 6.5 acres of riparian habitat; designate access points using boardwalks and viewing platforms, restore informal trails at El Capitan meadow; restoration of 10.9 acres of riparian ecosystem at the site of the former Yosemite Lodge units and cabins (those that were damaged after the 1997 flood and subsequently removed), remove fill, decompact soils, and plant riparian plant species.

Rerouting and consolidation of trails, restoration of road areas and meadows, restoration of floodplain, decompaction, and removal of informal trails could contribute to increased stormwater infiltration capacity and increased storm event hydrologic concentration times. Restoration of riparian and floodplain vegetation would generally slow floodwaters in the vicinity of the restored area, more closely mimicking natural conditions, resulting in a local, long-term, minor, beneficial impact to hydrology and flooding.

Relocation and removal of facilities located in floodplain areas, including removal of existing fill, removal of campsites, removal of informal trails, relocation of paths, and other proposed facility realignments would reduce existing constraints on the natural floodplain of the river. Reductions in these constraints would reduce existing interference within the floodplain. Installation of culverts would also support floodplain function and minimize ponding in inappropriate areas. Therefore, this is considered a segment-wide, long-term, minor, beneficial impact with respect to flooding.

Implementation of engineering solutions to promote water flow at the Orchard Parking Lot would alleviate existing stormwater/flood related constrictions at the parking lot. This would result in a local, long-term, minor, beneficial impact on flooding.

Construction of the proposed biological resources actions could result in temporary disturbance to surface sediments and vegetation. Disturbance would result primarily from the use of heavy machinery. Heavy machinery would be used for soil decompaction, removal and relocation of asphalt areas, recontouring of topography, rerouting of trails, removal of informal trails, and removal of other infrastructure as noted previously. Minimal additional disturbance could occur during restoration activities and boardwalk installation, due to localized disturbance. Additionally, construction related use of heavy machinery could result in accidental release of construction related fluids, oils, fuels, greases, hydraulic fluid, and other potential construction related water quality pollutants, during the construction process. Adhering to the proposed mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce these potential impacts to local, short-term, minor, and adverse.

Increases in riparian and floodplain vegetation associated with the proposed restoration activities, as noted above, would result in increased coverage of such vegetation along the river. Increases in riparian and floodplain vegetation coverage would result in reductions in sediment and other pollutant levels in stormwater that drains into the Merced River. Therefore, the proposed restoration activities would result in a segment-wide, long-term, negligible, beneficial impact on water quality.

Hydrologic/Geologic Resource Actions. Hydrologic/geologic resource actions that would occur under Alternative 5 along Segment 2 include movement of the unimproved parking area at Camp 6 north by approximately 150 feet away from the ordinary high water mark and restoration of riparian habitat along the river; removal of the Sugar Pine Bridge and berm, at Ahwahnee Bridge, connection of a trail and small bridge over the cut-off channel, and rerouting of trails to the north bank of the river; placement of large wood, brush layering, and an engineered log jam so as to reduce the effects of Stoneman Bridge on hydrology and flooding characteristics of the river; install culverts along Northside Drive to improve drainage.

Stoneman Bridge, Sugar Pine Bridge, and Ahwahnee Bridge currently cause hydrologic constrictions along the Merced River. During moderate flow conditions, constrictions associated with these bridges interferes with natural hydrologic processes along the river, including reduction of channel migration, alteration of scour, and other hydrologic alterations. During high and flood flows, the bridges constrict flood flows, resulting in backup of flows behind the bridges, increases in flow velocity and scour in the vicinity of the bridges, and reduction in flows downstream of the bridges, in comparison to natural conditions. Therefore, removal of Sugar Pine Bridge would alleviate these conditions in localized areas. Trail connections and realignments at Ahwahnee Bridge would alleviate existing interference that these structure exhibit within the Merced River, but would not directly address constriction associated with Ahwahnee Bridge. Installation of the proposed large wood, brush layering, and engineered log jam would reduce the deleterious effects of Stoneman Bridge on the hydrology and flooding characteristics of the Merced River in its vicinity, but would not completely alleviate the existing constriction. Therefore, implementation of these actions would result in a local, long-term, moderate, beneficial impact on hydrology and flooding.

Installation of the proposed culverts along Northside Drive would reduce existing stormwater drainage issues in that area, thereby reducing localized flooding conditions during major storm events. This would result in a net improvement with respect to flooding, and is considered a local, long-term, minor, beneficial impact on flooding.

Moving the unimproved parking area at Camp 6 north and away from the ordinary high water mark of the river would result in the removal of existing structures that interfere with floodplain function. Removal of these structures would thereby reduce existing obstructions within the floodplain, and would thereby result in a net local, long-term, minor, beneficial impact on flooding.

Removal of the various trails, berms, roadways, and intersections associated with the proposed bridge removals and the Camp 6 actions would represent the removal of existing obstructions within the floodway corridor of the Merced River. Removal of these features would contribute to a return towards natural flood stage hydrologic processes in the vicinity of these existing features, by removing floodplain obstructions from the 10-year floodplain. Therefore, these proposed actions would result in a local, long-term, minor, beneficial impact on flooding.

With respect to water quality, during construction, removal of one bridges and other infrastructure from the Merced River and its floodplain, placement of logjams and other infrastructure near Stoneman Bridge, trail realignments and connections, and associated restoration activities, would result in temporary construction related impacts to water quality. These could include incidental releases of sediment into natural waterways and the Merced River. Additionally, the use of heavy construction equipment during bridge removal could result in accidental release of construction related fluids, oils, fuels, greases, hydraulic fluid, and other potential construction related water quality pollutants during the construction period. Adhering to the proposed mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce these potential impacts to local, temporary, minor, and adverse.

Increases in riparian and floodplain vegetation associated with the proposed restoration activities, as noted above, would result in increased coverage of such vegetation along the river. Increases in riparian and floodplain vegetation coverage would result in reductions in sediment and other pollutant levels in stormwater that drains into the Merced River. Therefore, the proposed restoration activities would result in a segment-wide, long-term, negligible, beneficial impact on water quality.

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. Under Alternative 5, overall visitor use would be slightly reduced, including in riverside areas, thereby decreasing trampling, informal trail development, and riverbank erosion. While number of campsites and lodging units would increase, employee housing would decrease. In addition, informal parking would also be reduced. These actions would cause a marginal reduction in total impervious surface area, allowing soils and vegetation to recover, and lead to increased infiltration of runoff, reduced riverbank erosion, and increased streamflow dynamics. This would be expected to have a measurable effect on hydrology, but would not be expected to have an overall effect on the character of the Merced River thus resulting in a segmentwide, long–term, beneficial, minor impact on hydrology.

Temporary housing in the Lost Arrow parking lot would be removed and permanent housing constructed, resulting in no net change in impervious surface area. This action would not affect hydrology.

Removal of trails and formalizing picnic areas would increase infiltration of runoff, restore riparian vegetation, and restore a more natural hydrologic regime. Formalizing Merced River access points and trails would reduce vegetation trampling. This would be expected to have a measurable effect on hydrology in the river, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, long–term, minor, beneficial impact on hydrology.

Water Quality. Under Alternative 5, total visitation and residential development would be reduced, while parking, camping, and lodging facilities would be increased. Overall, these actions would reduce trampling of riparian vegetation, informal trail development, and riverbank erosion. Removal of housing and informal parking would slightly reduce impervious surface area, allow soils and vegetation to recover, and improve infiltration. With the number vehicles entering the Valley slightly increased, potential for vehicle-associated pollutants to be picked up by stormwater runoff would also increase. The net effect of these actions would be a detectable reduction in fine sediment and pollutants entering the Merced River, resulting in a segmentwide, long-term, minor, beneficial impact on water quality.

New/expanded parking areas west of Yosemite Lodge and Camp 6 would generate discharges of sediment and automobile related pollutants into stormwater. Release of these pollutants could result in minor degradation of water quality downstream, and these actions constitute a local, long-term, minor, adverse impact on water quality.

Removal of trails and formalizing picnic areas would restore riparian vegetation and reduce erosion. Formalizing Merced River access points and trails would also reduce vegetation trampling and help to stabilize riverbanks. This would be expected to result in a local, long-term, negligible, beneficial impact on water quality.

Floodplains. Under Alternative 5, existing development would be removed from the floodplain in several areas (see *Impacts of Actions to Protect and Enhance River Values*, above). The park would construct new campgrounds at the former Upper River and Upper Pines campgrounds, while allowing Lower River Campground to passively restore. New campground facilities would be constructed more than 150 feet from the river's ordinary high water mark; however, they would remain within the 100-year floodplain. The presence of such facilities would not be expected to substantially impact flood flows. Nonetheless, the presence of new campgrounds within the 100-year floodplain would make them susceptible to periodic flooding. The resulting floodplain impact would be local, long-term, negligible, and adverse.

Curry Village & Campground. Actions to manage user capacities, land use, and facilities in this area would include an increase in total units from 400 existing units to 453 units. Total lodging units would consist of 290 tent-style lodging units retained in Curry Village, 98 newly constructed hard-sided units in Boys Town, 18 units retained at Stoneman House, and 47 cabin-with-bath units retained in Curry Village.

Installation of the new units in Boys Town would require the addition of new impervious surfaces, and a net increase in total impervious surface area would be anticipated within this area. As noted

elsewhere, impervious surfaces increase stormwater runoff and shorten hydrologic concentration time. New impervious surfaces would be limited to facility footprints, and some additional access areas. Because new impervious surface areas would be limited in extent, these actions would result in a local, long-term, negligible, adverse impact on stormwater hydrology.

Construction of the proposed new units could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. The use of heavy construction equipment would also disturb surface sediments, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants. These activities would result in a local, short term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

The existing and proposed facilities would be located outside of the 100-year floodplain and therefore would not interfere with floodplain characteristics or flood flows.

Camp 6 and Yosemite Village. Actions to manage user capacities, land use, and facilities within this area of Segment 2 primarily concern transportation improvements. Proposed projects would involve improvements to intersection function at Village Drive and Northside Drive near Camp 6, including a traffic circle to alleviate traffic congestion; realignment of Northside Drive to the south of the Yosemite Village Day-Use Parking Area; consolidation of parking north of the road; redevelopment of the existing overflow parking area west of Yosemite Lodge to provide 300 additional parking spaces; relocation of Camp 6 day use parking area north by 150 feet in order to facilitate riparian restoration (restoration actions evaluated above); and installation of a three-way intersection at Sentinel Drive and the entrance to the parking area. The Camp 6/Village Center parking area would be increased to 750 units by redeveloping part of the current administrative footprint in that area. One hundred parking spaces would be added to the Yosemite Village parking area. The existing tour bus drop off area would replace temporary housing at Highland Court.

Installation of new parking areas, roadways, traffic circle, intersections, and realignment of roadways would require the construction of new impervious surfaces. Net increases in impervious surface area would be largely offset by the removal of select existing parking facilities and roadways, as noted above, as well as improvements in drainage facilities associated with the new structures, and the addition of bioswales in parking areas. However, based on the anticipated increase in parking and road area, a net increase in impervious surfaces is anticipated. As noted elsewhere, impervious surfaces increase stormwater runoff and a shorten hydrologic concentration time. The proposed actions would therefore result in a local, long-term, minor, adverse impact on stormwater hydrology. Relocation of the bus drop off area and additional bus loading and unloading spaces would not result in a change in impervious surfaces, because the affected areas are already impervious.

Demolition of existing parking areas and roadways slated for removal, as well as construction of new parking areas, roads, and the pedestrian underpass/ other activities discussed above, could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. Additionally, the use of heavy construction related equipment would also disturb

surface sediments, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants. These activities would result in a local, short term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

The use of the proposed new parking areas would serve to consolidate existing parking activities into formalized areas, reducing reliance on informal parking areas. Therefore, the anticipated increase in formalized parking spaces is not expected to result in increased use, but would accommodate existing use that currently relies on other facilities. Similarly, moving the existing bus stop to a new location would not represent a new or increased intensity of use. Therefore, no net change in water quality pollutants related to parking lots would be anticipated, because existing effects would be consolidated into formalized parking areas.

The existing Camp 6 day use parking area is located within the 10-year floodplain. Parking lots do not generally constitute major obstructions to flood flows, and so their presence within a floodplain is generally less obstructive than other vertical development; although minor effects, such as localized interference with flood flows, could still occur during a flooding event. A parking lot in the floodplain does, however, remove floodplain vegetation and soils. This rougher natural surface slows floodwaters, filters suspended sediment, and buffers the impacts of flooding. Moving the existing facility by up to 150 feet could result in a negligible reduction in the area of parking lot that is located within the 10-year floodplain. However, the parking lot would remain within the 100-year floodplain and therefore continue to have a local, long-term, minor, adverse impact with respect to flooding.

Yosemite Lodge and Camp 4. Actions to manage user capacities, land use, and facilities within this area of Segment 2 are limited to the replacement of the existing on-grade pedestrian crossing located west of the intersection of Northside Drive and Yosemite Lodge Drive with a pedestrian underpass. This action would be completed in order to alleviate pedestrian/vehicle conflicts.

Installation of an underpass would result in a slight expansion of the area of impervious facilities located on site, as compared with that of existing conditions. Because impervious surfaces increase stormwater runoff and peak runoff flows, the anticipated net increase in impervious surfaces would result in a local, long-term, negligible, adverse impact on hydrology.

Construction of the proposed underpass could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. The use of heavy excavation and construction related equipment would also disturb surface sediments within affected areas, could require stockpiling of spoils, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants into stormwater. These activities would result in a local, short term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

The facilities in question would be located outside of the existing floodplain, and therefore would not affect flooding.

Segment 2 Impact Summary: Actions to protect and enhance river values within Segment 2 would have local, long-term, minor to moderate, beneficial impacts on hydrology, water quality, and floodplains. Actions to manage user capacities, land use, and facilities would have local and segmentwide, long-term, negligible, beneficial impacts on hydrology and water quality, and a local, long-term, negligible, adverse impact on floodplains.

Segments 3 and 4: Merced Gorge and El Portal

Impacts of Actions to Protect and Enhance River Values

Hydrology. Oak protection, removal of fill, and decompaction of soils in the Odger's fuel storage area would promote infiltration in the area, but would not have a discernible effect on the hydrology of the Merced River, thus resulting in a local, long–term, negligible, beneficial impact on hydrology.

Water Quality. Parking restrictions in the Odger's fuel storage area would result in established vegetation that would be less likely to erode, thereby reducing fine sediment loads. This would not be expected to have a measurable effect on water quality and would result in a local, long-term, negligible, beneficial impact on water quality.

Impacts of Actions to Manage User Capacity, Land Use, and Facilities

Hydrology. Construction of new housing in the Rancheria Flatt area of El Portal would involve vegetation removal, soils compaction, and increased areas of impervious surfaces outside the 100-year floodplain. These actions would have a local, long-term, minor, adverse impact on hydrology.

Water Quality. Construction of new housing and parking lots, as described above, could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. Additionally, the use of heavy construction related equipment would also disturb surface sediments, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants into stormwater. These activities would result in a local, short-term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

Segments 3 & 4 Impact Summary: Actions to protect and enhance river values within Segment 4 would have local, long-term, negligible, beneficial impact on the river's hydrology and water quality. Actions to manage visitor capacity, land use, and facilities would have a long-term, minor, adverse impact on hydrology.

Segments 5, 6, 7, and 8: South Fork Merced River

Impacts of Actions to Protect and Enhance River Values

Biological Resource Actions. Along Segment 7 under Alternative 5, relocation of two stock use campground sites from sensitive biological resource areas to the Wawona Maintenance Yard area

would be the same as described for Alternative 2, except that the facility would be relocated to a slightly different area. Therefore, Alternative 5 would incur the same impacts as discussed for Alternative 2. Please refer to the discussion for Alternative 2.

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. The removal of facilities under Alternative 5 would reduce the amount of impervious surfaces within Segments 5, 6, 7, and 8, leading to a more natural hydrologic regime, though not to a measurable extent. This would result in a local, beneficial, negligible, long-term impact on hydrology.

Wawona. Removal of 13 campsites from areas located within 100 feet of the river would reduce existing effects of trampling on riverbank areas, and would support reduced erosion rates within the area. This would result in a local, long-term, negligible to minor, beneficial impact on water quality due to reduced erosion rates. Similarly, removal of 13 campsites from within the existing floodplain would result in a net reduction in floodplain area that is impacted by existing facilities. Removal of these sites would result in a local, long-term, negligible, beneficial impact on floodplains and flooding. Finally, removal of the existing facilities would involve minimal demolition related activities, which could include the use of heavy machinery, as well as other minor restoration activities. These construction activities would require implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), which would ensure that potential water quality impacts would be local, short-term, negligible, and adverse.

Segments 5-8 Impact Summary: Actions to protect and enhance river values within Segments 5-8 would have local, long-term, negligible to minor, beneficial impacts on hydrology, water quality, and floodplains. Actions to manage user capacities, land use, and facilities would have local and segmentwide, long-term, negligible, beneficial impacts on hydrology, water quality, and floodplains.

Summary of Impacts from Alternative 5: Enhanced Visitor Experiences and Essential Riverbank Restoration

Hydrology. Actions associated with Alternative 5 would have long-term, negligible to minor, beneficial impacts on hydrology. Restoration actions associated with Alternative 5 would decompact soil and restore meadow and riparian areas. Actions associated with the removal of impervious surfaces would increase infiltration and partially restore the natural hydrologic regime in a detectable manner. Actions associated with in-river restoration would add roughness and complexity to the Merced River, thereby restoring hydrologic processes in a detectable manner.

Water Quality. Actions associated with Alternative 5 would have long–term, minor, beneficial impacts on water quality. Restoration actions associated with Alternative 5 would restore denuded vegetation and limit informal trails, leading to a reduction in erosions. Actions associated with in-river restoration would help to stabilize eroded areas, thereby reducing fine sediment in a detectable manner. Construction activities associated with restoration have the potential to adversely affect water quality over the short term, but would be mitigated to a negligible level by instituting measure MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C).

Floodplains. Actions associated with Alternative 5 would have long-term, negligible to minor, beneficial and adverse impacts on floodplains. Restoration actions associated with Alternatives 2–6 would reconnect the Merced River and its floodplain in a detectable manner, resulting in a long-term, minor, beneficial impact on floodplains. Actions associated with in-river restoration would add roughness and complexity to the river, partially reconnecting the river to its floodplain, and creating a long-term, negligible, beneficial impact on 100-year floodplains.

Cumulative Impacts from Alternative 5: Enhanced Visitor Experiences and Essential Riverbank Restoration

The cumulative impacts analysis for Alternative 2 reflects the historic timeframe for installation of the various past, present, and reasonably foreseeable future actions listed below. The spatial dimension for the cumulative impacts analysis encompasses the portion of the Merced River watershed that is located within the park. The cumulatively considerable projects for Alternative 5 would be the same as those presented in Alternative 1.

Overall Cumulative Impact Common for Alternative 5: Enhanced Visitor Experiences and Essential Riverbank Restoration

Under Alternative 5, removal of riprap, removal of one bridge and unnecessary infrastructure, installation of logjams and other hydrology-enhancing actions, restoration of meadow hydrology, and improvements to wastewater collection would result in increased alluvial processes, reconnection of the Merced River to its floodplain, and enhanced water quality. This would contribute to local, long-term, moderate, beneficial cumulative impacts on hydrology and floodplains, and local, long-term, minor, beneficial cumulative impacts on water quality.

Environmental Consequences of Alternative 6: Diversified Visitor Experiences and Selective Riverbank Restoration

Segment 1: Merced River Above Nevada Fall

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. Pack stock used for administrative purposes would graze on meadow vegetation near the Merced Lake Ranger Station in accordance with established grazing capacities. This would help protect meadow vegetation, which in turn would produce a more natural hydrologic regime. This would result in a local, long-term, negligible, beneficial impact on hydrology.

The continuation of current levels of visitor use and concentrated camping has the potential to increase informal trails and vegetation trampling, which reduce the ability of the soil to infiltrate runoff. This action would not be expected to create a measurable change in hydrology in the Merced River and would result in a local, long-term, negligible, adverse impact on hydrology.

Water Quality. The continuation of current levels of visitor use and concentrated camping has the potential to increase informal trails and vegetation trampling. This would increase the potential for

erosion, but would not be expected to cause detectible change in Merced River water quality, thus resulting in a local, long-term, negligible, adverse impact on water quality.

Merced Lake High Sierra Camp. Under Alternative 6, all existing units would remain, but existing flush toilets would be replaced with composting toilets. The proposed changes would not result in any construction related effects on hydrology or water quality. Installation of composting toilets would not expand the footprint of existing facilities, and would not result in noticeable construction period disturbance. Use of composting toilets rather than the existing flush toilets would result in a local, long-term, negligible, beneficial impact on groundwater quality. No other appreciable hydrologic resources impacts would occur.

Segment 1 Impact Summary: Actions to manage user capacities, land use, and facilities within Segment 1 would result in a local, long-term, negligible, adverse impact on hydrology. These actions would also have a local, long-term, negligible, adverse and beneficial impact on water quality.

Segment 2: Yosemite Valley

Impacts of Actions to Protect and Enhance River Values

Hydrology. Under Alternative 6, the hydraulic effects of bridges would be mitigated by the placement of large wood and constructed logjams (including large trees with root wads). This action would add complexity by creating scour around the large wood area and deflecting flows. Depths would be deeper in the reduced area of the Merced River channel. This would have a slightly detectable impact on river dynamics, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, long–term, minor, beneficial impact on hydrology.

Under Alternative 6, all campsites and associated infrastructure within 100 feet of the ordinary high-water mark of the Merced River would be removed and restored to natural conditions. This would include campsites at Backpackers Camp, North Pines Campground, Upper Pines and Lower Pines campgrounds, Yellow Pines Campground, and tent-style lodging units at Housekeeping Camp. Other facilities that would be removed from the 100-year floodplain include select Yosemite Lodge infrastructure. Meadow restoration would take place at Ahwahnee, El Capitan, and Stoneman meadows.

Restoration actions would result in the restoration of approximately 156 acres of meadow, riparian, and other habitat types. The amount of impervious surface in restored areas would be reduced, increasing infiltration of runoff and restoring a more natural hydrologic regime. Removing infrastructure, including road prisms and ditches, would reconnect surface and groundwater within each meadow. Replanting restored areas with native vegetation would restore the natural runoff regime. These actions would be expected to have a measurable effect on hydrology in the Merced River, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, long–term, moderate to major, beneficial impact on hydrology.

Under Alternative 6, Merced River access would be more formalized, leading to a reduction in streambank erosion and soil compaction. Visitors would be directed to more stable river access points

throughout Segment 2, and areas of compacted soils would be decompacted and restored. This would improve bank stability at river access points, and restore natural runoff processes. This would be expected to have a measurable effect on hydrology in the Merced River, but would not be expected to have an overall effect on the character of the river, thus resulting in a local, long–term, minor, beneficial impact on hydrology.

Water Quality. Under Alternative 6, all campsites and associated infrastructure within 100 feet of the ordinary high-water mark of the Merced River would be removed and restored to natural conditions. This would include campsites at Backpackers Camp, North Pines and Upper Pines campgrounds, Lower Pines and Yellow Pines Campgrounds, and tent-style lodging units at Housekeeping Camp. Meadow restoration would take place at Ahwahnee, El Capitan, and Stoneman meadows. Methods for restoration would include recontouring, ditch removal, and decompaction. Recontouring would involve use of a skid steer, loader, excavator, dozer, and dump truck to remove excavated material from the site. An excavator or dozer could be used to excavate depressions, cut-off channels, and oxbows. On steep riverbanks, an excavator or dozer could push soils and material down the slope of the bank to create a gentler slope, which would increase revegetation success. Whenever possible, native fill would be used from the restoration site. Where possible, ditches would be contoured and leveled using fill material already present in associated berms. Soil decompaction would involve breaking up soils either manually, by using special decompaction tools, or with heavy equipment that can support ripping tines, such as excavators, skid steer, and dozers. Small pockets of fill would at times be blended into the soil as decompaction occurs, using an excavator or dozer with winged rippers. Earth-moving activities during construction have the potential to mobilize fine sediment, which would result in a local, short-term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce this impact to negligible. After construction, restored areas would result in established vegetation that would be less likely to erode, thereby reducing fine sediment loads. This would not be expected to have a measurable effect on water quality and would result in a local, long-term, negligible, beneficial impact on water quality.

Under Alternative 6, river access would be more formalized, leading to a reduction in streambank erosion and soil compaction. Visitors would be directed to more stable Merced River access points throughout the Segment 2, and areas of compacted soils would be decompacted and restored. This would improve bank stability at river access points, thus reducing erosion, though not to a measurable extent. This would result in a local, long-term, negligible, beneficial impact on water quality.

Floodplains. The placement of large wood and constructed logjams (including large trees with root wads) along the bases of Ahwahnee, Sugar Pine, and Stoneman bridges would increase roughness in the Merced River, allowing it to reconnect to its floodplain during moderate flows, though not in a manner that would have a substantial effect on the character of the river. This would result in a local, long-term, minor, beneficial impact on floodplains. During higher flows, this action could increase 100-year water surface elevations, though in a manner that would be minimally detectable, and would result in a local, long-term, minor, beneficial impact on floodplains and infrastructure located in floodplains.

Restoration. Restoration of areas within the 100-foot Merced River buffer would include locations at Backpackers Camp, North Pines Campground, Upper Pines and Lower Pines campgrounds, Yellow Pines Campground, former Upper River and Lower River campgrounds, Housekeeping Camp, the Curry Orchard parking lot, and Yosemite Lodge. Meadow restoration would take place at Ahwahnee, El Capitan, and Stoneman meadows, which would increase connectivity between the Merced River and its floodplain in a detectable manner. This would result in a local, long–term, minor, beneficial impact on floodplains.

Biological Resource Actions. Proposed biological resource actions associated with Alternative 6 that would be deployed along Segment 2 include replacement of a trail with boardwalk, removal or realignment of Northside Drive and bike path would not occur, improve hydrologic connectivity along both sides of the road by installing culverts, and remove fill and replace with a boardwalk at Ahwahnee Meadow; and application of redesign and engineering solutions to promote water flow at the Orchard Parking Lot, with installation of up to 275 feet of boardwalk at Curry Village; restoration of 16.5 acres of floodplain including decompaction of soils and removal of asphalt, former roads, and campsites, re-establishment of filled channels, placement of large box culverts under road to all water flow, close riparian zone to prevent trampling at former Upper and Lower Rivers Campground; removal of all campsites and infrastructure within a 100 foot buffer of the river along Valley campgrounds with restoration of 6.5 acres of riparian habitat; use restoration fencing to prohibit foot traffic into El Capitan meadow, restore informal trails, and selectively remove conifers that block views at El Capitan meadow; re-development of the disturbed footprint of the former Yosemite Lodge units and cabins (those that were damaged after the 1997 flood and subsequently removed).

Rerouting and consolidation of trails, restoration of road areas and meadows, restoration of floodplain, decompaction, and removal of informal trails and limits to riparian area access could contribute to increased stormwater infiltration capacity and increased storm event hydrologic concentration times. Restoration of riparian and floodplain vegetation would generally slow floodwaters in the vicinity of the restored area, more closely mimicking natural conditions, although redevelopment of the disturbed footprint of the former Yosemite Lodge units would partially offset this benefit, resulting in a local, long-term, negligible, beneficial impact to hydrology and flooding.

Relocation and removal of facilities located in floodplain areas, including removal of existing fill, removal of campsites, removal of informal trails, relocation of paths, and other proposed facility realignments would reduce existing constraints on the natural floodplain of the river. Reductions in these constraints would reduce existing interference within the floodplain. Installation of culverts would also support floodplain function and minimize ponding in inappropriate areas. Therefore, this is considered a segment-wide, long-term, minor, beneficial impact with respect to flooding.

Implementation of engineering solutions to promote water flow at the Orchard Parking Lot would alleviate existing stormwater/flood related constrictions at the parking lot. This would result in a local, long-term, minor, beneficial impact on flooding.

Construction of the proposed biological resources actions, as well as redevelopment of the former Yosemite Lodge units and cabins, could result in temporary disturbance to surface sediments and vegetation. Disturbance would result primarily from the use of heavy machinery. Heavy machinery

would be used for soil decompaction, removal and relocation of asphalt areas, recontouring of topography, rerouting of trails, removal of informal trails, and removal of other infrastructure as noted previously. Minimal additional disturbance could occur during restoration activities and boardwalk installation, due to localized disturbance. Additionally, construction related use of heavy machinery could result in accidental release of construction related fluids, oils, fuels, greases, hydraulic fluid, and other potential construction related water quality pollutants, during the construction process. Adhering to the proposed mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce these potential impacts to local, short-term, minor, and adverse.

Increases in riparian and floodplain vegetation associated with the proposed restoration activities, as noted above, would result in increased coverage of such vegetation along the river. Increases in riparian and floodplain vegetation coverage would result in reductions in sediment and other pollutant levels in stormwater that drains into the Merced River. Therefore, the proposed restoration activities would result in a segment-wide, long-term, negligible, beneficial impact on water quality.

Hydrologic/Geologic Resource Actions. Hydrologic/geologic resource actions that would occur under Alternative 6 along Segment 2 include movement of the unimproved parking area at Camp 6 north by approximately 150 feet away from the ordinary high water mark and restoration of riparian habitat along the river; all bridges would be retained under this alternative, but channel complexity would be increased by installing engineered log jams around Ahwahnee Bridge and Sugar Pine Bridge; the cut off channel before the Sugar Pine Bridge would be filled, and large wood would be placed below Sugar Pine bridge; placement of large wood, brush layering, and an engineered log jam so as to reduce the effects of Stoneman Bridge on hydrology and flooding characteristics of the river; install culverts along Northside Drive to improve drainage.

Stoneman Bridge, Sugar Pine Bridge, and Ahwahnee Bridge currently cause hydrologic constrictions along the Merced River. During moderate flow conditions, constrictions associated with these bridges interferes with natural hydrologic processes along the river, including reduction of channel migration, alteration of scour, and other hydrologic alterations. During high and flood flows, the bridges constrict flood flows, resulting in backup of flows behind the bridges, increases in flow velocity and scour in the vicinity of the bridges, and reduction in flows downstream of the bridges, in comparison to natural conditions. Therefore, installation of constructed logjams, placement of large wood, and filling of the cutoff channel before Sugar Pine Bridge, would in part reduce the existing effects of these structures on river hydrology and floodplain hydrology. Installation of the proposed large wood, brush layering, and engineered log jam would reduce the deleterious effects of Stoneman Bridge on the hydrology and flooding characteristics of the Merced River in its vicinity, but would not completely alleviate the existing constriction. Additionally, the long-term efficacy of these solutions is subject to uncertainty, and unanticipated washout would require periodic monitoring and maintenance of logjams and large wood placement by the NPS. If subsequent monitoring of riparian condition reveals insufficient improvement, more aggressive management action may be initiated, including the possible removal of Sugar Pine Bridge. Therefore, implementation of these actions would result in a local, long-term, minor, beneficial impact on hydrology and flooding.

Installation of the proposed culverts along Northside Drive would reduce existing stormwater drainage issues in that area, thereby reducing localized flooding conditions during major storm events.

This would result in a net improvement with respect to flooding, and is considered a local, long-term, minor, beneficial impact on flooding.

Moving the unimproved parking area at Camp 6 north and away from the ordinary high water mark of the river would result in the removal of existing structures that interfere with floodplain function. Removal of these structures would thereby reduce existing obstructions within the floodplain, and would thereby result in a net local, long-term, minor, beneficial impact on flooding.

With respect to water quality, during construction, removal of one bridges and other infrastructure from the Merced River and its floodplain, placement of logjams, fill, and other infrastructure within or along the Merced River, and other associated activities, would result in temporary construction related impacts to water quality. These could include incidental releases of sediment into natural waterways and the Merced River. Additionally, the use of heavy construction equipment during installation of these facilities could result in accidental release of construction related fluids, oils, fuels, greases, hydraulic fluid, and other potential construction related water quality pollutants during the construction period. Adhering to the proposed mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce these potential impacts to local, temporary, minor, and adverse.

Increases in riparian and floodplain vegetation associated with the proposed restoration activities, as noted above, would result in increased coverage of such vegetation along the river. Increases in riparian and floodplain vegetation coverage would result in reductions in sediment and other pollutant levels in stormwater that drains into the Merced River. Therefore, the proposed restoration activities would result in a segment-wide, long-term, negligible, beneficial impact on water quality.

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. Under Alternative 6, overall visitor use would increase, including in riverside areas, thereby increasing trampling, informal trail development, and riverbank erosion. While employee housing would decrease, the number of campsites and lodging units would increase. Informal parking would be reduced. Under Alternative 6, impervious surface area would be expected to be similar to that of Alternative 1. This would not be expected to have a measurable effect on hydrology in the river, thus resulting in a local, long–term, negligible, adverse impact on hydrology.

Temporary housing in the Lost Arrow parking lot would be removed and permanent housing constructed, resulting in no net change in impervious surface area. This action would not affect hydrology.

Water Quality. Under Alternative 6, total visitation, lodging, camping, and parking within the Valley would increase. Residential development, however, would be reduced. These shifts would bring more visitors and vehicles into the Valley, thereby increasing the potential for sedimentation and vehicle-related pollutants to be washed into the river. While removal of trails and formalizing picnic areas would restore riparian vegetation and reduce erosion, and formalizing Merced River access points and trails would also reduce vegetation trampling and help to stabilize riverbanks, the net effect of these actions would be expected to result in a local, long-term, negligible, adverse impact on water quality.

New/expanded parking areas west of Yosemite Lodge and Camp 6 would generate discharges of sediment and automobile related pollutants into stormwater. Release of these pollutants could result in minor degradation of water quality downstream, and these actions constitute a local, long-term, minor, adverse impact on water quality.

Curry Village & Campground. Actions to manage user capacities, land use, and facilities in this area would include an increase in total units from 400 existing units to 453 units. Total lodging within this area would consist of 290 tent-style lodging units retained in Curry Village, 98 newly constructed hard-sided units in Boys Town, 18 units retained at Stoneman House, and 47 cabin-with-bath units retained in Curry Village.

Installation of the new units in Boys Town would require the addition of new impervious surfaces, and a net increase in total impervious surface area would be anticipated within this area. As noted previously, impervious surfaces increase stormwater runoff and shorten hydrologic concentration time. New impervious surfaces would be limited to facility footprints, and some additional access areas. Because new impervious surface areas would be limited in extent, these actions would result in a local, long-term, negligible, adverse impact on stormwater hydrology.

Construction of the proposed new units could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. The use of heavy construction equipment would also disturb surface sediments, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants. These activities would result in a local, short term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

Floodplains. Under Alternative 6, existing development would be removed from the floodplain in several areas (see *Impacts of Actions to Protect and Enhance River Values*, above). The park would construct new campgrounds at the former Upper and Lower Rivers campgrounds, Upper Pines Campground, and install new RV camping facilities west of Yosemite Lodge. While these facilities would be constructed more than 150 feet from the river's ordinary high water mark, they would remain within the 100-year floodplain. The presence of such facilities would not be expected to substantially impact flood flows. Nonetheless, the presence of these campgrounds within the 100-year floodplain would make them susceptible to periodic flooding. The resulting floodplain impact would be local, long-term, negligible, and adverse.

Camp 6 and Yosemite Village. Actions to manage user capacities, land use, and facilities within this area of Segment 2 primarily concern transportation improvements. Proposed projects would involve improvements to intersection function at Village Drive and Northside Drive near Camp 6, including construction of a pedestrian underpass and traffic circle to alleviate traffic congestion, and installation of a second traffic circle at the Sentinel Drive/Northside Drive intersection; installation of a three-way intersection at Sentinel Drive and the entrance to the parking area; redevelopment of the existing overflow parking area west of Yosemite Lodge to provide 300 additional parking spaces; and relocation of the Camp 6 day use parking area north by 150 feet in order to facilitate riparian restoration (restoration actions evaluated above). The Camp 6/Village Center parking area would be

increased to 850 units by redeveloping part of the current administrative footprint in that area. One hundred parking spaces would be added to the Yosemite Village parking area. The existing tour bus drop off area would be relocated to the Highland Court area. A 4,000 square foot addition to the Concessioner Maintenance and Warehouse building would also be installed.

Installation of new parking areas, roadways, traffic circles, the Concessioner Maintenance and Warehouse building, the new three-way intersection, and the pedestrian underpass would require the construction of new impervious surfaces. Net increases in impervious surface area would be largely offset by the removal of select existing parking facilities and roadways, as noted above, as well as improvements in drainage facilities associated with the new structures, and the addition of bioswales in parking areas. However, based on the anticipated increase in parking, road, and building area, a net increase in impervious surfaces is anticipated. As noted elsewhere, impervious surfaces increase stormwater runoff and a shorten hydrologic concentration time. The proposed actions would therefore result in a local, long-term, minor, adverse impact on stormwater hydrology. Relocation of the bus drop off area and additional bus loading and unloading spaces would not result in a change in impervious surfaces, because the affected areas are already impervious.

Demolition of existing parking areas and roadways slated for removal, as well as construction of new parking areas, roads, traffic circles, and the pedestrian underpass and other activities discussed above, could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. Additionally, the use of heavy construction related equipment would also disturb surface sediments, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants. These activities would result in a local, short term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

The use of the proposed new parking areas would serve to consolidate existing parking activities into formalized areas, reducing reliance on informal parking areas. Therefore, the anticipated increase in formalized parking spaces is not expected to result in increased use, but would accommodate existing use that currently relies on other facilities. Similarly, moving the existing bus stop to a new location would not represent a new or increased intensity of use. Therefore, no net change in water quality pollutants related to parking lots is anticipated, because existing effects would be consolidated into formalized parking areas.

The existing Camp 6 day use parking area is located within the 10-year floodplain. Parking lots do not generally constitute major obstructions to flood flows, and so their presence within a floodplain is generally less obstructive than other vertical development; although minor effects, such as localized interference with flood flows, could still occur during a flooding event. A parking lot in the floodplain does, however, remove floodplain vegetation and soils. This rougher natural surface slows floodwaters, filters suspended sediment, and buffers the impacts of flooding. Moving the existing facility by up to 150 feet could result in a negligible reduction in the area of parking lot that is located within the 10-year floodplain. However, the parking lot would remain within the 100-year floodplain and therefore continue to have a local, long-term, minor, adverse impact with respect to flooding.

Yosemite Lodge and Camp 4. Actions to manage user capacities, land use, and facilities within this area of Segment 2 are limited to the replacement of the existing on-grade pedestrian crossing located west of the intersection of Northside Drive and Yosemite Lodge Drive with a pedestrian underpass. This action would be completed in order to alleviate pedestrian/vehicle conflicts.

Installation of an underpass would result in a slight expansion of the area of impervious facilities located on site, as compared with those of existing conditions. Because impervious surfaces increase stormwater runoff and peak runoff flows, the anticipated net increase in impervious surfaces would result in a local, long-term, negligible, adverse impact on hydrology.

Construction of the proposed underpass could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. The use of heavy excavation and construction related equipment would also disturb surface sediments within affected areas, could require stockpiling of spoils, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants. These activities would result in a local, short term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

The facilities in question would be located outside of the existing floodplain, and therefore would not affect flooding.

Segment 2 Impact Summary: Actions to protect and enhance river values within Segment 2 would have local, long-term, minor, beneficial impacts on hydrology, water quality, and floodplains. Actions to manage user capacities, land use, and facilities would have local and segmentwide, long-term, negligible to minor, adverse impacts on hydrology, water quality, and floodplains.

Segments 3 and 4: Merced Gorge and El Portal

Impacts of Actions to Protect and Enhance River Values

Hydrology. Oak protection, removal of fill, and decompaction of soils in the Odger's fuel storage area would promote infiltration in the area, but would not have a discernible effect on the hydrology of the Merced River, thus resulting in a local, long-term, negligible, beneficial impact on hydrology.

Water Quality. Parking restrictions in the Odger's fuel storage area would result in established vegetation that would be less likely to erode, thereby reducing fine sediment loads. This would not be expected to have a measurable effect on water quality and would result in a local, long-term, negligible, beneficial impact on water quality.

Impacts of Actions to Manage User Capacity, Land Use, and Facilities

Hydrology. Construction of new housing in the Rancheria Flatt and Abbieville areas of El Portal would involve vegetation removal, soils compaction, and increased areas of impervious surfaces outside the 100-year floodplain. These actions would have a local, long-term, minor, adverse impact on hydrology.

Water Quality. Construction of new housing and parking lots, as described above, could cause an increase in the amounts of debris, sediment, and other potential water quality pollutants picked up by stormwater runoff. Additionally, the use of heavy construction related equipment would also disturb surface sediments, and could result in the accidental release of fuels, oils, greases, antifreeze, and other potential construction-related water quality pollutants into stormwater. These activities would result in a local, short-term, minor, adverse impact on water quality. Implementation of mitigation measures MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C), would reduce the intensity of potential demolition and construction related water quality impacts to negligible.

Segments 3 & 4 Impact Summary: Actions to protect and enhance river values within Segment 4 would have local, long-term, negligible, beneficial impact on the river's hydrology and water quality. Actions to manage visitor capacity, land use, and facilities would have a long-term, minor, adverse impact on hydrology.

Segments 5, 6, 7, and 8: South Fork Merced River

Impacts of Actions to Protect and Enhance River Values

Hydrology. The removal and restoration of campsites either within the 100-year floodplain or in culturally sensitive areas would result in a decrease of trampling and an increase in soil infiltration. Impervious surfaces would be reduced, leading to an increase in the infiltration capacity of the area, thereby restoring the hydrologic regime. This would be expected to have a measurable effect on hydrology in the Merced River, but would not be expected to have an overall effect on the character of the river and would result in a local, long–term, minor, beneficial impact on hydrology.

Water Quality. The removal and restoration of campsites that are either within the 100-year floodplain or in culturally sensitive areas would result in reduced trampling and established vegetation that would be less likely to erode, thereby reducing fine sediment loads. This would not be expected to have a measurable effect on water quality and would result in a local, long-term, negligible, beneficial impact on water quality.

Floodplains. The removal and restoration of campsites either within the 100-year floodplain or in culturally sensitive areas would increase connectivity between the Merced River and its floodplain in a detectable manner. This would result in a local, long–term, minor, beneficial impact on floodplains.

Biological Resource Actions. Along Segment 7 under Alternative 6, relocation of two stock use campground sites from sensitive biological resource areas to Wawona Stables would be the same as described for Alternative 2, and therefore would incur the same impacts as discussed for Alternative 2. Please refer to the discussion for Alternative 2.

Impacts of Actions to Manage User Capacities, Land Use, and Facilities

Hydrology. The removal of facilities under Alternative 6 would reduce the amount of impervious surfaces within Segments 5, 6, 7, and 8, leading to a more natural hydrologic regime, though not to a measurable extent. This would result in a local, long-term, negligible, beneficial impact on hydrology.

Wawona. Removal of 13 campsites from areas located within 100 feet of the river would reduce existing effects of trampling on riverbank areas, and would support reduced erosion rates within the area. This would result in a local, long-term, minor, beneficial impact on water quality due to reduced erosion rates. Similarly, removal of 13 campsites from within the existing floodplain would result in a net reduction in floodplain area that is impacted by existing facilities. Removal of these sites would result in a local, long-term, negligible, beneficial impact on floodplains and flooding. Finally, removal of the existing facilities would involve minimal demolition related activities, which could include the use of heavy machinery, as well as other minor restoration activities. These construction activities would require implementation of mitigation measures MM-HYD-1, through MM-HYD-5, as appropriate (see Appendix C), which would ensure that potential water quality impacts would be local, short-term, negligible, and adverse.

Segments 5-8 Impact Summary: Actions to protect and enhance river values within Segments 5-8 would have local, long-term, negligible to minor, beneficial impacts on hydrology, water quality, and floodplains. Actions to manage user capacities, land use, and facilities would have local and segmentwide, long-term, negligible, beneficial impacts on hydrology, water quality, and floodplains.

Summary of Impacts from Alternative 6: Diversified Visitor Experiences and Selective Riverbank Restoration

Hydrology. Actions associated with Alternative 6 would have long-term, negligible to minor, beneficial impacts on hydrology. Restoration actions associated with all Alternative 6 would decompact soil and restore meadow and riparian areas. Actions associated with the removal of impervious surfaces would increase infiltration and partially restore the natural hydrologic regime in a detectable manner. Actions associated with in-river restoration would add roughness and complexity to the Merced River, thereby restoring hydrologic processes in a detectable manner.

Water Quality. Actions associated with Alternative 6 would have long-term, minor, beneficial impacts on water quality. Restoration actions associated with Alternative 6 would restore denuded vegetation and limit informal trails, leading to a reduction in erosion. Actions associated with in-river restoration would help to stabilize eroded areas, thereby reducing fine sediment in a detectable manner. Construction activities associated with restoration have the potential to adversely affect water quality over the short term, but would be mitigated to a negligible level by instituting measure MM-HYD-1 through MM-HYD-5, as appropriate (see Appendix C).

Floodplains. Actions associated with Alternative 6 would have long-term, negligible to minor, beneficial and adverse impacts on floodplains. Restoration actions associated with Alternative 6 would reconnect the Merced River and its floodplain in a detectable manner. Actions associated with in-river restoration would add roughness and complexity to the river, partially reconnecting the river to its floodplain and creating a long-term, negligible, beneficial impact on 100-year floodplains.

Cumulative Impacts from Alternative 6: Diversified Visitor Experiences and Selective Riverbank Restoration

The cumulative impacts analysis for Alternative 2 reflects the historic timeframe for installation of the various past, present, and reasonably foreseeable future actions listed below. The spatial dimension for the cumulative impacts analysis encompasses the portion of the Merced River watershed that is located within the Park. The cumulatively considerable projects for Alternative 2 would be the same as those presented in Alternative 1.

Overall Cumulative Impact Common for Alternative 6: Diversified Visitor Experiences and Selective Riverbank Restoration

Under Alternative 6, removal of riprap, removal of unnecessary infrastructure, restoration of meadow hydrology, installation of logjams and other hydrologic enhancements along Merced River, and improvements to wastewater collection would result in increased alluvial processes, reconnection of the Merced River to its floodplain, and enhanced water quality. This would contribute to local, long-term, minor, beneficial cumulative impacts on hydrology, floodplains, and water quality.