Biological Assessment

for the

U. S. Army Corps of Engineers Authorized Operations and Maintenance of Existing Fish Passage Facilities at Daguerre Point Dam on the Lower Yuba River

US Army Corps of Engineers®
Sacramento District

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8.0 Conclusions and Determinations

The following discussion provides the Corps' conclusions and determinations concerning whether the Proposed Action is likely to adversely affect spring-run Chinook salmon, steelhead and green sturgeon, or designated critical habitat within the Action Area. The conclusions in this BA are based on the best scientific and commercial data available, and are intended to assist NMFS in reaching its own determinations regarding project-related effects to listed species in the context of the formal ESA consultation process.

Three possible determinations exist regarding a proposed action's effects on listed species under the ESA (USFWS and NMFS 1998). These determinations are as follows:

- ***No effect*** - "*No effect*" is the appropriate conclusion when it is determined that the proposed action will not affect a listed species or designated critical habitat.
- ***May affect, but is not likely to adversely affect*** - "*May affect, but is not likely to adversely affect*" is the appropriate conclusion when effects on ESA protected species are expected to be discountable, insignificant, or completely beneficial. "*Insignificant effects relate to the size of the impact, and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur* (USFWS and NMFS 1998)."
- ***May affect, is likely to adversely affect*** - "*May affect, is likely to adversely affect*" is the appropriate conclusion if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant or beneficial. In fact, in the event the overall effect of the proposed action is beneficial to an ESA-protected species, but also is likely to cause some adverse effects, then the proposed action "*is likely to adversely affect*" the listed species. If incidental take is anticipated to occur as a result of the proposed action, an "*is likely to adversely affect*" determination should be made (USFWS and NMFS 1998).

The analyses presented in Chapter 7 of this BA was conducted to assist NMFS in determining whether the Proposed Action will cause "…*some deterioration in the* *species' pre-action condition*" (*National Wildlife Federation v. NMFS, 524 F.3d 917 (9th Cir. 2008*). Specifically for this consultation, the conservation measures associated with the Proposed Action have been implemented over the past few years, representing a reduction in stressors and improvement over the pre-action condition of spring-run Chinook salmon and steelhead.

8.1 Listed Species

The Proposed Action is comprised of the Corps' authorized discretionary O&M activities at the existing fish passage facilities at Daguerre Point Dam, including the administration of two outgrants associated with O&M of the facilities, and specified conservation measures. The Proposed Action will improve pre-action Environmental Baseline conditions in the Action Area of the lower Yuba River for spring-run Chinook salmon and steelhead because it will: (1) improve passage ability due to continuing to keep the fish ladder control gates open at high flow levels; (2) improve within-ladder hydraulics and attraction flows by adjustment of within-ladder flashboards and fish ladder gated orifices; (3) improve within ladder hydraulics by removal of debris and sediment accumulation within the fish ladder bays and thereby improve passage conditions; (4) direct sheet flow that spills over the top of Daguerre Point Dam into the fish ladders, and thereby improve the ability of adult fish to locate the fish ladders and migrate upstream to spawning and rearing habitats; and (5) direct downstream migrating juvenile spring-run Chinook salmon and steelhead into the fish ladders, and thereby reduce physical injury and potential mortality from spilling over the dam, and potentially reduce predation due to disorientation in the plunge pool below the dam.

Implementation of voluntary conservation measures would: (1) expand suitable spawning habitat in the Englebright Dam Reach for spring-run Chinook salmon and steelhead, and may encourage additional behavioral segregation of spawning spring-run Chinook salmon; and (2) provide additional LWM and corresponding habitat complexity and diversity (and therefore predator escape cover, velocity shelter, feeding stations) for rearing juvenile spring-run Chinook salmon and steelhead, relative to the pre-action Environmental Baseline conditions.

In addition, the Proposed Action will not increase the long-term risks to green sturgeon because the Proposed Action will not introduce new stressors or substantially exacerbate ongoing stressors. Within the Action Area, the one known stressor to green sturgeon is Daguerre Point Dam, which was not designed to provide for green sturgeon passage upstream of the dam. However, the Proposed Action would not affect green sturgeon in the lower Yuba River because stressors on green sturgeon associated with Daguerre Point Dam are part of the Environmental Baseline. Consequently, the Proposed Action will not result in increased harm to the species over pre-action Environmental Baseline conditions in the Action Area of the lower Yuba River.

8.1.1 Incidental Take Considerations

Under the Federal ESA, take is defined as "…*to harm, harass, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct*" [ESA§3(19)]. Harass, pursue, hunt, shoot, wound, kill, trap, capture or collect can be classified as actions that would have a direct effect on a species, at the individual level. Conversely, harm, which is a form of take, is further defined to include "…*significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering*" (USFWS and NMFS 1998).

8.1.1.1 Sediment Management

There is some potential that sediment excavation activities directly upstream of Daguerre Point Dam may interfere with the egress of adult individuals from the fish ladders, causing temporary behavioral alteration. Sediment excavation also may result in temporary behavioral alteration of spring-run Chinook salmon and steelhead juvenile rearing and downstream migration. These potential temporary behavioral alterations could be considered to represent "harassment" as a form of take. Additionally, there is the more remote possibility of physical injury or direct mortality to juveniles from being contacted by the excavator bucket. Consequently, implementation of the sediment management plan has the limited potential to result in minor amounts of "take" of adult and juvenile spring-run Chinook salmon and steelhead individuals. Overall, however, the long-term benefits to listed anadromous salmonids resulting from continued implementation of sediment management activities at Daguerre Point Dam are expected to outweigh any potential occurrences of incidental take (or harm) that may occur to individual fish during sediment excavation activities. Therefore, the sediment management component of the Proposed Action represents an overall beneficial effect, but the Corps has determined that this component "*may affect, is likely to adversely affect"* because of the remote possibility of low amounts of incidental take of spring-run Chinook salmon and steelhead.

8.1.1.2 Flashboard Management

The Daguerre Point Dam Flashboard Management Plan was developed to benefit spring-run Chinook salmon and steelhead by improving the ability of adult fish to locate the fish ladders and migrate upstream to spawning and rearing habitats. Ancillary benefits include directing downstream migrating juvenile spring-run Chinook salmon and steelhead into the fish ladders, and thereby avoiding physical injury and potential mortality from spilling over the dam, and potentially increased predation due to disorientation in the plunge pool below the dam.

There is a potential that the flashboards may collect debris that have an associated limited potential to entrap downstream migrating spring-run Chinook salmon and steelhead, which might contribute to juvenile fish mortality. However, the plan specifies that the flashboards will be monitored at least once per week, and perhaps as frequently as daily in conjunction with CDFW and/or PSMFC monitoring of the VAKI systems, and that all adjustments to the flashboards will be made as necessary in coordination with NMFS and CDFW. During the period that flashboards are installed, the flashboards will be cleared within 24 hours of finding a blockage, or as soon as it is safe to clear them. Further, flashboards will be removed within 24 hours, if directed by the Corps, NMFS or CDFW. Consequently, implementation of the flashboard management plan has the limited potential to result in temporary, minor amounts of "take" of juvenile spring-run Chinook salmon and steelhead individuals. Overall, however, the long-term benefits to listed anadromous salmonids resulting from continued implementation of flashboard management at Daguerre Point Dam are expected to outweigh any potential occurrences of incidental take (or harm) that may occur to individual fish during flashboard installation, operation and removal activities. Therefore, the flashboard management component of the Proposed Action represents an overall beneficial effect, but the Corps has determined that this component "*may affect, is likely to adversely affect"* because of the remote possibility of low amounts of incidental take of juvenile spring-run Chinook salmon and steelhead.

8.1.1.3 Debris Maintenance and Removal

For this Proposed Action, debris maintenance and removal activities and maintenance of the VAKI Riverwatcher in the fish ladders at Daguerre Point Dam could temporarily disrupt adult spring-run Chinook salmon and steelhead undisturbed upstream migration behavior and be considered as a form of harassment. In addition, there is a remote possibility that juvenile spring-run Chinook salmon or steelhead could be within the bays of the fish ladders during debris maintenance activities. Consequently, there is a corresponding remote possibility that physical harm or mortality could occur to individual fish, which could represent minor amounts of "take" of adult and juvenile spring-run Chinook salmon and steelhead individuals, on a temporary basis. Overall, however, the long-term benefits to listed anadromous salmonids resulting from continued implementation of debris maintenance and removal at Daguerre Point Dam are expected to outweigh any potential occurrences of incidental take (or harm) that may occur to individual fish during implementation. Therefore, the debris maintenance and removal component of the Proposed Action represents an overall beneficial effect, but the Corps has determined that this component "*may affect, is likely to adversely affect*" because of the remote possibility of low amounts of incidental take of spring-run Chinook salmon and steelhead.

8.1.1.4 Voluntary Conservation Measures

Some relatively minor amounts of take have the potential to result from the construction/implementation phases of the voluntary conservation measures. Gravel injection has the potential to result in disturbance of individuals due to noise and vibration. It also could result in physical injury or direct mortality of juvenile spring-run

Chinook salmon and steelhead, although it is likely that individuals would vacate the area during construction activities. Similarly, construction and placement of LWM features also have the potential to result in relatively minor amounts of take due to physical injury or direct mortality of juvenile spring-run Chinook salmon and steelhead. If it is necessary to use heavy equipment close to the river, there is a potential for noise and vibration to disturb spring-run Chinook salmon and steelhead. It is not likely that adults of either species would be directly or indirectly impacted due to natural avoidance behavior. Therefore, the voluntary conservation measures of the Proposed Action represents an overall beneficial effect, but the Corps has determined that these components "*may affect, is likely to adversely affect*" because of the remote possibility of low amounts of incidental take of spring-run Chinook salmon and steelhead.

Voluntary conservation measures are not likely to result in incidental take of green sturgeon, because these measures would be located several miles upstream of Daguerre Point Dam, which represents the upstream extent of the potential presence of green sturgeon in the lower Yuba River.

8.2 Critical Habitat

The Proposed Action will not adversely affect the critical habitat PCEs or their management in a manner likely to appreciably diminish or preclude the role of that habitat in the recovery of the Central Valley spring-run Chinook salmon and steelhead.

The Proposed Action will not increase the risks to the spring-run Chinook salmon or steelhead critical habitat because it will improve pre-action Environmental Baseline conditions in the lower Yuba River. Specific conservation measures will increase the suitability and availability of critical habitat for spring-run Chinook salmon and steelhead in the lower Yuba River through the ongoing implementation of a gravel augmentation program in the Englebright Dam Reach, as well as development of a LWMMP for the lower Yuba River.

The Cumulative Condition would generally result in seasonal flow increases upstream of Daguerre Point Dam (as measured at the Smartsville Gage) and seasonal flow decreases downstream of Daguerre Point Dam (as measured at the Marysville Gage), primarily during the summer months of July, August and September. Seasonal reductions in flow under the Cumulative Condition would have the greatest potential to affect juvenile spring-run Chinook salmon and steelhead rearing habitat suitability through resultant changes in water temperature. However, analyses of both monthly mean flow- and water temperature-related changes under the Cumulative Condition, relative to the current conditions, would not be anticipated to adversely affect any of the spring-run Chinook salmon or steelhead lifestages in the lower Yuba River.

Green sturgeon critical habitat in the lower Yuba River extends from Daguerre Point Dam downstream to the confluence with the lower Feather River. A unique specific PCE essential for the conservation of the Southern DPS of North American green sturgeon is deepwater pool habitat. The Proposed Action will not adversely affect the critical habitat PCEs or their management in a manner likely to appreciably diminish or preclude the role of that habitat in the recovery of green sturgeon.

The relatively minor seasonal flow reductions under the Cumulative Condition relative to the current conditions would be expected to result in corresponding minor reductions in deepwater pool depth and habitat availability below Daguerre Point Dam. During low flow conditions, deepwater pool habitat availability under the Cumulative Condition would be essentially equivalent during all months of the evaluation period, relative to the current conditions. Minor flow-related changes to depth or areal extent of deepwater pool habitat under the Cumulative Condition relative to the current conditions indicate no substantive effects to the unique specific PCE of deepwater pool habitat associated with green sturgeon critical habitat in the lower Yuba River. Moreover, minor changes in water temperatures under the Cumulative Condition relative to the current conditions indicate no substantive effects for any of the green sturgeon lifestages in the lower Yuba River.

8.3 Conclusions and Determinations

Conclusions and determinations take into account both the magnitude and probability of occurrence of effects to listed species and their habitats resulting from the Proposed

Action. According to the ESA Consultation Handbook (USFWS and NMFS 1998) …"*Insignificant effects relate to the size of the impact, and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur*."

In consideration of the foregoing effects assessments, because some incidental take potentially could occur as a result of the Proposed Action, the Corps concludes that the the Proposed Action "*may affect, and are likely to adversely affect*" Central Valley spring-run Chinook salmon and steelhead. Potential adverse effects to critical habitat of spring-run Chinook salmon and steelhead in the Action Area due to the Proposed Action are expected to be discountable and/or insignificant.

As previously discussed, other than infrequent adult occupancy, no other lifestage of green sturgeon has ever been reported in the lower Yuba River. The ongoing stressors associated with Daguerre Point Dam's blockage of green sturgeon are due to the presence of the dam and configuration of the fish ladders, so they are part of the Environmental Baseline. The Corps does not currently have the authority to lessen the potential passage/blockage effects from these structures on green sturgeon.

The Proposed Action primarily includes physical activities within the fish ladders at Daguerre Point Dam and actions upstream. The LWMMP (Corps 2012d) reports that LWM placement sites are located in the approximate 4-mile reach of the lower Yuba River downstream of the Highway 20 Bridge, often referred to as the Parks Bar to Hammon Bar Reach, and that additional sites upstream of the Highway 20 Bridge also may be considered. Thus, LWM placement sites are located several miles upstream of Daguerre Point Dam. The only physical activities downstream of Daguerre Point Dam include placement of excavated sediment above the waterline along the shore approximately 1/4 mile downstream of Daguerre Point Dam. Physical injury or direct mortality to listed species associated with excavated sediment placement is not expected to occur. The foregoing effects evaluations indicate that potential adverse effects to critical habitat of green sturgeon in the Action Area due to the Proposed Action are expected to be discountable and/or insignificant. Therefore, the Corps concludes that the Proposed Action "*may affect, but is not likely to adversely affect*" green sturgeon and its critical habitat.

7.0 Effects of the Proposed Action

Under the aggregate effects assessment approach, the Environmental Baseline and the status of the species are viewed together to determine the ability of each listed species to withstand additional stressors or the exacerbation of existing stressors. As the NMFS (1999) policy document states: "[i]*f the species' status is poor and the baseline is degraded at the time of consultation, it is more likely that any additional adverse effects caused by the proposed or continuing action will be significant*".

7.1 Assessment of the Environmental Baseline

Past, present, and future effects associated with the physical presence of the existing facilities at Daguerre Point Dam are included in the Environmental Baseline. With the exception of potential effects related to fish ladder performance associated with authorized discretionary operations and maintenance activities at Daguerre Point Dam, the Corps does not have the authority or discretion to lessen other stressors associated with these facilities. Therefore, it is appropriate that the ongoing impacts from the stressors associated with the continued existence of Daguerre Point Dam are included in the Environmental Baseline. The limiting factors, threats and stressors associated with the Environmental Baseline, which have led to the current status of each of the listed species, are described in detail in Chapter 4 of this BA and are summarily discussed by ESU and DPS below, followed by Environmental Baseline stressors in the Action Area of the lower Yuba River, to provide context for the aggregate effects analysis.

7.1.1 Spring-run Chinook Salmon ESU

The key limiting factors, threats and stressors associated with the Environmental Baseline affecting the spring-run Chinook salmon ESU include the following.

- Habitat Blockage
- Water Development

- Water Conveyance and Flood Control
- Land Use Activities
- Water Quality
- Non-Native Invasive Species
- Hatchery Operations and Practices
- Disease and Predation
- Overutilization (ocean commercial and sport harvest, inland sport harvest)
- Environmental Variation (natural environmental cycles, ocean productivity, global climate change, ocean acidification)

The Central Valley spring-run Chinook salmon ESU continues to display broad fluctuations in abundance. According to NMFS (2011a), recent anomalous conditions in the coastal ocean, along with consecutive dry years affecting inland freshwater conditions, have contributed to statewide spring-run Chinook salmon escapement declines. As a species' abundance decreases, and spatial structure of the ESU is reduced, a species has less flexibility to withstand changes in the environment.

The BO for the CVP/SWP OCAP consultation (NMFS 2009a) covered CVP and SWP facilities and potentially affected waterbodies. The lower Yuba River is not included in the CVP or SWP, and spring-run Chinook salmon would not be affected by CVP/SWP operations while in the lower Yuba River. However, the Yuba River spring-run Chinook salmon population would be subject to CVP/SWP operational and ESU-wide effects associated with the Environmental Baseline while in their migratory lifestages in the lower Feather River, lower Sacramento River, and the Delta, as well as in the Pacific Ocean. The NMFS (2009a) BO, therefore, is used in this BA for an assessment of the entire Central Valley spring-run Chinook salmon ESU.

NMFS' evaluation of potential effects of the CVP/SWP OCAP (NMFS 2009a) included an assessment of the VSP parameters of abundance, productivity, spatial structure, and diversity. Regarding abundance, NMFS (2009a) stated that long-term CVP/SWP system-wide operations are expected to result in substantial mortality to juvenile spring-run Chinook salmon, and that CVP/SWP-related entrainment into the Central and South

Delta greatly increase the risk of mortality from direct (entrainment and impingement at the pumps) and indirect (predation) effects. NMFS (2009a) also stated that population growth rate of spring-run Chinook salmon would be expected to decline in the future.

According to NMFS (2009a), operations of the CVP and SWP reduce the population's current spatial structure (by reducing habitat quantity and quality) and negatively affect the diversity of spring-run Chinook salmon in the mainstem Sacramento River. CVP/SWP operations are expected to continue these effects. The operations of the DCC, and historical operations of RBDD have affected the temporal distribution of adult spring-run on their spawning migration to mainstem Sacramento River spawning grounds, and potentially result in introgression with fall-run Chinook salmon and continues the pattern of genetic introgression and hybridization that has occurred since RBDD was built in the late 1960s (CDFG 1988; NMFS 2004b; TCCA 2008 as cited in NMFS 2009a). In addition, the FRFH program has affected the diversity of the Central Valley spring-run Chinook salmon and, together with the loss of the San Joaquin River Basin spring-run populations, the diversity of the Central Valley spring-run Chinook salmon ESU has been reduced (NMFS 2004).

Critical habitat for spring-run Chinook salmon is composed of PCEs that are essential for the conservation of the species, including but not limited to, spawning habitat, rearing habitat, migratory corridors, and estuarine areas. Most of the historic spawning and rearing habitat for the Central Valley spring-run Chinook salmon ESU is above impassable dams. According to NMFS (2009a), substantial habitat degradation and alteration also has affected the rearing, migratory, and estuarine areas used by spring-run Chinook salmon. Some general examples of how spring-run Chinook salmon critical habitat has been degraded include the loss of natural river function and floodplain connectivity through levee construction, and direct losses of floodplain and riparian habitat, effects to water quality associated with agricultural, urban, and industrial land use, and substantial changes to Delta estuarine habitat (NMFS 2009a).

Due to past and ongoing effects, the current condition of spring-run Chinook salmon critical habitat is considered to be highly degraded, and does not provide the conservation value necessary for the survival and recovery of the species (NMFS 2009a). In addition, climate change is expected to further degrade the suitability of habitats in the Central Valley through increased temperatures, increased frequency of drought, increased frequency of flood flows, and overall drier conditions (Lindley et al. 2007).

According to NMFS (2009a), all of the above factors, which reduce the spatial structure, diversity, and abundance, compromise the capacity for the spring-run Chinook salmon ESU to respond and adapt to environmental changes. NMFS' VSP analysis at the population and diversity group scales showed reduced viability of extant spring-run Chinook salmon populations and diversity groups. Additionally, high quality critical habitat containing spawning sites with adequate water and substrate conditions, or rearing sites with adequate floodplain connectivity, cover, and water conditions (i.e., key PCEs of critical habitat that contribute to its conservation value) is considered to be limited. Future projections over the duration of evaluated long-term CVP/SWP operations (i.e., through 2030), considering both increasing water demands and climate change, exacerbate risks to the Central Valley spring-run Chinook salmon ESU. NMFS (2009a) stated that the Central Valley spring-run Chinook salmon ESU is at moderate risk of extinction.

NMFS (2009a) concluded that long-term CVP/SWP operations are likely to jeopardize the continued existence of Central Valley spring-run Chinook salmon, and are likely to destroy or adversely modify critical habitat for Central Valley spring-run Chinook salmon.

NMFS (2009a) initially attempted to devise a RPA for spring-run Chinook salmon and its critical habitat by modifying CVP/SWP project operations (e.g., timing/magnitude of releases from dams, closure of operable gates and barriers, and reductions in negative flows). In some cases, however, altering CVP/SWP project operations was not sufficient to ensure that the CVP and SWP projects would be likely to avoid jeopardizing the species or adversely modifying critical habitat. Consequently, NMFS (2009a) developed focused actions designed to compensate for particular stressors, considering the full range of authorities that Reclamation and DWR may use to implement these actions. NMFS concentrated on actions that have the highest likelihood of alleviating the stressors with the most significant effects on the species, rather than attempting to address every project stressor for each species or every PCE for critical habitat.

The NMFS (2009a) RPA is composed of numerous elements for each of the various CVP/SWP project divisions and associated stressors. NMFS recognized that the RPA must be an alternative that is likely to avoid jeopardizing listed species or adversely modifying their critical habitats, rather than a plan that will achieve recovery. Short-term actions are presented in NMFS (2009a) for each division of the CVP/SWP, and are summarized for each species to ensure that the likelihood of survival and recovery is not appreciably reduced in the short term (i.e., one to five years). In addition, because evaluated long-term CVP/SWP system-wide operations extend until 2030, the consultation also included long-term actions that NMFS identified as being necessary to address CVP/SWP project-related adverse effects on the likelihood of survival and recovery of the species over the next two decades. However, the Federal Court for the Eastern District of California held that the jeopardy conclusion of the 2009 NMFS BO was correct, but that the RPA actions were not adequately justified or supported by the record. The NMFS 2009 BO was remanded (Consol. Salmonid Cases, 791 F. Supp. 2d 802 (E.D. Cal. 2011)).

For the ESU-wide Environmental Baseline effects assessment of the spring-run Chinook salmon, NMFS (2009a) found that the entire suite of limiting factors, threats and stressors associated with the Environmental Baseline result in an unstable ESU at moderate risk of extinction.

7.1.2 Steelhead DPS

The aforementioned list of limiting factors and stressors pertinent to the spring-run Chinook salmon ESU also pertain to the steelhead DPS. Stressors that are unique to the steelhead DPS, or substantially differ in the severity from the stressor for the previously described spring-run Chinook salmon ESU, are discussed in Chapter 4 of this BA and include the following.

- ❑ Destruction, Modification, or Curtailment of Habitat or Range

- ❑ Overutilization for Commercial, Recreational, Scientific or Education Purposes (inland sport harvest)
- ❑ Disease and/or Predation
- ❑ Inadequacy of Existing Regulatory Mechanisms (Federal efforts, non-Federal efforts)
- ❑ Other Natural and Man-Made Factors Affecting the Continued Existence of the DPS
- ❑ Non-Lifestage Specific Threats and Stressors for the DPS (artificial propagation programs, small population size, genetic integrity and long-term climate change)

As previously discussed for the Central Valley spring-run Chinook salmon ESU, the BO for the CVP/SWP OCAP consultation (NMFS 2009a) covered CVP and SWP facilities and potentially affected waterbodies, which did not include the lower Yuba River.

NMFS (2009a) stated that CVP/SWP system-wide operations are expected to result in direct mortality to steelhead, including: (1) increased predation of juveniles when the RBDD gates are down; (2) entrainment of juveniles into the Central and South Delta; (3) entrainment and impingement of juveniles at the CVP/SWP pumps in the South Delta (both direct and indirect loss); and (4) loss associated with the collection, handling, trucking and release program.

According to NMFS (2009a), steelhead habitat conditions in the mainstem Sacramento River and the Delta have been adversely affected by long-term CVP/SWP system-wide operations in several ways, including but not limited to: (1) delaying the upstream migration of adult steelhead through RBDD operations; (2) reducing the availability of quality rearing habitat through the seasonal creation of Lake Red Bluff; and (3) creating improved feeding opportunities at RBDD for predators such as pikeminnow and striped bass. In these ways, the CVP/SWP system-wide operations reduced the population’s spatial structure (by reducing habitat quantity and quality), which increases the risk of extinction of the mainstem Sacramento River steelhead population (NMFS 2009a). Beginning in September 2011 and implemented in response to the NMFS OCAP BO (2009a), the RBDD gates were permanently raised, which has likely improved fish passage conditions at the RBDD. The Red Bluff Fish Passage Improvement Project, which included construction of a pumping plant to allow for diversion of water from the Sacramento River without closing the RBDD gates, was completed in 2012 (Tehama-Colusa Canal Authority 2012).

NMFS (2009a) stated that the diversity of mainstem Sacramento River steelhead also may be affected by CVP/SWP system-wide operations due to changed thermal regimes and food web structures in the Sacramento River such that a resident life history strategy may have fitness advantages over anadromous forms, although little is known about the relationship of resident and anadromous forms of *O. mykiss*. Without knowing the roles that resident *O. mykiss* play in population maintenance and persistence of anadromous *O. mykiss*, it is difficult to assess whether the current conditions on the Sacramento River, which may favor residency, are detrimental to the anadromous population in the Sacramento River or not (Lindley et al. 2007). In addition, widespread hatchery steelhead production within this DPS also raises concerns about the potential ecological interactions between introduced stocks and native stocks (Corps 2007).

According to NMFS (2009a), critical habitat for steelhead is composed of PCEs that are essential for the conservation of the species including, but not limited to, spawning habitat, rearing habitat, migratory corridors, and estuarine areas. Based on the host of stressors to spawning, rearing, migratory, and estuarine habitats in the Central Valley, it is apparent that the current condition of steelhead critical habitat is degraded, and does not provide the conservation values necessary for the survival and recovery of the species (NMFS 2009a).

NMFS (2009a) stated that CVP/SWP system-wide operations are expected to place critical habitat for mainstem Sacramento River steelhead at considerable risk. The status of steelhead critical habitat, within the mainstem Sacramento River is suggested by NMFS (2009a) to be substantially degraded due to factors such as warm water temperatures and low flows, loss of natural river function and floodplain connectivity through levee construction, direct loss of floodplain and riparian habitat, loss of tidal wetland habitat, a collapsed pelagic community in the Delta, and poor water quality associated with agricultural, urban, and industrial land use. Additionally, NMFS (2009a) stated that climate change is expected to further degrade the suitability of habitats in the Central Valley through increased temperatures, increased frequency of drought, increased frequency of flood flows, and overall drier conditions. Estuarine habitats also have been substantially degraded (e.g., Sommer et al. 2007) and climate change is expected to further alter these habitats through sea level rise and hydrological changes.

As described by NMFS (2009a), there are few data with which to assess the status of Central Valley steelhead populations. According to NMFS (2009a), data are lacking to suggest that the Central Valley steelhead DPS is at low risk of extinction, or that there are viable populations of steelhead anywhere in the DPS. Conversely, NMFS (2009a) states that there is evidence to suggest that the Central Valley steelhead DPS is at moderate or high risk of extinction. Most of the historical habitat once available to steelhead has been lost, and the observation that anadromous *O. mykiss* are becoming rare in areas where they were probably once abundant indicates that an important component of life history diversity is being suppressed or lost (NMFS 2009a). Lindley et al. (2007) stated that even if there were adequate data on the distribution and abundance of steelhead in the Central Valley, approaches for assessing steelhead population and DPS viability might be problematic because the effect of resident *O. mykiss* on the viability of steelhead populations and the DPS is unknown.

NMFS (2009a) concluded that long-term CVP/SWP operations are likely to jeopardize the continued existence of Central Valley steelhead and are likely to destroy or adversely modify critical habitat for Central Valley steelhead.

NMFS (2009a) developed RPA actions for each of the various CVP/SWP project divisions and associated waterbodies to avoid jeopardy and adverse modification of critical habitat. However, as previously discussed, the Federal Court for the Eastern District of California held that the jeopardy conclusion of the 2009 NMFS BO was correct, but that the RPA actions were not adequately justified or supported by the record. The NMFS 2009 BO was remanded (Consol. Salmonid Cases, 791 F. Supp. 2d 802 (E.D. Cal. 2011)).

For the DPS-wide Environmental Baseline effects assessment of steelhead, NMFS (2009a) found that the entire suite of limiting factors, threats and stressors associated with the Environmental Baseline result in an unstable DPS at moderate or high risk of extinction.

7.1.3 Southern DPS of North American Green Sturgeon

The key limiting factors, threats and stressors associated with the Environmental Baseline affecting the Southern DPS of North American green sturgeon, discussed in Chapter 4 of this BA, include the following.

- Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range (reduction in spawning habitat, alteration of habitat – flows, water temperatures, delayed or blocked migration, impaired water quality, dredging and ship traffic, ocean energy projects)
- Commercial, Recreational, Scientific or Educational Overutilization
- Disease and Predation
- Inadequacy of Existing Regulatory Mechanisms
- Other Natural and Man-Made Factors Affecting the Species' Continued Existence (non-native invasive species, entrainment)

As discussed in Chapter 4, about 217 green sturgeon have been acoustically-tagged in the Central Valley (CFTC 2012 as cited in YCWA 2013a). However, the current status of Southern DPS of North American green sturgeon abundance and productivity is unknown (NMFS 2009a). CVP/SWP system-wide operations, including closures of the ACID dam and the RBDD gates historically resulted in increased loss of individual fish and reduced abundance of adult fish in the green sturgeon population (NMFS 2009a). Closure of the gates at RBDD from May 15 through September 15 previously precluded all access to green sturgeon spawning grounds above the dam during that time period. However, as previously discussed, the RBDD gates were permanently raised during September 2011. With the RBDD gates raised, Vogel (2011) reports that green sturgeon have unimpeded access to upstream reaches as far as the ACID dam near Redding, CA.

Larval and juvenile green sturgeon entrainment or impingement from screened and unscreened agricultural, municipal, and industrial water diversions along the Sacramento River and within the Delta also are considered important threats (71 FR 17757).

The Southern DPS of North American green sturgeon is at substantial risk of future population declines (NMFS 2009a). The potential threats faced by green sturgeon include increased vulnerability due to the reduction of spawning habitat into one concentrated area on the Sacramento River, lack of good empirical population data, vulnerability of long-term cold water supply for egg incubation and larval survival, loss of juvenile green sturgeon due to entrainment at the project fish collection facilities in the South Delta and agricultural diversions within the Sacramento River and Delta systems, alterations of food resources due to changes in the Sacramento River and Delta habitats, and exposure to various sources of contaminants throughout the basin to juvenile, sub-adult, and adult lifestages (NMFS 2009a).

According to NMFS (2009a), past RBDD gate closures blocking access to upstream spawning areas decreased the productivity and spatial structure of the green sturgeon population. Fish forced to spawn below RBDD were believed to have a lower rate of spawning success compared to those fish that spawned above the RBDD. Furthermore, NMFS (2009a) stated that reductions in genetic diversity may occur due to the separation of upstream and downstream populations created anthropogenically by the closure of the RBDD. When the gates were down, RBDD precluded access to 53 miles of spawning habitat for 35-40 percent of the spawning population of green sturgeon. NMFS (2009a) mandated an RPA action for RBDD that required the gates to be raised year-round by 2012. As previously discussed, the Red Bluff Diversion Dam Fish Passage Improvement Project was completed in 2012. At the time that NMFS conducted the consultation for the CVP/SWP OCAP, green sturgeon critical habitat had been proposed but a final rule designating critical habitat had not yet been adopted. NMFS (2009a) therefore referred to "proposed" green sturgeon critical habitat in its evaluations.

According to NMFS (2009a), the proposed critical habitat at that time for the Southern DPS of North American green sturgeon is degraded over its historical conditions. It does not provide the full extent of conservation values necessary for the recovery of the species, particularly in the upstream riverine habitat. In particular, passage and water flow PCEs have been impacted by human actions, substantially altering the historical river characteristics in which green sturgeon evolved. In addition, the alterations to the Delta may have a particularly strong impact on the survival and recruitment of juvenile green sturgeon due to the protracted rearing time in the delta and estuary. Loss of individuals during this phase of the life history of green sturgeon represents losses to multiple year classes rearing in the Delta, which can ultimately impact the potential population structure for decades to come (NMFS 2009a).

NMFS (2009a) stated that CVP/SWP system-wide operations are expected to reduce the conservation value of green sturgeon critical habitat. The principal factor for the decline of green sturgeon reportedly comes from the reduction of green sturgeon spawning habitat to a limited area of the Sacramento River (70 FR 17391). The potential for catastrophic events to affect such a limited spawning area increases the risk of the green sturgeon's extirpation. The value of the upstream migration corridor is currently degraded mainly by the installation of the ACID dam (NMFS 2009a). Elevated water temperatures in the spawning and rearing habitat likely also pose threats to this species (70 FR 17391). The effects of future CVP/SWP system-wide operations under climate change scenarios would likely further degrade the water quality PCE.

As described by NMFS (2009a), there are few data with which to assess the status of green sturgeon in the Central Valley domain. NMFS (2009a) stated that the green sturgeon DPS is data deficient. Nonetheless, NMFS (2009a) concluded that the Southern DPS of North American green sturgeon remains vulnerable to becoming endangered in the future. Key factors upon which this conclusion was based include: (1) the DPS is comprised of only one spawning population, which has been blocked from a considerable portion of its potential spawning range by dams; (2) the DPS has a risk associated with catastrophes and environmental perturbations (i.e., water temperatures from Shasta Dam) affecting current spawning areas; and (3) mortality rates have significant effects on the adult and sub-adult life history phases of this long-lived species (NMFS 2009a).

NMFS (2009a) concluded that continued operations of the CVP/SWP would be expected to have population level consequences for the single extant population in the mainstem

Sacramento River, and greatly increase the extinction risk of the species (NMFS 2009a). Additionally, NMFS (2009a) concluded that the conservation value of the critical habitat, as designated for the conservation of green sturgeon, would be reduced.

NMFS (2009a) developed a RPA for green sturgeon in order to avoid jeopardy and adverse modification of critical habitat. The green sturgeon RPA specifies many significant actions that will reduce the adverse effects of the continued operation of the CVP/SWP and bring about the proper functioning of PCEs of its proposed critical habitat (NMFS 2009a).

The entire suite of limiting factors, threats, and stressors associated with the Environmental Baseline are likely to jeopardize the continued existence of the Southern DPS of North American green sturgeon (NMFS 2009a).

7.1.4 Lower Yuba River

The vast majority of the available information for the lower Yuba River addresses spring-run Chinook salmon where specifically identified, Chinook salmon in general where runs are not specifically identified, and *O. mykiss* (anadromous and resident forms). There is a paucity of information available regarding green sturgeon in the lower Yuba River.

Anadromous salmonid populations in the Yuba River watershed have endured nearly 150 years of intense human degradation of their riverine habitat, starting with hydraulic gold mining in the mid-nineteenth century, and continuing through the construction of dams and the ongoing development of water for hydropower and consumptive uses (NMFS 2007). According to UC Davis Professor Dr. Gregory Pasternack, "*the LYR is moving along on a path of natural, self-driven ecological recovery that is directly attributable to the existence of Englebright Dam. Englebright Dam protects the river from the vast wastes of a degraded watershed blocked upstream*" (see Appendix B, Attachment 3).

For this BA, the assessment of the Environmental Baseline within the Action Area for listed fish species considers: (1) past, present and ongoing limiting factors, threats and stressors described in Chapter 4; (2) full implementation of the Yuba Accord, which has occurred as a pilot program basis since 2006; and (3) the results of available lower Yuba

River fisheries monitoring data, current status of the listed species and the viability of these species as discussed in detail in Chapter 4.

It is problematic to incrementally assess the magnitude of an individual stressor because of the interconnectivity of individual stressors, and because the entire suite of limiting factors, threats and stressors associated with the Environmental Baseline has resulted in the current status and viability of the listed species within the Action Area. Nonetheless, based upon available information (see Chapter 4 of this BA) the following sections discuss, to the extent possible, each of the stressors associated with the Environmental Baseline regarding the relative magnitude of its contribution to the current status and viability of each listed species in the lower Yuba River.

7.1.4.1 Spring-run Chinook Salmon

The key limiting factors, threats and stressors associated with the Environmental Baseline affecting the spring-run Chinook salmon in the lower Yuba River include the following.

- Passage Impediments/Barriers
- Poaching
- Entrainment
- Loss of Natural River Morphology and Function
- Loss of Riparian Habitat and Instream Cover (riparian vegetation, instream woody material)
- Harvest/Angling Impacts
- Loss of Floodplain Habitat
- Predation
- Physical Habitat Alteration (including Waterway 13)
- Hatchery Effects (FRFH genetic considerations, straying into the lower Yuba River) and other genetic considerations

PASSAGE IMPEDIMENTS/BARRIERS

As described in Chapter 4 (Status of the Species), Englebright Dam presents an impassable barrier to the upstream migration of anadromous salmonids, and marks the upstream extent of currently accessible spring-run Chinook salmon habitat in the lower

Yuba River, whereas Daguerre Point Dam presents an impediment to upstream migration in the Action Area.

BARRIERS UPSTREAM OF THE ACTION AREA (ENGLEBRIGHT DAM)

Although located upstream of the Action Area, NMFS (2007, 2009) reports that the greatest impact to listed anadromous salmonids in the Yuba River watershed is the complete blockage of access for these species to their historical spawning and rearing habitat above Englebright Dam. Because this historic habitat is no longer accessible, spring-run Chinook salmon and steelhead are relegated to the 24 miles of the lower Yuba River from Englebright Dam to the confluence with the lower Feather River. Since construction of Englebright Dam in 1941, these species are required to complete all of their riverine lifestages in the 24 miles of the lower Yuba River, which previously served primarily as a migratory corridor to upstream spawning and rearing habitats.

The long-standing effects of Englebright Dam on the status of spring-run Chinook salmon and steelhead have affected the viability of these populations in the Yuba River. The lack of access to historic habitats upstream of Englebright Dam has reduced all four VSP parameters (abundance, productivity, spatial structure and genetic diversity) for spring-run Chinook salmon (and steelhead). Although the effects of the presence of Englebright Dam persist and continue to affect the status of the species in the Action Area, recent actions have ameliorated some of the stressors on these populations, which now are restricted to the lower Yuba River.

The NMFS (2009) Draft Recovery Plan states that, for currently occupied habitats below Englebright Dam, it is unlikely that habitats can be restored to pre-dam conditions, but many of the processes and conditions that are necessary to support viable independent populations of spring-run Chinook salmon and steelhead can be improved with provision of appropriate instream flow regimes, water temperatures, and habitat availability. Flow schedules specified in the Fisheries Agreement of the Yuba Accord were first implemented on a pilot program basis in 2006 and 2007, and then were implemented on a long-term basis in 2008, after the SWRCB made the necessary changes to YCWA's water right permits. Continued implementation of the Yuba Accord addresses flow-related major stressors, including flow-dependent habitat availability, flow-related habitat complexity and diversity, and water temperatures, and considerably improves conditions in the lower Yuba River (NMFS 2009).

Related to external influences in the upper Yuba River watershed that have the potential to affect the status of listed species present in the Action Area, NMFS (2007) identified the following non-flow related stressors associated with Englebright Dam: (1) blocking access of listed salmonids to the habitat above the dam; (2) forcing overlapping use of the same spawning areas by spring and fall-run Chinook salmon below the dam; (3) forcing fish to spawn in a limited area without the benefit of smaller tributaries, which can provide some level of refuge in the event of catastrophic events; and (4) preventing the recruitment of spawning gravel and LWM from upstream of the dam into the lower river.

Information developed since 2007 provides clarification regarding the fourth component in the foregoing list of stressors, as well as the influence of fluvial geomorphological processes affecting PCEs in the Action Area of the lower Yuba River.

The fluvial geomorphology of the Yuba River is so unique that it is crucial to evaluate it on its own terms and not to apply simple generalizations and concepts from other rivers with dams (Pasternack 2010). First, unlike most other rivers below dams, lack of spawning gravel is not limiting in the lower Yuba River, with the localized exception of the Englebright Dam Reach of the river, which extends from immediately downstream of Englebright Dam to the vicinity of the confluence with Deer Creek. In this reach, no rounded river gravels/cobbles, suitable for spawning, were present until a small amount (about 500 tons) of gravel was injected artificially by the Corps in the Narrows II pool area of the Englebright Dam Reach during November 2007 and the subsequent injections by the Corps of: (1) 5,000 tons of suitable spawning substrate downstream of the Narrows I powerhouse during the fall of 2010 extending to January 2011; (2) 5,000 tons of suitable spawning substrate downstream of the Narrows I powerhouse during July and August of 2012; and (3) 5,000 tons in the Englebright Dam Reach during July and August of 2013.

In the Timbuctoo Bend area of the lower Yuba River, Pasternack (2008) reported that there is adequate physical habitat to support spawning of Chinook salmon and steelhead. Farther downstream, spawning habitat does not appear to be limited by an inadequate supply of gravel within the Parks Bar and Hammon Bar reaches of the lower Yuba River, due to ample storage of mining sediments in the banks, bars, and training walls (cbec and McBain & Trush 2010). For the remainder of the lower Yuba River, Beak Consultants, Inc (1989) stated that the spawning gravel resources in the river are considered to be excellent based on the abundance of suitable gravels, and that the tremendous volumes of gravel remaining in the river as a result of hydraulic mining make it unlikely that spawning gravel will be in short supply in the foreseeable future.

Pasternack (2010) concluded that because of the pre-existing, unnatural condition of the river corridor influenced by mining debris, Englebright Dam… "*is actually contributing to the restoration of the river toward its historical geomorphic condition, in the truest meaning of the term - going back to the pre-existing state prior to hydraulic gold mining*." He further concluded that most of the lower Yuba River is still geomorphically dynamic and the river has a diversity of in-channel physical habitats, and that because Englebright Dam prevents residual mining wastes from moving downstream into the Action Area, channel complexity and habitat diversity in the lower Yuba River have been re-emerging, and that process continues.

Regarding the recruitment of woody material, some woody material may not reach the lower Yuba River due to collecting on the shoreline and sinking in Englebright Reservoir, or due to New Bullard's Bar Dam blocking natural downstream migration. However, Englebright Dam does not functionally block woody material from reaching the lower Yuba River because any accumulated woody material either spills over the dam during uncontrolled flood events or otherwise is pushed over the dam by the Corps.

In conclusion, the lack of spawning gravel (or recruitment thereof) is not a significant stressor to spring-run Chinook salmon in the lower Yuba River, with the exception of the Englebright Dam Reach. Moreover, the abundance of LWM in the lower Yuba River is not substantively attributable to the presence of Englebright Dam. Ongoing effects associated with Englebright Dam include the loss of historical spawning and rearing habitat above Englebright Dam, resultant loss of reproductive isolation and subsequent hybridization with fall-run Chinook salmon, restriction of spatial structure and associated vulnerability to catastrophic events. Although the genesis of these stressors emanate upstream of the Action Area at Englebright Dam, the manifestation of these stressors affect the current status of the species in the Action Area in the lower Yuba River.

IMPEDIMENTS WITHIN THE ACTION AREA (DAGUERRE POINT DAM)

Adult Upstream Migration

Daguerre Point Dam has been reported to be an impediment to upstream migration of adult salmon and steelhead under certain conditions. When high flow conditions occur during winter and spring, adult spring-run Chinook salmon (and steelhead) have been reported to experience difficulty in finding the entrances to the ladders because of the relatively low amount of attraction flows exiting the fish ladders, compared to the magnitude of the sheet-flow spilling over the top of Daguerre Point Dam. The angles of the fish ladder entrance orifices and their proximities to the plunge pool also increase the difficulty for fish to find the entrances to the ladders. Periodic obstruction of the ladders by sediment and woody debris may temporarily block passage or reduce attraction flows at the ladder entrances.

Other configuration and design features of the fish ladders and passage facilities that reportedly could either delay or impede access to spawning and rearing areas above the dam include: (1) the fish ladder control gate entrance, acting as a submerged orifice, is more passable at low flows (actual flow data are unavailable) during the summer and fall than at high flows during winter and spring; (2) unfavorable within-bay hydraulic characteristics, particularly associated with debris collection; (3) "masking" of the entrances to the ladders when overflow over the spillway occurs; (4) insufficient attraction flows during non-overflow operational conditions; (5) unfavorable fish ladder geometric configurations; (6) proximity of the ladder exits to the spillway, potentially resulting in adult fish exiting the ladder being immediately swept by flow back over the dam; and (7) sediment accumulation and unfavorable habitat conditions at the upstream exits of the fish ladders, resulting in reduced unimpeded passage from the ladders to the main channel, and the potential for fish to "fall-back" into the ladders. In addition, it has been suggested that poaching within the fish ladders and downstream of the dam occurs when fish become concentrated in the area due to delayed passage (NMFS 2005a), although grates have been installed over most of the ladder bays during 2011.

NMFS (2007) suggested that the biological consequences of blockage or passage delays include changes in spawning distribution, increased adult pre-spawning mortality, and decreased egg viability, which may result in the reduction of the abundance and productivity of spring-run Chinook salmon and steelhead. Each of these potential biological consequences is discussed below in consideration of information that has become available since 2007 (also see the discussion regarding fish ladders and fish passage in Chapter 5).

Recent information (2009, 2010 and 2011 acoustic tracking) demonstrates that phenotypic spring-run Chinook salmon (Chinook salmon that enter the lower Yuba River during spring months) display variable upstream migration and holding patterns, and that some fish may remain in the lower Yuba River in areas downstream (and proximate) to Daguerre Point Dam for extended periods of time during the spring and summer. It is uncertain whether, or to what extent, the duration of residency in the large pool located downstream of Daguerre Point Dam is associated with upstream passage impediment and delay, or volitional habitat utilization prior to spawning in upstream areas.

The RMT (2013) examined passage and flow data to evaluate whether upstream passage could be associated with either an ascending or descending hydrograph, or that the fish ladders may impede or prohibit passage at high or low flow levels. Examination of the daily number of adult Chinook salmon passing upstream of Daguerre Point Dam obtained by the VAKI Riverwatcher system from 2004 through 2011, and mean daily flows at the Marysville Gage did not reveal any consistent trend or relationship between adult Chinook salmon passage upstream of Daguerre Point Dam and flow rate. Chinook salmon passage was observed over a variety of flow conditions, including ascending or descending flows, as well as during extended periods of stable flows.

The RMT (2013) further evaluated whether adult Chinook salmon upstream passage through the ladders at Daguerre Point Dam is associated with specific flow levels. They reported that Chinook salmon upstream passage through the ladders at Daguerre Point Dam not only occurs over a wide range of flows but that, at least to some degree, passage occurs during the upstream migration period irrespective of flow rates (over the range of flows examined). In other words, passage occurs at higher flows during "wetter" years characterized by high flows from spring into summer, and at lower flows during “drier” years characterized by low flows from spring into summer. Flow thresholds prohibiting passage of Chinook salmon through the ladders at Daguerre Point Dam were not apparent in the data.

The RMT’s 3-year acoustic telemetry study of adult Chinook salmon tagged during the phenotypic adult spring-run Chinook salmon upstream migration period has provided new information to better understand adult spring-run Chinook salmon temporal and spatial distributions in the Yuba River. The results from the acoustic telemetry study found past characterizations of temporal and spatial distributions to be largely unsupported, as adult spring-run Chinook salmon were observed to exhibit a much more diverse pattern of movement, and holding locations in the lower Yuba River were more expansive than has been previously reported (RMT 2013). Observations from the telemetry study identified that a large longitudinal extent of the lower Yuba River was occupied by the tagged spring-run Chinook salmon during immigration and holding periods. Also, temporal migrations to areas upstream of Daguerre Point Dam occurred over an extended period of time. A longitudinal analysis of acoustic tag detection data indicated that distributions were non-random, and that the tagged spring-run Chinook salmon were selecting locations for holding.

Flows under the Yuba Accord have provided adult spring-running Chinook salmon migratory access to areas located throughout the lower Yuba River, as well as a broad expanse of longitudinally distributed areas selected for holding. In general, acoustically-tagged spring-run Chinook salmon exhibited an extended holding period, followed by a rapid movement into upstream areas (i.e., the upper Timbuctoo Reach, Narrows Reach, and Englebright Dam Reach) during September (RMT 2013).

Regarding potential changes in spawning distribution, it is not possible to assess if, or the manner in which, extended duration of holding below Daguerre Point Dam could potentially change spawning distribution, because no base data are available for conditions without the presence of Daguerre Point Dam.

During the RMT’s pilot redd survey conducted from the fall of 2008 through spring of 2009, the vast majority (i.e., 96%) of fresh Chinook salmon redds constructed by the first week of October 2008, potentially representing spring-run Chinook salmon, were observed upstream of Daguerre Point Dam. Similar distributions were observed during the other two years of redd surveys, when weekly redd surveys were conducted. About 97% and 96% of the fresh Chinook salmon redds constructed by the first week of October were observed upstream of Daguerre Point Dam during 2009 and 2010, respectively.

The similar percentage distribution of Chinook salmon redds, potentially representing spring-run Chinook salmon, located upstream of Daguerre Point Dam occurred despite considerable differences in flow (monthly average cfs) that occurred from late spring into fall prior to each of the redd survey periods, as indicated below.

	June	July	August	September
Marysville Gage				
2008	597	866	882	622
2009	1,846	1,737	1,715	768
2010	4,067	2,698	1,991	768
Smartsville Gage				
2008	1,334	1,621	1,490	868
2009	2,065	1,992	1,866	832
2010	4,516	3,104	2,273	896

Regarding increased adult prespawning mortality, one way that adult prespawning mortality could occur is the potential for fish to jump out of the fish ladders. Because this phenomenon has rarely been observed or reported historically, and potential effects have been further eliminated/reduced following the installation of locking metal grates over 25 of the 33 unscreened bays of the fish ladders during the summer of 2011, it has likely represented a low impact to Yuba River spring-run Chinook salmon, but nonetheless has been identified as a stressor that could harm adult fish. Another way that adult prespawning mortality could occur is associated with anecdotal reported observations of Chinook salmon (run unspecified) leaping into the downstream face of Daguerre Point Dam, although no information is available regarding the potential extent or frequency of this reported phenomenon. It is possible that prespawning adult mortality could occur from repeated attempts to pass over the dam and injuries resulting from contact with the rough concrete surface of the dam face. However, it is unlikely that this represents a significant source of mortality to spring-run Chinook salmon.

Adult prespawning acute or latent mortality also could occur due to exposure to elevated water temperatures, which could also affect egg viability. The RMT (2013) included evaluation of water temperatures during the spring-run Chinook salmon adult upstream immigration and holding lifestage, which addressed considerations regarding both water temperature effects to pre-spawning adults and egg viability. They found that available water temperature monitoring data at all three gages (i.e., Smartsville, Daguerre Point Dam, Marysville) were always below the upper tolerance WTI values for adult immigration and holding. Thus, it is unlikely that this represents a significant source of mortality to spring-run Chinook salmon.

Juvenile Downstream Migration

Concern has been expressed that if emigrating salmon and steelhead juveniles encounter high water temperatures in the reach below Daguerre Point Dam, they cannot return to the lower-temperature habitat upstream because their passage is blocked by the dam (DWR and Corps 2003). However, this concern was raised prior to implementation of the Yuba Accord minimum flow schedules and associated water temperatures (initiated as a Pilot Program in 2006 and continuing to present). The RMT (2013) also included evaluation of water temperatures in the lower Yuba River during the year-round juvenile rearing period for spring-run Chinook salmon (and steelhead), and found that water temperatures at all three gages (i.e., Smartsville, Daguerre Point Dam, Marysville) were always below the upper tolerance WTI values for the juvenile rearing and outmigration lifestage. Thus, it is unlikely that this represents a significant source of mortality to spring-run Chinook salmon.

Daguerre Point Dam may influence predation rates on emigrant juvenile anadromous salmonids. Although it is recognized that there is a paucity of information regarding predation rates on juvenile salmonids in the lower Yuba River, predation likely represents a stressor of relatively high magnitude to the juvenile rearing lifestage of Yuba River spring-run Chinook salmon. The presence of Daguerre Point Dam may influence predation rates above Daguerre Point Dam compared to below Daguerre Point Dam. The higher abundance of juvenile anadromous salmonids above Daguerre Point Dam may be due to larger numbers of spawners, greater amounts of more complex, high-quality cover, and lower densities of predators such as striped bass and American shad, which reportedly are generally restricted to areas below the dam due to their limited ability to pass through the fish ladders, relative to anadromous salmonids (YCWA et al. 2007). Daguerre Point Dam also may influence localized predation rates by increased predation of juveniles in the plunge pool located immediately downstream of the dam.

Summary

Given the entire suite of considerations associated with the design configuration and features of Daguerre Point Dam and its associated fish ladders that reportedly could either delay or impede adult upstream migration, as well as issues identified regarding juvenile downstream passage, the effects associated with the presence of Daguerre Point Dam likely represent a medium to high stressor to Yuba River spring-run Chinook salmon under the Environmental Baseline.

HARVEST/ANGLING IMPACTS

Angling regulations on the lower Yuba River are intended to protect sensitive species, in particular spring-run Chinook salmon (and wild steelhead). The lower Yuba River from its confluence with the lower Feather River up to Englebright Dam is closed year-round to salmon fishing, and no take or possession of salmon is allowed.

Fishing for hatchery trout or hatchery steelhead is allowed on the lower Yuba River from its confluence with the lower Feather River up to the Highway 20 Bridge year-round. Incidental impacts have the potential to occur to spring-run Chinook salmon through physical disturbance of salmonid redds, and incidental hooking and catch-and-release stress or mortality. However, the lower Yuba River, between the Highway 20 Bridge and Englebright Dam, is closed to fishing from September through November to protect spring-run Chinook salmon spawning activity and egg incubation.

Harvest/angling likely represents a negligible impact to Yuba River adult spring-run Chinook salmon. Hence, harvest/angling is characterized as a stressor of low magnitude to spring-run Chinook salmon.

Poaching

Poaching of adult Chinook salmon at the fish ladders and at the base of Daguerre Point Dam has been previously suggested to represent a stressor to spring-run Chinook salmon. NMFS' Draft Recovery Plan (NMFS 2009) identified poaching as a stressor of “low” importance to spring-run Chinook salmon in the lower Yuba River. The only actual account of documented poaching was provided in a declaration by Nelson (2009) in which he stated that during his tenure at CDFW (which extended until 2006) he personally observed people fishing illegally in the ladders, and further observed gear around the ladders used for poaching. It is not clear regarding the time period to which he was referring, although it may have been referring to the period prior to 2000. The VAKI Riverwatcher infrared and videographic sampling system began operations in 2003. CDFW monitored VAKI Riverwatcher operations at Daguerre Point Dam seasonally from 2003 through 2005, and CDFW and/or PSMFC have monitored the system on an approximate every other day basis, year-round, since 2006. Over this 10-year period, neither CDFW nor PSMFC staff has reported poaching in the ladders, or immediately downstream of Daguerre Point Dam.

More recently, in a July 2011 Court Order, the Federal Court of the Eastern District of California concluded that “*installation of locked metal grates over the Daguerre fish ladders is necessary to prevent irreparable harm to the survival and recovery of the species during the interim period*”. In response to the Court’s Order, the Corps installed locking metal grates over the Daguerre Point Dam fish ladder bays[1] in August/September 2011 to prevent fish from jumping out of the ladders and to prevent poaching in the fish ladders.

[1] Excluding the eight bays on the lowermost section of the south fish ladder at Daguerre Point Dam so that CDFW can maintain continued access to the flow modification equipment that is located in the fish ladder and designed to improve fish passage conditions.

The extent to which spring-run Chinook salmon are targeted for poaching in the lower Yuba River is unknown, and it is unclear whether the previous reports of poaching were directed toward spring-run or fall-run Chinook salmon. With the installation of the metal grates over the Daguerre Point Dam fish ladders, poaching likely represents a low (or negligible) stressor to Yuba River adult spring-run Chinook salmon.

Physical Habitat Alteration

According to NMFS (2009), the stressor associated with physical habitat alteration specifically addressed the issue of return flows and attraction of anadromous salmonids into the Yuba Goldfields through Waterway 13. As previously discussed in Chapter 5, efforts have been undertaken to prevent anadromous salmonids from entering the Goldfields via Waterway 13 during the mid-1980s, 1997, and 2003. In May 2005, heavy rains and subsequent flooding breached the structure at the east (upstream facing) end. Subsequently, the earthen “plug” was replaced with a "leaky-dike" barrier intended to serve as an exclusion device for upstream migrating adult salmonids (AFRP 2010). During July of 2011, it was confirmed that the "leaky-dike" barrier had been washed out, presumably due to high flood flows that occurred during May of 2011. Because of the episodic occurrence of attraction flows emanating from Waterway 13, it likely represents a relatively low stressor to the adult lifestage of Yuba River spring-run Chinook salmon.

In addition to Waterway 13 issues, physical habitat alternation stressors include Lake Wildwood operations, which are controlled by the Lake Wildwood Association, and the potential for stranding of adult Chinook salmon in Deer Creek, near its confluence with the lower Yuba River, due to changes in Lake Wildwood operations. Given the infrequent observation of this phenomenon and the relative magnitude compared to the lower Yuba River, Lake Wildwood operations likely represent a relatively low stressor to the adult lifestage of Yuba River spring-run Chinook salmon.

Entrainment

Water diversions at and in the vicinity of Daguerre Point Dam in the lower Yuba River generally occur during two seasons. The agricultural irrigation season generally extends from approximately April 1 through mid-October. Additional diversions occur during the waterfowl/straw management season which generally extends from mid-October through January. Overall, diversions are relatively low from January through March, and diversions are highest from May through August.

As described in Chapter 5, a new state-of-the-art fish screen that meets NMFS and CDFW screening criteria was installed at the BVID Pumpline Diversion Facility in 1999 (SWRCB 2001; NMFS 2002; CALFED and YCWA 2005). The SWRCB (2001) determined that the new fish screen at the BVID diversion facility provided adequate protection for juvenile salmonids, and that BVID should continue to operate and maintain the fish screen in compliance with NMFS and CDFW criteria. The BVID diversion is not licensed by the Corps and it has no direct physical link to Corps property.

Under the Environmental Baseline, ongoing effects of diversions at the Hallwood-Cordua and South Yuba/Brophy diversion facilities represent potential threats to juvenile salmonids (NMFS 2009). The relatively recent fish screen constructed at the Hallwood-Cordua diversion is considered a notable improvement over the previous design, and likely has eliminated any significant entrainment at the Hallwood-Cordua diversion.

The issues of impingement and entrainment at the South Yuba/Brophy Diversion Canal and Facilities have been the subject of numerous evaluations over the past many years. NMFS (2007) noted that several studies have suggested that the structure does not exclude juvenile salmonids from being entrained into this diversion. However, Bergman et al. (2013) concluded that present operations at the diversion facility provide adequate bypass flows to create positive sweeping velocities along the rock gabion, and measured approach velocities satisfied NMFS approach velocity standards except at a bend at the upstream end of the rock gabion, where an eddy draws water up-river. The end of the gabion where an eddy draws water up-river was identified because this anomalous area of higher approach velocities did not meet the NMFS (2011d) criteria of providing “nearly uniform” flow distribution along the face of a screen and, thus, may increase susceptibility of juvenile salmonids to impingement or entrainment.

Spring-run Chinook salmon spawn upstream of Daguerre Point Dam, but only a portion of the annual year-class of outmigrant juvenile spring-run Chinook salmon pass Daguerre Point Dam during the diversion season, particularly during the relatively high diversion period extending from May through August. Based on analysis of RST data, most (over 85 percent) of outmigrant juvenile Chinook salmon are captured during the relatively low diversion period extending from late fall through March and therefore would be reasonably assumed to be subjected to commensurate relatively low amounts of entrainment. Also, many of these fish exceed fry size, which is the size most susceptible to entrainment. Consequently, entrainment likely represents a stressor of low to medium magnitude to the juvenile lifestage of Yuba River spring-run Chinook salmon.

Predation

The extent of predation on juvenile Chinook salmon in the lower Yuba River is not well documented (NMFS 2009). Although predation is a natural component of salmonid ecology, it has been suggested that the rate of predation of salmonids in the lower Yuba River has potentially increased through the introduction of non-native predatory species such as striped bass, largemouth bass and American shad, and through the alteration of natural flow regimes and the development of structures that attract predators (NMFS 2009).

Daguerre Point Dam creates a large plunge pool at its base, which may provide ambush habitat for predatory fish in an area where emigrating juvenile salmonids may be disoriented after plunging over the face of the dam into the deep pool below (NMFS 2002). It has been suggested that the rate of predation of juvenile salmonids passing over dams in general, and Daguerre Point Dam in particular, may be unnaturally high (NMFS 2007). It also has been suggested that unnaturally high predation rates may also occur in the diversion channel associated with the South Yuba/Brophy diversion (NMFS 2007). Demko and Cramer (2000a) reviewed all studies previously performed at the South Yuba/Brophy diversion, and found that none of the research by USFWS, CDFW, or fisheries consultants had indicated that juvenile Chinook became disoriented upon entering the diversion channel, or that abnormally high predation on juvenile Chinook salmon occurred. Nonetheless, SWRCB (2001) stated that there was no way to prevent water from entering the diversion channel when water was not being diverted into the South Canal for irrigation, and that therefore losses due to predation occur even when no water is being diverted for beneficial use.

Other structure-related predation issues in the Environmental Baseline include the potential for increased rates of predation of juvenile salmonids: (1) in the entryway of the Hallwood-Cordua diversion canal upstream of the fish screen; and (2) at the point of return of fish from the bypass pipe of the Hallwood-Cordua diversion canal into the lower Yuba River. The relatively recent fish screen constructed at the Hallwood-Cordua diversion is considered a notable improvement over the previous design, but the configuration of the bypass return pipe and predation losses of emigrating fry and juvenile Chinook salmon, including spring-run Chinook salmon, remain a concern.

As previously discussed, most juvenile Chinook salmon and steelhead rearing has been reported to occur above Daguerre Point Dam. The higher abundance of juvenile salmonids above Daguerre Point Dam may be due to larger numbers of spawners, greater amounts of more complex, high-quality cover, and lower densities of predators such as striped bass and American shad, which reportedly are generally restricted to areas below the dam (YCWA et al. 2007).

For the purpose of stressor identification in this BA, predation includes the predation associated with increases in predator habitat and predation opportunities for piscivorous species created by major structures and diversions, and predation resulting from limited amounts of prey escape cover in the lower Yuba River. Consequently, predation of juvenile salmonids by introduced and native piscivorous fishes occurs throughout the lower Yuba River potentially at relatively high rates. Therefore, predation likely represents a high stressor to the juvenile lifestage of Yuba River spring-run Chinook salmon.

Loss of Natural River Morphology and Function

The loss of natural river morphology and function is the result of river channelization and confinement, which leads to a decrease in riverine habitat complexity and, thus, to a decrease in the quantity and quality of adult and juvenile anadromous salmonid habitat. This is a particularly operative stressor affecting juvenile anadromous salmonid rearing habitat availability.

From a floodplain meander perspective, braided channels, side channels, and channel sinuosity are created through complex hydraulic-geomorphic interactions. Attenuated peak flows and controlled flow regimes emanating from the upper Yuba River watershed, and the influence of gravel berms along portions of the lower Yuba River have affected the natural meandering of the lower Yuba River in the Action Area. As stated by UC Davis Professor Greg Pasternack (see Appendix B, Attachment 3) "… *the morphology of the LYR is self-determined, dynamic, and increasing habitat complexity over time due to the restorative role of Englebright Dam relative to the vast reservoir and continuing influx of hydraulic mining waste upstream of that barrier. It is true that the LYR's morphology is altering, but all the evidence indicates that the alterations are beneficial, not harmful, and are driven by understandable and beneficial natural processes*". Nonetheless, loss of natural river morphology and function presently continues to represent a relatively high stressor to Yuba River spring-run Chinook salmon under the Environmental Baseline.

LOSS OF FLOODPLAIN HABITAT

Off-channel habitats such as floodplains, riparian, and wetland habitats have been suggested to be of major importance for the growth and survival of juvenile salmon (Moyle 2002). These habitats also promote extended rearing and expression of the stream-type rearing characteristic of spring-run Chinook salmon. Within the Yuba Goldfields area (RM 8–14), confinement of the river by massive deposits of cobble and gravel derived from hydraulic and dredge mining activities resulted in a relatively simple river corridor dominated by a single main channel and large cobble-dominated bars, with little riparian and floodplain habitat (DWR and PG&E 2010).

For this BA, a distinction is made between floodplain habitat and the previously discussed stressors of physical habitat alteration and loss of natural morphology and function, both of which focused on habitat and complexity in the lower Yuba River. Considerations of those stressors included adult and juvenile lifestages. Floodplain habitat, as considered in this section of the BA, is more narrowly focused on the inundation of floodplain habitat and associated effects on juvenile rearing. In consideration that this stressor primarily addresses one lifestage, that inundation of floodplain habitat occurs relatively frequently compared to other Central Valley streams (see Chapter 4), that inundation of floodplain habitat would not necessarily occur each year even under unaltered hydrologic conditions, and that the lower Yuba River floodplain is comprised of unconsolidated alluvium without an abundance of characteristics associated with increased juvenile salmonid growth, loss of floodplain habitat availability likely represents a medium stressor to Yuba River juvenile spring-run Chinook salmon.

LOSS OF RIPARIAN HABITAT AND INSTREAM COVER (RIPARIAN VEGETATION, INSTREAM WOODY MATERIAL)

Mature riparian vegetation is relatively sparse and intermittent along the lower Yuba River, leaving much of the bank areas unshaded. It has previously been reported that relatively low amounts of LWM occur in the lower Yuba River because of the general paucity of riparian vegetation throughout much of the lower Yuba River, and because some of the upstream dams in the upper Yuba River watershed reduce the downstream transport of LWM (cbec and McBain & Trush 2010).

In 2012, YCWA conducted a riparian habitat and woody material studies in the Yuba River from Englebright Dam to the confluence with the Feather River. In the lower Yuba River, although woody material was found to be relatively ubiquitous (see Appendix B, Attachment 3), it was generally found in bands of willow (*Salix sp.*) shrubs near the wetted edge, dispersed across open cobble bars, and stranded above normal high-flow indicators. Most (77-96%) pieces of wood found in each reach surveyed were smaller than 25 feet in length and smaller than 24 inches in diameter, which is the definition of LWM (RMT 2013). The largest size classes of LWM (i.e., longer than 50 feet and greater than 24 inches in diameter) were rare or uncommon (i.e., fewer than 20 pieces total) with no discernible distribution. Pieces of this larger size class were counted as "key pieces", as were any pieces exceeding 25 inches in diameter and 25 feet in length and showing any morphological influence (e.g., trapping sediment or altering flow patterns). A total of 15 key pieces of LWM were found in all study sites, including six in the Marysville study site. Few of the key pieces were found in the active channel or exhibiting channel forming processes. As previously discussed, the abundance of LWM in the lower Yuba River is not substantively attributable to the presence of Englebright

Dam upstream of the Action Area because accumulated woody material spills over the dam during uncontrolled flood events and otherwise is pushed over by the Corps.

LWM creates both micro- and macro-habitat heterogeneity by forming pools, back eddies and side channels and by creating channel sinuosity and hydraulic complexity. This habitat complexity provides juvenile salmonids numerous refugia from predators and water velocity, and provides efficient locations from which to feed. Snorkeling observations in the lower Yuba River have indicated that juvenile Chinook salmon had a strong preference for near-shore habitats with instream woody material (JSA 1992).

In consideration of the importance that riparian vegetation and LWM play in the habitat complexity and diversity which potentially limits the productivity of juvenile salmonids, the abundance and distribution of these physical habitat characteristics in the lower Yuba River, and the fact that the present availability of riparian habitat and instream cover (in the form of LWM) is a stressor that is manifested every year, it represents a stressor of relatively high magnitude to Yuba River juvenile spring-run Chinook salmon.

Hatchery Effects (FRFH Genetic Considerations, Straying into the Lower Yuba River) and other Genetic Considerations

FRFH hatchery spring-run Chinook salmon straying into the lower Yuba River and interbreeding with naturally-spawning Yuba River spring-run Chinook salmon has been suggested to represent a threat to the genetic integrity of the naturally-spawning spring-run Chinook salmon population in the lower Yuba River. This suggested threat raises the question of the present genetic integrity of the fish expressing phenotypic characteristics of spring-run Chinook salmon in the lower Yuba River.

Between 1900 and 1941, debris dams constructed on the lower Yuba River by the California Debris Commission completely or partially blocked the migration of Chinook salmon and steelhead to historic spawning and rearing habitats. Upstream of the Action Area, Englebright Dam (constructed in 1941) continues to completely block spawning runs of Chinook salmon and steelhead, and is the upstream limit of anadromous salmonid migration. CDFG (1991) reported that a small spring-run Chinook salmon population historically occurred in the lower Yuba River, but the run virtually disappeared by 1959.

Since the completion of New Bullards Bar Reservoir in 1970 by YCWA, higher, colder flows in the lower Yuba River have improved conditions for over-summering and spawning of spring-run Chinook salmon in the lower Yuba River downstream of Englebright Dam (YCWA et al. 2007). As of 1991, a remnant spring-run Chinook salmon population reportedly persisted in the lower Yuba River downstream of Englebright Dam, maintained by fish produced in the lower Yuba River, fish straying from the Feather River, or fish previously and infrequently stocked from the FRFH (CDFG 1991).

If spring-run Chinook salmon were extirpated from the lower Yuba River in 1959 and, as reported by CDFG (1991), a population of spring-run Chinook salmon became reestablished in the 1970s due to improved habitat conditions and fish straying from the Feather River or stocked and straying from the FRFH, then it is likely that spring-run Chinook salmon on the lower Yuba River do not represent a “pure” ancestral genome. In fact, in the report titled *Salmonid Hatchery Inventory and Effects Evaluation* (NMFS 2004), through an analysis of Yuba River Chinook salmon tissues, NMFS genetically linked the spring-run and fall-run Chinook salmon populations, which exhibit a merged run timing similar to that found in the Feather River. More recently, NMFS Southwest Fisheries Science Center conducted a preliminary genetic analysis of tissues collected from adult Chinook salmon downstream of Daguerre Point Dam in the lower Yuba River during May 2009 (i.e., phenotypic spring-run Chinook salmon). Of the 43 samples, 28 were positively identified as Feather River spring-run Chinook salmon. The remaining 15 samples were all identified as Central Valley fall-run Chinook salmon, primarily from the Feather River. These preliminary results are presented with the strong cautionary note that the genetic analyses have somewhat limited ability to distinguish Central Valley fall-run Chinook salmon from Feather River spring-run Chinook salmon due to past introgression, and due to incomplete databases for some Central Valley populations.

Available information indicates that the phenotypic spring-run Chinook salmon in the lower Yuba River actually represents hybridization between spring- and fall-run Chinook salmon in the lower Yuba River, and hybridization with Feather River stocks including the FRFH spring-run Chinook salmon stock, which itself represents a hybridization between Feather River fall- and spring-run Chinook salmon populations (RMT 2013).

The FRFH "spring-run" stock is dominated by fall-run ancestry (Garza et al. 2008). However, the FRFH "spring" run retains remnants of the phenotype and ancestry of the Feather River spring-run Chinook salmon that existed prior to the Oroville Dam and the FRFH, but has been heavily introgressed by fall-run Chinook salmon through some combination of hatchery practices and hybridization induced by lack of access to spring-run Chinook salmon habitat above Oroville Dam. This suggests that it may be possible to preserve some additional component of the ancestral Central Valley spring-run Chinook salmon genomic variation through careful management of this stock, although it will not be possible to reconstitute a "pure" spring-run stock from these fish (Garza et al. 2008).

The FRFH spring-run Chinook salmon population is part of the Central Valley spring-run Chinook salmon ESU (NMFS 2005d) and, therefore, is protected by the applicable provisions of the ESA. At the time of issuance of the final rule regarding the listing status of the Central Valley ESU of spring-run Chinook salmon, NMFS (2005d) recognized that naturally spawning spring-run Chinook in the Feather River are genetically similar to the FRFH spring-run Chinook stock, and that the hatchery stock shows evidence of introgression with Central Valley fall-run Chinook salmon. However, NMFS also stated that FRFH stock should be included in the ESU because the FRFH spring-run Chinook salmon stock may play an important role in the recovery of spring-run Chinook salmon in the Feather River Basin, as efforts progress to restore natural spring-run populations in the Feather and Yuba Rivers (NMFS 2005d).

In summary, available information indicates the following.

- ❑ Two fishways, one for low water and the other for high water, were constructed at Daguerre Point Dam prior to the floods of 1927-1928. The ladders were destroyed by floods in 1927 and 1928.
- ❑ Fish passage was not provided until a new ladder was constructed on the south end of the dam in 1938.
- ❑ Between 1928 through 1934, there was a 10-year drought, which raised water temperatures below Daguerre Point Dam much higher than those tolerated by Chinook salmon and may have caused the extirpation of spring-run Chinook salmon from the lower Yuba River.

- A small spring-run Chinook salmon population historically occurred in the lower Yuba River, but the run virtually disappeared by 1959.
- By 1991, a small spring-run Chinook salmon population became reestablished in the lower Yuba River due to improved habitat conditions and due to recolonization by fish straying from the Feather River, fish previously and infrequently stocked from the FRFH, or possible production from a remnant population in the lower Yuba River.
- The phenotypic spring-run Chinook salmon in the lower Yuba River actually represents hybridization between spring- and fall-run Chinook salmon in the lower Yuba River, and hybridization with Feather River stocks including the FRFH spring-run Chinook salmon stock.
- The FRFH spring-run Chinook salmon stock itself represents a hybridization between Feather River fall- and spring-run Chinook salmon populations.
- Straying from FRFH origin "spring-run" Chinook salmon into the lower Yuba River has and continues to occur, and this rate of straying is associated with "attraction flows" – the relative proportion of lower Yuba River flows to lower Feather River flows (see Chapter 4 of this BA).
- The FRFH spring-run Chinook salmon is included in the ESU, and is therefore afforded protection under the ESA, in part because of the important role this stock may play in the recovery of spring-run Chinook salmon in the Feather River Basin, including the Yuba River (NMFS 2005d).
- Although the FRFH spring-run Chinook salmon population is part of the Central Valley spring-run Chinook salmon ESU, concern has been expressed that straying of FRFH fish into the lower Yuba River may represent an adverse impact to the genetic integrity of lower Yuba River stocks. This concern is due to the potential influence of previous hatchery management practices on the genetic integrity of FRFH spring-run Chinook salmon.

Straying of FRFH "spring-run" Chinook salmon into the lower Yuba River has oftentimes been suggested to represent an adverse impact on lower Yuba River "spring-run" Chinook salmon stocks. It is reasonable to assume that such straying would represent an impact if the lower Yuba River stocks represented a genetically distinct, independent population. However, given the foregoing available information, spring-run Chinook salmon on the lower Yuba River do not represent a "pure" ancestral genome.

In conclusion, past hatchery practices and straying of FRFH fish into the lower Yuba River have resulted in a stressor of a relatively high magnitude on the potential for the lower Yuba River to support a genetically distinct, independent population of spring-run Chinook salmon. The continued and ongoing influx of FRFH-origin fish under the Environmental Baseline would represent a relatively high stressor if the management goal is to reestablish a genetically distinct, independent population of spring-run Chinook salmon in the lower Yuba River. However, data obtained through the course of implementing the M&E Program demonstrate that phenotypically "spring-running" Chinook salmon in the lower Yuba River do not represent an independent population – rather, they represent an introgressive hybridization of the larger Feather-Yuba river regional population (RMT 2013). Continued influx of FRFH-origin fish into the lower Yuba River contributes to the present and ongoing maintenance of phenotypic spring-run Chinook salmon populations in the lower Yuba River.

Summary of Environmental Baseline Stressors on Spring-run Chinook Salmon

The Yuba Accord RMT prepared an interim report of the Monitoring and Evaluation Program in April 2013, which assessed the VSP parameters using all information available up to that time. Given the information presently available, following is a summary of Environmental Baseline stressors on spring-run Chinook salmon.

Intermittently from the early 1900s until 1941, and consistently since 1941 with the construction of Englebright Dam by the California Debris Commission, access to historic habitats upstream of Englebright Dam has been blocked and has therefore reduced all four VSP parameters (abundance, productivity, spatial structure and genetic diversity) for spring-run Chinook salmon in the Yuba River watershed. Although the stressors associated with the presence of Englebright Dam persist and continue to affect the status of the species in the Action Area, recent actions have ameliorated flow-related stressors on the spring-run Chinook salmon population now restricted to the lower Yuba River.

This BA has presented available information regarding the present status of the VSP parameters of abundance, productivity, spatial structure and diversity of spring-run Chinook salmon in the lower Yuba River. Additionally, available information regarding the PCEs and characteristics of critical habitat in the Action Area (i.e., the lower Yuba River extending from the upstream extent of where in-river gravel placement has occurred (an area that is located within the first 300 feet below Englebright Dam) downstream to the mouth of the lower Yuba River) has been described and discussed, including the relative magnitude of the stressors affecting the Yuba River spring-run Chinook salmon population associated with the Environmental Baseline. The entire suite of information and analyses indicates that the phenotypic spring-run Chinook salmon annual abundance in the lower Yuba River over the evaluated time period (2004-2011) is stable, and is not exhibiting a significant declining trend (RMT 2013). Under the Environmental Baseline, these abundance and trend considerations would correspond to low extinction risk according to NMFS criteria (Lindley et al. 2007). However, the RMT (2013) questions the applicability of any of these criteria addressing extinction risk, because they presumably apply to independent populations and, as previously discussed, lower Yuba River anadromous salmonids represent introgressive hybridization of larger Feather-Yuba river populations, with substantial contributions of hatchery-origin fish to the annual runs.

7.1.4.2 Steelhead

Many of the most important stressors specific to steelhead in the Action Area of the lower Yuba River correspond to the stressors described for spring-run Chinook salmon. These stressors include passage impediments and barriers, harvest and angling impacts, poaching, physical habitat alteration, loss of riparian habitat and instream cover (e.g., riparian vegetation, LWM), loss of natural river morphology and function, loss of floodplain habitat, entrainment, predation, and hatchery effects. The foregoing discussion in this BA addressing stressors for the phenotypic spring-run Chinook salmon population in the lower Yuba River that are pertinent to the steelhead population in the lower Yuba River is not repeated here. Stressors that are unique to steelhead in the lower Yuba River, and stressors that substantially differ in severity for steelhead, include harvest/angling impacts, poaching, and hatchery effects were specifically described in Chapter 4 of this BA. The remainder of this section summarily discusses each of the stressors associated with the Environmental Baseline, regarding the relative magnitude of the stressor and its contribution to the current status of steelhead in the lower Yuba River.

Passage Impediments/Barriers

Barriers Upstream of the Action Area (Englebright Dam)

Lack of spawning gravel (or recruitment thereof) is not a significant stressor to steelhead, and the reported restricted abundance of LWM in the lower Yuba River is not substantively attributable to the presence of Englebright Dam. Some of the other upstream dams in the upper Yuba River watershed reduce the downstream transport of LWM, and Englebright Dam does not functionally block woody material from reaching the lower Yuba River because accumulated woody material spills over the dam during uncontrolled flood events and otherwise is pushed over by the Corps. Nonetheless, the loss of historical spawning and rearing habitat above Englebright Dam, restriction of spatial structure and associated vulnerability to catastrophic events, represent very high stressors to Yuba River steelhead. Although the genesis of these stressors emanate upstream of the Action Area at Englebright Dam, the manifestation of these stressors affect the current status of the species in the Action Area in the lower Yuba River.

Impediments in the Action Area (Daguerre Point Dam)

Given the entire suite of considerations associated with the design configuration and features of Daguerre Point Dam and its associated fish ladders that reportedly could either delay or impede adult upstream migration, as well as issues identified regarding juvenile downstream passage, the presence of Daguerre Point Dam likely represents a medium to relatively high stressor to Yuba River steelhead under the Environmental Baseline.

Harvest/Angling Impacts

Angling regulations on the lower Yuba River are intended to protect sensitive species, including wild steelhead. Possession of wild steelhead (characterized by an intact adipose fin) is prohibited. Harvest/angling likely represents a low stressor to Yuba River adult and sub-adult steelhead.

POACHING

By contrast to the previous discussion regarding the potential for poaching to be a stressor to spring-run Chinook salmon, no occurrences have been reported regarding the potential poaching of steelhead at the fish ladders, or at the base of Daguerre Point Dam. The NMFS Draft Recovery Plan (NMFS 2009) identified poaching as a stressor of "low" importance to steelhead in the lower Yuba River. In response to the Court's order, the Corps installed locking metal grates over the Daguerre Point Dam fish ladder bays in August/September 2011, in part, to prevent poaching in the fish ladders. Consequently, poaching likely represents a low (or negligible) stressor to Yuba River adult steelhead.

PHYSICAL HABITAT ALTERATION

No references have been reported specifically regarding the attraction of adult steelhead into the Yuba Goldfields through Waterway 13. Nonetheless, because of the episodic occurrence of attraction flows emanating from Waterway 13, it likely represents a relatively low stressor to the adult lifestage of Yuba River steelhead.

Lake Wildwood operations changes are primarily associated with annual maintenance activities during the fall (e.g., October) and changed inflows to Deer Creek. The potential for stranding of adult steelhead in Deer Creek, near its confluence with the lower Yuba River, due to changes in Lake Wildwood operations likely represents a negligible to low stressor to the adult lifestage of Yuba River steelhead due to disjunct temporal periodicity.

ENTRAINMENT

Because the BVID diversion is not licensed by the Corps, water rights are not regulated by the Corps, and it has no direct physical link to Corps property, the BVID diversion facility and associated effects of diversion on the listed species and their habitat in the lower Yuba River are in the Environmental Baseline. As described above, a new state-of-the-art fish screen was installed at the BVID diversion facility in 1999, and BVID continues to operate and maintain the fish screen in compliance with NMFS and CDFW criteria. Consequently, the BVID diversion facility represents a low or negligible stressor to juvenile steelhead outmigration.

The relatively recent fish screen constructed at the Hallwood-Cordua diversion is considered a notable improvement over the previous design, and likely has eliminated any significant entrainment at the Hallwood-Cordua diversion.

As previously discussed, an anomalous area of higher approach velocities at the South Yuba/Brophy Diversion Canal and Facilities where an eddy draws water up-river was found to not meet the NMFS (2011d) criteria of providing "nearly uniform" flow distribution along the face of a screen (Bergman et al. 2013) and, thus, may increase susceptibility of juvenile salmonids to impingement or entrainment. However, only a portion of the annual year-class of outmigrant juvenile steelhead passes Daguerre Point Dam during the diversion season, particularly during the relatively high diversion period extending from May through August. Based on analysis of RST data, the percentage of steelhead fry from May through August, relative to the total annual number of outmigrant steelhead juveniles, potentially susceptible to entrainment is 26% (although actual entrainment is much lower than potential susceptibility to entrainment). Consequently, entrainment likely represents a relatively low stressor to Yuba River juvenile steelhead.

Predation

It is recognized that there is a paucity of information regarding predation rates on juvenile salmonids in general, and juvenile steelhead in particular, in the lower Yuba River. However, steelhead primarily spawn upstream of Daguerre Point Dam, and most juvenile steelhead must at some time pass over the spillway at Daguerre Point Dam, through the fish ladders, or past the diversion structures located in the vicinity of Daguerre Point Dam and are subject to predation at this location. As previously discussed in Chapter 5, field studies were conducted during 2012 to investigate potential sources of juvenile salmonid mortality, including predation due to a concentration of predators in the diversion canal, associated with the South Yuba/Brophy Diversion Canal and Facilities located immediately upstream of Daguerre Point Dam. Contrary to that which has been previously reported, the data suggest that the diversion channel does not support a unique concentration of predators (Bergman et al. 2013). Adult pikeminnow densities were not significantly different between the diversion channel and the mainstem lower Yuba River adjacent to the diversion. However, predation of juvenile salmonids by introduced and native piscivorous fishes occurs throughout the lower Yuba River at potentially relatively high rates. Therefore, predation likely represents a high stressor to the juvenile lifestage of Yuba River steelhead.

Loss of Natural River Morphology and Function

The loss of natural river morphology and function and resultant decrease in riverine habitat complexity affects steelhead very similarly as was previously described for spring-run Chinook salmon in the lower Yuba River. Consequently, it likely represents a relatively high stressor to Yuba River steelhead under the Environmental Baseline.

Loss of Floodplain Habitat

Floodplain habitat considerations previously presented for spring-run Chinook salmon also pertain to steelhead in the lower Yuba River. Consequently, loss of floodplain habitat availability likely represents a medium stressor to Yuba River juvenile steelhead under the Environmental Baseline.

Loss of Riparian Habitat and Instream Cover (Riparian Vegetation, Instream Woody Material)

The previous assessment of the importance that riparian vegetation and LWM play in the habitat complexity and diversity that potentially limits the productivity of juvenile spring-run Chinook salmon, is applicable to steelhead. Therefore, the present availability of riparian habitat and instream cover (in the form of LWM) is a stressor of relatively high magnitude to Yuba River juvenile steelhead under the Environmental Baseline.

Hatchery Impacts (FRFH Genetic Considerations Straying into the Lower Yuba River) and Other Genetic Considerations

As previously discussed, the experimental fish hatchery on a tributary (i.e., Fiddle Creek) of the North Fork Yuba River was reported to hatch and rear trout, including steelhead, from 1929 to 1950 (CDNR 1931; Leitritz 1969). From 1970 to 1979, CDFW annually stocked 27,270–217,378 fingerlings, yearlings, and sub-catchable steelhead from

Coleman National Fish Hatchery into the lower Yuba River (CDFG 1991). CDFW stopped stocking steelhead into the lower Yuba River in 1979.

The observation of adipose fin clips on adult steelhead passing upstream through the VAKI Riverwatcher system at Daguerre Point Dam demonstrates that hatchery straying into the lower Yuba River has occurred, and continues to occur. Although no information is presently available regarding the origin of adipose-clipped steelhead observed at the VAKI Riverwatcher system at Daguerre Point Dam, it is reasonable to surmise that these fish most likely originate from the FRFH.

As previously discussed in Chapter 4 of this BA, only two years of data (2010/2011 and 2011/2012) are available identifying adipose fin-clipped *O. mykiss* passing through the VAKI Riverwatcher system at Daguerre Point Dam, during which extensive inoperable periods did not occur during the adult steelhead upstream migration period. Analysis of the VAKI Riverwatcher data indicates that the percent contribution of hatchery-origin adult upstream migrating fish (represented by the percentage of adipose fin-clipped adult steelhead relative to the total number of adult upstream migrating steelhead, because 100% of FRFH-origin steelhead have been marked since 1996) was approximately 43% for the 2010/2011 biological year, and about 63% for the 2011/2012 biological year (RMT 2013).

Past hatchery practices, including the Yuba River experimental fish hatchery until 1950, FRFH hatchery practices from 1967 to present, and straying of FRFH fish into the lower Yuba River have likely resulted in a stressor of relatively high magnitude on the potential for the lower Yuba River to support a genetically distinct, independent population of steelhead. As previously discussed for spring-run Chinook salmon, the continued and ongoing straying of hatchery-origin fish would represent a relatively high stressor if the management goal is to reestablish a genetically distinct, independent population of steelhead in the lower Yuba River. However, data obtained through the course of implementing the M&E Program demonstrate that continued influx of FRFH-origin fish into the lower Yuba River contributes to the present and ongoing maintenance of steelhead populations in the lower Yuba River (RMT 2013).

SUMMARY OF ENVIRONMENTAL BASELINE STRESSORS ON STEELHEAD

This BA has presented available information regarding the present status of the VSP parameters, the PCEs and characteristics of critical habitat in the lower Yuba River, and the stressors affecting the Yuba River steelhead population associated with the Environmental Baseline. The data limitations previously discussed, particularly in Chapter 4 of this BA, preclude multi-year abundance and trend analyses and therefore application of the extinction risk criteria. Consequently, the steelhead population in the lower Yuba River is categorized as data deficient, and therefore cannot be concluded to be stable or at a specific risk of extinction.

7.1.4.3 Green Sturgeon

As previously discussed, Daguerre Point Dam was not constructed for green sturgeon passage, and it is a complete barrier to the upstream migration of green sturgeon because they are unable to ascend the fish ladders on the dam, or otherwise pass over or around the structure. The existing fish ladders at Daguerre Point Dam were constructed to provide passage for Chinook salmon and steelhead.

Moreover, in 1938, a biological study was financed by the U.S. Army Corps of Engineers, under the supervision of the U.S. Bureau of Fisheries, to determine the effects of mining debris dams and hydraulic mining on fish life in the Yuba and American rivers. The survey was conducted by F.H. Sumner, Assistant Aquatic Biologist with the U.S. Army Corps of Engineers and Osgood R. Smith, Assistant Aquatic Biologist with the U.S. Bureau of Fisheries, in accordance with methods used by the U.S. Bureau of Fisheries. The 1939 survey report included a list of native and introduced fishes known or presumed to occur in the Yuba and American River basins at that time - which did not list the green sturgeon (Sumner and Smith 1939).

The scarcity of information on green sturgeon in the lower Yuba River makes it difficult to determine how these fish are utilizing the habitat in the river, or for what purpose green sturgeon are entering the river (NMFS 2007). However, because the ongoing stressors associated with Daguerre Point Dam's blockage of green sturgeon are due to the presence of the dam and configuration of the fish ladders, the Corps does not have the ability to lessen the potential passage/blockage stressors, and therefore they are part of the Environmental Baseline.

Despite the fact that historical accounts of fish species known or presumed to occur in the lower Yuba River do not include reference to green sturgeon (Sumner and Smith 1939), NMFS (2007) suggested that the abundance, productivity, spatial structure and diversity of the green sturgeon population in the lower Yuba River could be improved if green sturgeon had access to areas upstream of Daguerre Point Dam. Mora et al. (2009) suggest that Daguerre Point Dam blocks approximately 4 ± 2 km (~2.5 miles ± 1.2 miles) of potential green sturgeon habitat in the lower Yuba River. Regardless, designated critical habitat for green sturgeon does not extend upstream of Daguerre Point Dam.

Over the many years of sampling and monitoring in the lower Yuba River, only one sighting of an adult green sturgeon was confirmed before 2011, although studies specifically designed to search for green sturgeon in the lower Yuba River have not been implemented until the past few years. Sampling conducted during May 2011 with underwater videography indicated the presence of four or five adult green sturgeon just downstream of Daguerre Point Dam (Cramer Fish Sciences 2011). During 2012, underwater videography also was used in an attempt to document the presence of green sturgeon downstream of Daguerre Point Dam, although no green sturgeon were observed.

Under the Environmental Baseline, a total of 26 general pool locations exhibiting deepwater pool habitat potentially available to green sturgeon (i.e., greater than 10.0 feet in depth) was identified within the Yuba River downstream of Daguerre Point Dam (YCWA 2013a). **Table 7-1** shows: (1) the total wetted area of the pool habitats for each flow; and (2) the incremental increase in the wetted pool area compared to the previous flow value.

The period of February through November represents the months when adult green sturgeon may potentially be holding, including the pre-spawning holding, spawning, and post-spawning periods (Adams et al. 2002; Klimley et al. 2007). Examination of Table 7-1 demonstrates that a Marysville flow of 500 cfs would provide about 295,218 square

Table 7-1. Areal extent of deepwater pool habitat availability in the Yuba River downstream of Daguerre Point Dam (YCWA 2013a).

Marysville Flow (cfs)	Wetted Pool Area (sq. ft.)	Incremental Increase in Pool Area (%)
300	249,453	--
350	261,441	4.8%
400	274,005	4.8%
450	284,508	3.8%
530	301,644	6.0%
600	316,044	4.8%
622	320,400	1.4%
700	335,484	4.7%
800	354,501	5.7%
880	370,296	4.5%
930	380,070	2.6%
1,000	395,181	4.0%
1,300	456,930	15.6%
1,500	499,626	9.3%
1,700	548,487	9.8%
2,000	634,266	15.6%
2,500	804,861	26.9%
3,000	1,000,071	24.3%
4,000	1,400,292	40.0%
5,000	1,579,815	12.8%
7,500	1,859,247	17.7%
10,000	1,920,357	3.3%
15,000	1,936,989	0.9%
21,100	1,938,600	0.1%
30,000	1,938,465	0.0%
42,200	1,938,600	0.0%

feet of deepwater pool habitat downstream of Daguerre Point Dam. Modeled mean monthly flows under the Environmental Baseline simulation for each individual month from February through November (over the entire simulation period from WY 1922 through WY 2008) demonstrates that mean monthly flows at the Marysville Gage exceed 500 cfs nearly all of the time from February through June, and equal or exceed 500 cfs about 85-90% of the time from July through November (see the Cumulative Condition analysis, below). Consequently, a substantial amount of deepwater pool habitat is generally available for the relatively low numbers of green sturgeon that may be present downstream of Daguerre Point Dam under the Environmental Baseline. According to

NMFS (2009a), the current population status of the Southern DPS of North American green sturgeon is unknown. For the Central Valley Domain, currently there are limited data on population sizes, population trends, or productivity of green sturgeon (NMFS 2009e). No information regarding these topics is available for the lower Yuba River, due to the rarity of even sighting green sturgeon in the river.

Hence, it is not practicable to attempt to apply the VSP concepts developed for salmonids to green sturgeon in the lower Yuba River. Moreover, the lack of information pertaining to abundance, productivity, habitat utilization, life history and behavioral patterns in the lower Yuba River, due to infrequent sightings over the past several decades, does not provide the opportunity for reliable alternative methods of viability assessment of green sturgeon in the lower Yuba River. Data limitations preclude application of the extinction risk criteria to green sturgeon in the lower Yuba River. Consequently, green sturgeon in the lower Yuba River cannot be concluded to be stable or at a specific risk of extinction.

The foregoing discussion indicates that the potential stressor of flow-related habitat availability is low or negligible for green sturgeon in the Action Area below Daguerre Point Dam in the lower Yuba River.

The other potential flow-related stressor to green sturgeon in the Action Area below Daguerre Point Dam in the lower Yuba River is water temperature suitability. Water temperature monitoring over the past six years demonstrated that water temperatures remain below the upper WTI values for all lifestages of green sturgeon at Daguerre Point Dam, and for most lifestages at the Marysville Gage. The upper end of the WTI value range for post-spawning adult holding (i.e., 61°F) was exceeded at the Marysville Gage during a portion of this lifestage evaluation period (see Chapter 4).

Water temperature modeling demonstrated similar results as water temperature monitoring. Modeled mean monthly water temperatures under the Environmental Baseline (i.e., current conditions simulation) for each individual month from February through November (over the entire simulation period from WY 1922 through WY 2008) demonstrates that mean monthly water temperatures at Daguerre Point Dam always remain below the upper WTI value range for all lifestages of green sturgeon. Modeled water temperatures at the Marysville Gage also remained below the upper WTI value range for all lifestages of green sturgeon with the exception of post-spawning holding. The upper end of the WTI value range for post-spawning adult holding (i.e., 61°F) was exceeded at the Marysville Gage during variable portions of time from June through September (see the Cumulative Condition analysis, below).

7.2 Effects of the Proposed Action

The Proposed Action is comprised of the Corps' authorized discretionary O&M activities of the existing fish passage facilities at Daguerre Point Dam, including the administration of two outgrants associated with O&M of the facilities, and specified conservation measures. The two outgrants administered by the Corps that are associated with Daguerre Point Dam include: (1) a license issued to CDFW for VAKI Riverwatcher operations; and (2) a license issued to Cordua Irrigation District for flashboard installation, removal and maintenance.

Of the stressors associated with the Environmental Baseline affecting the spring-run Chinook salmon in the lower Yuba River, the Proposed Action (including protective conservation measures) does not have the capability of affecting poaching, entrainment, loss of natural river morphology and function, harvest/angling impacts, physical habitat alteration (including Waterway 13), loss of floodplain habitat, and hatchery and other genetic considerations. The remaining stressors are evaluated below.

7.2.1 Operation and Maintenance Activities of Fish Passage Facilities at Daguerre Point Dam

In this BA, a distinction is made between effects on listed species attributable to the current design of the Daguerre Point Dam facilities that have been operational since 1965 – which are part of the Environmental Baseline, and effects associated with the Corps' authorized discretionary O&M activities associated with the fish ladders as part of the Proposed Action. The Corps has the authority and discretion to lessen adverse effects associated with O&M of the fish ladders and sediment removal upstream of Daguerre Point Dam, removal of sediment and woody debris from the fish ladders themselves, and minor adjustments to the hydraulic performance of the ladders, as described in Section

2.1.1. The Corps' authorized discrectionary O&M activities associated with the fish ladders include making minor modification as necessary to maintain and improve the existing fish ladder performance. Additionally, conservation measures incorporated into the Proposed Action and associated with discretionary O&M activities of existing fish passage facilities are considered to be authorized, discretionary actions by the Corps. Therefore, effects to listed species associated specifically with these activities are characterized as effects of the Proposed Action. All other stressors associated with design and on-going existence of the ladders and other Daguerre Point Dam facilities are part of the Environmental Baseline.

7.2.1.1 Fish Ladder Operations

The Corps' fish ladder operations consist of adjusting the fishway gates, within-ladder flashboards, and the fish ladder gated orifices. Fishway gates allow water to enter the fish ladders, and the fish ladder gated orifices regulate the point where upstream migrating fish can most easily enter the ladders (Corps 1966). The Proposed Action also includes continued collaboration with CDFW regarding adjustment of the within-ladder flashboards that were installed in the lower bays of the south fish ladder during June 2010. Adjustment of these within-ladder flashboards influence hydraulics and have been shown to improve adult anadromous salmonid attraction flows to the south ladder (Grothe 2011). As part of these activities, the Corps also will continue to coordinate with CDFW and NMFS regarding operations at the existing ladders and fishway structure to provide passage opportunities for anadromous salmonids.

Related Stressors and Effects

Operations-related passage impediments associated with upstream migration of adult spring-run Chinook salmon and steelhead include: (1) intermittent passage ability due to closure of the fish ladder control gates at high flow levels; (2) unfavorable within-ladder hydraulics resulting in passage impediment or delay; and (3) insufficient attraction flows exiting the fish ladders.

The stressors related to this component of the Proposed Action include the potential for blockage or passage delays in the upstream migration of adult spring-run Chinook salmon and steelhead. The Proposed Action will: (1) improve passage ability due to continuing to keep the fish ladder control gates open at high flow levels; (2) improve within-ladder hydraulics and attraction flows by adjustment of within-ladder flashboards and fish ladder gated orifices. Operations-related components of the Proposed Action are not expected to substantively affect stressors associated with juvenile downstream migration. The operations-related components of the Proposed Action will not substantively affect these stressors. Consequently, with implementation of the operations-related components of the Proposed Action, these stressors remain characterized as "medium to high".

7.2.1.2 Fish Passage Facility Maintenance

Corps and CDFW joint maintenance activities include cleaning the bays of the fish ladders, cleaning the grates covering the fish ladder bays, and other minor maintenance activities. Presently, PSMFC staff, in collaboration with CDFW, operating the VAKI Riverwatcher devices, make observations of the fish ladders on an approximately daily basis, and the Corps coordinates with them regarding observations of debris or blockages, and/or adult salmonid upstream passage observations. Since August 2010, the Corps also has conducted sub-surface inspections of the ladders, after NMFS advised the Corps of the possibility of sub-surface blockage. The Proposed Action includes continuation of the routine maintenance of removal of debris from the fish ladders.

Additionally, the Corps and NMFS have been holding monthly meetings to coordinate regarding maintenance activities and other issues pertaining to the lower Yuba River since the spring of 2010. These meetings would continue as part of the Proposed Action.

RELATED STRESSORS AND EFFECTS

The stressors related to fish passage facility maintenance activities also include the potential for blockage or passage delays in the upstream migration of adult spring-run Chinook salmon and steelhead. Potential impediments to upstream migration of adult salmon and steelhead may include: (1) sediment accumulation at the upstream exits of the fish ladders, potentially resulting in blockage of egress from the ladders and/or upstream migration routes, and "fall-back" of adults into the ladders; and (2) obstruction of the ladders by sediment and woody debris that can block passage or substantially reduce attraction flows to the fish ladder entrances.

In recognition of the ongoing maintenance-related potential impediments to upstream migration of adult salmon and steelhead, the Corps has identified protective conservation measures and incorporated them into the Proposed Action. These maintenance-related protective conservation measures are: (1) implementation of the Daguerre Point Dam Fish Passage Sediment Management Plan; and (2) implementation of a Debris Monitoring and Maintenance Plan at Daguerre Point Dam. Consequently, evaluation of the manner in which the Proposed Action influences stressors associated with maintenance-related activities at the fish passage facilities at Daguerre Point Dam includes consideration of these measures, and is presented below.

7.2.2 Staff Gage Maintenance

The Proposed Action includes continuation of maintaining, reading, and filing all records obtained from the staff gage located on the right abutment of Daguerre Point Dam. No stressors to the listed species or their critical habitats have been identified associated with this component of the Proposed Action.

7.2.3 Administration of a License Issued to CDFW for VAKI Riverwatcher Operations at Daguerre Point Dam

The Proposed Action includes continued administration of the license to CDFW (DACW05-3-03-550) to install and operate electronic fish counting devices, referred to as a VAKI Riverwatcher infrared and photogrammetric system, in the fish ladders at Daguerre Point Dam, which remains in effect until 2018. The only potential stressor identified to be associated with the VAKI Riverwatcher system is the potential collection of debris and resultant impediments to passage. However, the Debris Monitoring and Maintenance Plan at Daguerre Point Dam specifies that CDFW is responsible for inspecting and clearing the portion of the ladders containing the VAKI device, and that the Corps is responsible for all other parts of the ladders. Implementation of this plan is included in the evaluation of that protective conservation measure, below.

7.2.4 Administration of a License Issued to Cordua Irrigation District for Flashboard Installation, Removal and Maintenance at Daguerre Point Dam

In 2011, the Corps, NMFS and CDFW collaborated in the development of the Daguerre Point Dam Flashboard Management Plan. The Flashboard Management Plan was incorporated into the September 27, 2011 license amendment issued by the Corps to Cordua Irrigation District. The Proposed Action includes continued administration of the license issued to Cordua Irrigation District which incorporates the Flashboard Management Plan, until the license expires in 2016. Implementation of this plan is included in the evaluation of that protective conservation measure, below.

7.2.5 Protective Conservation Measures

The Corps has committed to incorporate several conservation measures into its activities for this Proposed Action. These measures are intended to improve conditions for listed salmonids in the lower Yuba River.

7.2.5.1 Implementation of the Daguerre Point Dam Fish Passage Sediment Management Plan

The Proposed Action includes continued implementation of the Daguerre Point Dam Fish Passage Sediment Management Plan. The Corps, through collaboration with NMFS, CDFW, and USFWS, developed an updated Daguerre Point Dam Fish Passage Sediment Management Plan in February 2009 (Corps 2009). The purpose of the plan is to describe the methods used to manage the sediment that accumulates upstream of Daguerre Point Dam in order to improve flows to the ladders at Daguerre Point Dam, to provide suitable adult salmonid migratory habitat conditions upstream of the Daguerre Point Dam fish ladders, and to provide attraction to the ladders downstream of Daguerre Point Dam.

Related Stressors and Effects

Sediment accumulation results in unfavorable habitat conditions at the upstream exits of the fish ladders, which impedes the upstream migration of adult spring-run Chinook salmon and steelhead. Resultant stressors include reduced unimpeded passage from the ladders to the main channel, the potential for adult fish exiting the ladder being immediately swept by flow back over the dam, and the potential for fish to “fall-back” into the ladders.

Implementation of the Daguerre Point Dam Fish Passage Sediment Management Plan will provide passage ability of spring-run Chinook salmon and steelhead due to the maintenance of migratory pathways upstream of the dam. Because the plan was developed in February 2009 and has been implemented since that time, implementation of this protective conservation measure will maintain the status quo relative to the Environmental Baseline. However, stressors associated with sediment accumulation upstream of the face of Daguerre Point Dam have occurred over the many years that have led to the current status of the species. Hence, this component of the Proposed Action may be considered to improve conditions, and lessen stressors associated with sediment accumulation at Daguerre Point Dam. Consequently, stressors specifically associated with sediment accumulation at Daguerre Point Dam are characterized as remaining "low" under the Proposed Action.

This component of the Proposed Action will reduce stressors associated with the PCE of "freshwater migratory corridor" of critical habitat for spring-run Chinook salmon and steelhead. With improvements to passage at Daguerre Point Dam resulting from implementation of this protective conservation measure, it is reasonable to expect improved accessibility for adult spring-run Chinook salmon and steelhead to critical habitat located upstream of Daguerre Point Dam when compared with the totality of the temporal effect of the Environmental Baseline.

7.2.5.2 Management of a Long-term Flashboard Program at Daguerre Point Dam

The Proposed Action includes implementation of the Flashboard Management Plan (see Section 2.1.4) through the administration of a license issued to Cordua Irrigation District.

If the Corps does not renew the license to Cordua Irrigation District or another entity when it expires in 2016, then the Corps will assume responsibility for implementing the operations and maintenance activities addressing the placement, timing and configuration of the flashboards at Daguerre Point Dam that are described in the Flashboard Management Plan, on a long-term basis.

Related Stressors and Effects

Sheet flow over the top of Daguerre Point Dam can "mask" the ability of upstream migrating adult salmonids to find the entrance to the fish ladders. Resultant stressors include potential delay or disruption of upstream migration. The purpose of the plan is to benefit spring-run Chinook salmon and steelhead by directing sheet flow that spills over the top of Daguerre Point Dam into the fish ladders, thereby improving the ability of adult fish to locate the fish ladders and migrate upstream to spawning and rearing habitats.

Additional potential stressors associated with sheet flow over the top of Daguerre Point Dam include physical injury to juveniles spilling over the top of the dam onto the concrete apron at the downstream base of the dam, and increased susceptibility to predation in the plunge pool below Daguerre Point Dam due to disorientation.

Ancillary benefits include directing downstream migrating juvenile spring-run Chinook salmon and steelhead into the fish ladders, and thereby avoiding physical injury from spilling over the dam, and avoiding potentially increased predation due to disorientation in the plunge pool below the dam.

The Flashboard Management Plan was incorporated into the September 27, 2011 license amendment issued by the Corps to Cordua Irrigation District. Thus, continued implementation of this protective conservation measure will maintain the status quo relative to the Environmental Baseline. However, relative to stressors associated with sheet flow over Daguerre Point Dam that occurred prior to 2011 that have led to the current status of the species, this component of the Proposed Action may be considered to improve conditions, and lessen stressors (masking adult attraction flows, physical injury and predation of juveniles) associated with sheet flow over Daguerre Point Dam.

This component of the Proposed Action will reduce stressors associated with the PCE of "freshwater migratory corridor" of critical habitat for each listed species. With improvements to passage at Daguerre Point Dam resulting from implementation of this protective conservation measure, it is reasonable to expect improved accessibility for adult spring-run Chinook salmon and steelhead to critical habitat located upstream of Daguerre Point Dam when compared with the totality of the temporal effect of the Environmental Baseline.

In addition, because the Proposed Action includes the commitment that, if necessary, the Corps will assume responsibility for implementing the Flashboard Management Plan on a long-term basis, this component provides an assurance that related stressors also will be reduced on a long-term basis. Consequently, stressors specifically associated with sheet flow over Daguerre Point Dam are characterized as "medium" under the Proposed Action.

7.2.5.3 Implementation of a Debris Monitoring and Maintenance Plan at Daguerre Point Dam

The Proposed Action includes implementation of the Debris Monitoring and Maintenance Plan for clearing accumulated debris and blockages in the fish ladders at Daguerre Point Dam. The plan specifies the frequency and conduct of routine inspection and clearing of debris from the two fish ladders at Daguerre Point Dam, and debris maintenance associated with specific flow events.

RELATED STRESSORS AND EFFECTS

Accumulation of debris and sediment within the bays of the ladders at Daguerre Point Dam can result in unfavorable within-bay hydraulic characteristics and resultant passage delay or blockage of upstream migrating adult salmonids. Debris and sediment accumulation within the ladder bays also can affect flow through the ladders and resultant attraction flow for upstream migrating adult spring-run Chinook salmon and steelhead.

The purpose of the Debris Monitoring and Maintenance Plan is to benefit spring-run Chinook salmon and steelhead by improving the ability of adult fish to locate the fish ladders and successfully pass through the ladders to upstream spawning and rearing habitats. To the extent that reduced debris accumulation in the fish ladders would potentially increase flow through the ladders and reduce sheet flow over Daguerre Point Dam, ancillary benefits include reducing the severity of the stressors on downstream migrating juvenile spring-run Chinook salmon and steelhead, susceptibility to physical injury from spilling over the dam, and potentially increased predation due to disorientation in the plunge pool below the dam.

This component of the Proposed Action will reduce stressors associated with the PCE of "freshwater migratory corridor" of critical habitat for each listed species. With improvements to passage at Daguerre Point Dam resulting from implementation of this protective conservation measure, it is reasonable to expect improved accessibility for adult spring-run Chinook salmon and steelhead to critical habitat located upstream of Daguerre Point Dam when compared with the totality of the temporal effect of the Environmental Baseline.

Continued implementation of the Debris Monitoring and Maintenance Plan would be expected to reduce the severity of the stressors associated with debris and sediment accumulation within the bays of the fish ladders at Daguerre Point Dam on a long-term basis. Consequently, stressors specifically associated with debris and sediment in the fish passage facilities at Daguerre Point Dam are characterized as "low" under the Proposed Action.

7.2.6 Voluntary Conservation Measures

In addition to protective measures integrated into the Proposed Action, the Corps proposes to implement additional conservation measures to avoid or minimize potential effects and to improve conditions for listed salmonids in the lower Yuba River through implementation of voluntary conservation measures. These voluntary conservation measures are subject to the availability of funding.

7.2.6.1 Gravel Injection in the Englebright Dam Reach of the Lower Yuba River

The Proposed Action includes continued implementation of a spawning gravel injection program in the Englebright Dam Reach of the lower Yuba River. Four separate gravel injection efforts have been undertaken from 2007-2013, with approximately 15,500 tons of gravel/cobble placed into the Englebright Dam Reach. The Corps is using the Gravel/Cobble Augmentation Implementation Plan (GAIP) (Pasternack 2010) to provide guidance for a long-term gravel injection program. The purpose of the program is to provide Chinook salmon, and spring-run Chinook salmon in particular, spawning habitat in the bedrock canyon downstream of Englebright Dam.

RELATED STRESSORS AND EFFECTS

The stressor related to this conservation measure is lack of suitable spawning gravels in the Englebright Dam Reach. Implementation of this voluntary conservation measure is expected to expand available spawning habitat, primarily for spring-run Chinook salmon. No anticipated increased adverse effects associated with lack of suitable spawning gravel would be expected to occur. By contrast, the intensity, frequency, and duration of stressors associated with the lack of spawning habitat in the Englebright Dam Reach would be reduced relative to the Environmental Baseline. Expansion of suitable spawning habitat in the Englebright Dam Reach may encourage additional behavioral segregation between spawning spring-run and fall-run Chinook salmon, because spring-run Chinook salmon tend to spawn in the uppermost reaches of the Yuba River whereas fall-run Chinook salmon spawning is more spread throughout downstream locations.

This voluntary conservation measure will beneficially affect the PCEs of critical habitat of "freshwater spawning sites" for spring-run Chinook salmon, as well as for steelhead. With the addition of suitable spawning gravels in the Englebright Dam Reach, habitat suitability and availability will be improved for the spawning lifestages of spring-run Chinook salmon and steelhead, and a likely response will be increased reproductive success or capacity.

Consequently, the stressor of the lack of suitable spawning gravels in the Englebright Dam Reach would be lessened relative to the Environmental Baseline. However, spawning habitat is abundant and readily available throughout the lower Yuba River, and available spawning habitat is not considered to be limiting to the spring-run Chinook salmon population in the lower Yuba River. Hence, this voluntary conservation measure is intended to contribute to an increased likelihood of recovery of spring-run Chinook salmon, with ancillary benefits to steelhead spawning habitat availability. With continued implementation of the gravel injection program in the Englebright Dam Reach, subject to available funding, stressors specifically associated with the lack of suitable spawning gravels in the Englebright Dam Reach are characterized as "low".

7.2.6.2 Large Woody Material Management Program

The Corps has prepared a LWMMP, which includes the implementation of a pilot study in order to enhance juvenile rearing conditions for spring-run Chinook salmon and steelhead (Corps 2012d). The Corps proposed to initiate a pilot study to determine an effective method of replenishing the supply of LWM back into the lower Yuba River. The pilot study will use LWM from existing stockpiles at New Bullards Bar Reservoir for placement at selected sites along the lower Yuba River, and will include monitoring of placed materials, which will be used to assess the effectiveness of LWM placement in the lower Yuba River to develop a long-term program (Corps 2012d). Based upon the outcome of the pilot study, the Corps will refine the draft plan, consistent with recreation safety needs and findings from the pilot study, and implement a long-term LWMMP for the lower Yuba River, subject to available funding.

RELATED STRESSORS AND EFFECTS

The stressors related to this voluntary conservation measure are associated with the reported relative paucity of habitat complexity and diversity associated with structural elements in the lower Yuba River. LWM plays a significant role in determining the suitability of aquatic habitats for juvenile salmonids, including providing concealment from predators, shelter from fast current, feeding stations and nutrient inputs, as well as for other organisms upon which salmonids depend for food.

Under the Environmental Baseline, reduced abundance of LWM was identified as a "high" stressor to the juvenile rearing lifestage of Yuba River spring-run Chinook salmon and steelhead. Implementation of this voluntary conservation measure would reduce the intensity, frequency, and duration of stressors associated with the reduced abundance of LWM providing habitat complexity and diversity (and therefore predator escape cover, velocity, shelter, and feeding stations) for rearing juvenile salmonids, relative to the Environmental Baseline.

This voluntary conservation measure will beneficially affect the PCE of "freshwater rearing sites" of critical habitat for spring-run Chinook salmon, as well as for steelhead. With the addition of LWM, habitat suitability and availability will be improved for the juvenile rearing lifestages of spring-run Chinook salmon and steelhead. Likely responses include the potential for reduced predation on juvenile spring-run Chinook salmon and steelhead in the lower Yuba River.

Consequently, stressors associated with relatively low abundance of LWM would be lessened relative to the Environmental Baseline. With continued implementation of the LWMMP, stressors specifically associated with the abundance of LWM in the Action Area of the lower Yuba River are characterized as "medium to high" due to lack of certainty of benefit associated with results of the pilot study, uncertainty of specific elements as yet undefined in the long-term plan, and uncertainty associated with funding availability.

7.3 Interrelated Actions

Interrelated actions are defined by the Federal regulations as "…*those that are part of a larger action and depend on the larger action for their justification*" (50 CFR 402.02). The effects of "interrelated actions" (i.e., actions that would not occur "but for" a larger action) (Federal Register 19957; USFWS and NMFS 1998), along with the direct and indirect effects of the Proposed Action, are compared to the Environmental Baseline in determining whether the Proposed Action will jeopardize the continued existence of a listed species (50 CFR 402.02, 402.12(f)(4)).

7.3.1 Potential Effects Associated with Interrelated Actions

There are no interrelated actions associated with the Proposed Action.

7.4 Interdependent Actions

Interdependent actions are defined by the Federal regulations as "…*those that have no independent utility apart from the action under consideration*" (50 CFR 402.02). The effects of "interdependent actions" (i.e., other actions would not occur "but for" this action (USFWS and NMFS 1998)), along with the direct and indirect effects of the Proposed Action, are compared to the Environmental Baseline to determine whether the Proposed Action will jeopardize the continued existence of a listed species (50 CFR 402.02, 402.12(f)(4)).

7.4.1 Potential Effects Associated with Interdependent Actions

There are no interdependent actions associated with the Proposed Action.

7.5 Cumulative Effects

Cumulative effects are defined by Federal regulations as "…*those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation*" (50 CFR 402.02). Cumulative effects must be considered in the analysis of the effects of the Proposed Action (50 CFR 402.12(f)(4)).

7.5.1 Wheatland Project

7.5.1.1 Cumulative Effects Flow Analysis

Overall, the Cumulative Condition would generally result in higher flows above Daguerre Point Dam (as measured at the Smartsville Gage) and lower flows below Daguerre Point Dam (as measured at the Marysville Gage), primarily during the summer months of July, August and September. Comparisons of model simulations of monthly mean flows at each of these gages under the Cumulative Condition, relative to the current conditions, are provided below.

<u>FLOW AT THE SMARTSVILLE GAGE</u>

Examination of model output presented in Appendix F of this BA demonstrates that over the 87-year simulation period, long-term average monthly flows at the Smartsville Gage would increase slightly from May through October (ranging from a 0.6% flow increase in May to a 2.4% flow increase in July), would decrease slightly from December through April (ranging from a 0.7% flow reduction in March to a 1.7% flow reduction in December), and would not change during November under the Cumulative Condition, relative to the current conditions. None of the minor reductions in long-term average monthly flows from December through April under the Cumulative Condition, relative to the current conditions, would result in long-term average monthly flows below the monthly minimum instream flows of Flow Schedule A, and therefore would remain above the corresponding optimum flow level.

For Wet and Above Normal water years, flow at the Smartsville Gage changed slightly during most months of the year, with no reductions in average monthly flow exceeding 10% under the Cumulative Condition relative to the current conditions. The largest average monthly flow increase (2.2%) occurred in July and the largest flow reduction (4.3%) occurred during February of Above Normal water years under the Cumulative Condition relative to the current conditions. Average monthly flow values under the Cumulative Condition and the current conditions remained well above the monthly minimum instream flows of Flow Schedule A, and therefore remained above the corresponding optimum flow level.

For Below Normal water years, average monthly flows at the Smartsville Gage changed slightly during most months of the year, with no reductions in average monthly flow exceeding 10%. The largest average monthly flow increase (2.3%) occurred in July and the largest flow reduction (4.1%) occurred during March under the Cumulative Condition relative to the current conditions. Average monthly flow values under the Cumulative Condition and the current conditions remained well above the monthly minimum instream flows of Flow Schedule A, and therefore remained above the corresponding optimum flow level.

For Dry and Critical water years, no change or relatively minor reductions in average monthly flow occur during winter (January, February and March), but flow increases occur during all other months of the year with the largest increases in average monthly flow occurring from May through September. During Dry water years, average monthly flow changes ranged from an 8.6% flow increase during July to a 3.7% flow reduction during January of Dry water years. Changes in flows did not result in average monthly flow values below the monthly minimum instream flows of Flow Schedule A, and therefore remained above the corresponding optimum flow level. During Critical water years, average monthly flows generally increased, and flow changes ranged from an 8.4% flow increase during August to a 0.6% flow reduction during January. Except for September, flow changes did not result in average monthly flow values below the monthly minimum instream flows of Flow Schedule A and therefore remained above the corresponding optimum flow level. Although average monthly flows under the Cumulative Condition increased by 5.4% during September, the average monthly flows under both the Cumulative Condition (689 cfs) and the current conditions (653 cfs) were below the corresponding monthly minimum instream flow (700 cfs) identified for September in Flow Schedule A.

Examination of monthly mean flow exceedance distributions over the 87-year simulation period at the Smartsville Gage indicate minor differences in flow reductions between the Cumulative Condition and the current conditions. Relatively minor flow decreases would occur during winter months. The greatest reduction in monthly mean flows would occur during January, although reductions of 10% or more would be expected with less than a 6% probability of occurrence under the Cumulative Condition relative to the current conditions. However, this reduction and other minor reductions primarily would occur at high flow levels (above the corresponding optimum flow level of 700 cfs). Conversely, flow increases of 10% or more would be expected to occur during July and August with a 1% and 9% probability of occurrence, respectively, under the Cumulative Condition relative to the current conditions.

Low flow conditions are defined as flows in the lowest 25 percent of the cumulative flow distribution, which for this period of simulation represents the 22 lowest ranked flow values each month. During low flow conditions, a flow reduction of 10% or more would be expected to occur only once out of the 22 years during November. Flow increases of 10% or more at Smartsville would occur once out of the 22 years during July, and 8 out of the 22 years during August under the Cumulative Condition, relative to the current conditions.

FLOW AT THE MARYSVILLE GAGE

Examination of model output presented in Appendix F of this BA demonstrates that over the 87-year simulation period, the long-term average monthly flows at the Marysville Gage would be reduced slightly from October through June (ranging from a 0.4% flow reduction in April to a 3.2% flow reduction in June) under the Cumulative Condition relative to the current conditions. Long-term average monthly flows at the Marysville Gage would be reduced by 7.1%, 9.2% and 8.7% during July, August and September, respectively under the Cumulative Condition relative to the current conditions. However, none of the reductions in long-term average monthly flows under the Cumulative Condition relative to the current conditions would result in long-term average monthly flow below the monthly minimum instream flows of Flow Schedule 1 and therefore remained above the upper optimum flow levels.

For Wet and Above Normal water years, average monthly flows at the Marysville Gage changed slightly during most months of the year, with no reductions in average monthly flow exceeding 10% with the exceptions of September (10.5%) during Wet water years, and August (13.0%) and September (10.3%) during Above Normal water years under the Cumulative Condition relative to the current conditions. However, these reductions during August and September under the Cumulative Condition relative to the current conditions did not result in average monthly flow values below the monthly minimum instream flows of Flow Schedule 1 and therefore remained above the upper optimum flow levels.

For Below Normal water years, average monthly flows at the Marysville Gage changed slightly during most months of the year, with no reductions in average monthly flow exceeding 10% with the exception of July (12.2%). However, this reduction during July under the Cumulative Condition relative to the current conditions did not result in average monthly flow values below the monthly minimum instream flows of Flow Schedule 2 and therefore remained above the lower optimum flow level.

Even less change in average monthly flow at the Marysville Gage would be expected to occur during Dry and Critical water years under the Cumulative Condition relative to the current conditions. Flow changes would range from a 1.1% flow increase during December of Dry water years to a 4.1% flow reduction during January of Dry water years. During Critical water years, flow changes would range from a 0.7% flow increase during April to a 3.4% flow reduction during November.

Examination of monthly mean flow exceedance distributions over the 87-year simulation period at the Marysville Gage indicates minor differences between the Cumulative Condition and the current conditions from October through June. During these months, flow decreases of 10% or more would be expected with less than a 6% probability of occurrence. Larger differences in flow would be expected to occur during July, August and September, with flow decreases of 10% or more with about a 32%, 28% and 53% probability of occurrence, respectively, under the Cumulative Condition relative to the current conditions. However, these differences primarily would occur at high flow levels (above the upper optimum flow level of 700 cfs during July, 600 cfs during August and 500 cfs during September). Resultant flows under the Cumulative Condition generally remain above the lower optimum flow levels during July, August and September.

Low flow conditions are defined as flows in the lowest 25 percent of the cumulative flow distribution, which for this period of simulation represents the 22 lowest ranked flow values each month. During low flow conditions, a flow reduction of 10% or more would be expected to occur only twice out of the 22 years during November, and once out of the 22 years during each month from May through September.

The aforementioned examination of model simulation of monthly mean flows indicates that flow reductions at the Marysville Gage primarily would occur during the months of July, August and September under the Cumulative Condition, relative to the current conditions. However, when reductions in flow occurred during July, August and

September, resultant flows under the Cumulative Condition nearly always remained at or above the lower optimum flow levels.

FLOW-RELATED EFFECTS ON SPRING-RUN CHINOOK SALMON

From the spatial and temporal distribution information presented in Chapter 4 of this BA, the lifestage-specific periodicities used for this evaluation of monthly mean flows for spring-run Chinook salmon are as follows.

- Adult immigration and holding (April through September)
- Spawning (September through mid-October)
- Embryo incubation (September through December)
- Juvenile rearing (Year-round)
- Juvenile downstream movement (Mid-November through June)
- Smolt (yearling+) emigration (October through mid-May)

ADULT IMMIGRATION AND HOLDING

Spring-run Chinook salmon immigrate up through the lower Yuba River from early spring into July, August, or as late as September, and primarily hold upstream or just downstream of Daguerre Point Dam until initiation of spawning during September. Overall, monthly mean flows at the Smartsville Gage are increased during April though August and are similar during September of the adult immigration and holding time period under the Cumulative Condition relative to the current conditions. It is expected that these changes in flow would result in very minor differences in holding pool depth and areal extent upstream of Daguerre Point Dam. The magnitude of flow reductions during July, August and September below Daguerre Point Dam (as indicated by the Marysville Gage) under the Cumulative Condition relative to the current conditions also would result in very minor differences in holding pool depth or areal extent.

These relatively minor reductions in flow would not be expected to significantly affect passage at Daguerre Point Dam. RMT (2013) found that passage at Daguerre Point Dam occurs over a wide range of flows, and generally occurs irrespective of flow rates over the range of flows examined. No flow thresholds prohibiting passage of Chinook salmon through the ladders at Daguerre Point Dam were apparent in the 8 years of VAKI Riverwatcher data (RMT 2013).

These relatively minor reductions in flow also would not be expected to significantly affect attraction flows. As described in Chapter 4 of this BA, a positive and significant relationship was identified between the percentage of adipose fin-clipped Chinook salmon passing Daguerre Point Dam during the spring-run Chinook salmon upstream migration period, and the ratio of lower Yuba River flow relative to lower Feather River flow and the ratio of lower Yuba River water temperature relative to lower Feather River water temperature, four weeks prior to the time of passage at Daguerre Point Dam. However, the relatively minor reductions in flow under the Cumulative Condition relative to the current conditions also would not be expected to significantly affect attraction of adipose fin-clipped Chinook salmon for two reasons.

First, the time series of Chinook salmon moving daily upstream of Daguerre Point Dam illustrated in Chapter 4 exhibit a plurality of modes with large inter-annual variation in timing and magnitude. The phenotypic adult spring-run Chinook salmon upstream migration period generally began during May or June of each year, although the end date of the annual migration period varied among years. For the eight years of available VAKI Riverwatcher data, the phenotypic spring-run Chinook salmon upstream migration period end date ranged from early July to early September. However, most phenotypic spring-run Chinook salmon passed upstream of Daguerre Point Dam by the end of July or August during all eight years. Because the attraction flow and water temperature relationship with the percentage of adipose fin-clipped Chinook salmon passing Daguerre Point Dam occurs four weeks prior to passage at the dam, the potentially affected "attraction" period primarily occurs during May and June for most years, and into July of some years.

Second, and perhaps more importantly, the relatively minor changes in flow at the Marysville Gage under the Cumulative Condition, relative to the current conditions, would result in flow reductions and therefore would not be expected to additionally contribute to the attraction of adipose fin-clipped (hatchery) spring-run Chinook salmon into the lower Yuba River from the lower Feather River.

SPAWNING AND EMBRYO INCUBATION

During the spring-run Chinook salmon spawning and embryo incubation period (September through December), relatively minor changes in flow occur at the Smartsville Gage, generally remain above those flow levels specified in Flow Schedule A and thus remain above the corresponding upper optimum flow level. Consequently, monthly mean flow changes under the Cumulative Condition relative to the current conditions would not be expected to substantively affect the spring-run Chinook salmon spawning and embryo incubation lifestage.

JUVENILE REARING

Most juvenile spring-run Chinook salmon rearing occurs above Daguerre Point Dam. In general, juvenile Chinook salmon have been observed throughout the lower Yuba River, but with higher abundances above Daguerre Point Dam (SWRI et al. 2000). This may be due to larger numbers of spawners, greater amounts of more complex, high quality cover, and lower densities of predators such as striped bass and American shad, which reportedly are restricted to areas below the dam (YCWA et al. 2007; NMFS 2009). Therefore, although flow changes under the Cumulative Condition relative to the current conditions at the Smartsville Gage have the potential to affect most juvenile spring-run Chinook salmon rearing in the lower Yuba River, the relatively minor changes in flow would not be expected to substantively affect juvenile rearing physical habitat.

Flow changes under the Cumulative Condition relative to the current conditions at the Marysville Gage would not affect most juvenile spring-run Chinook salmon rearing in the lower Yuba River. Moreover, changes in juvenile spring-run Chinook salmon rearing habitat under the Cumulative Condition relative to the current conditions would have the highest potential to affect habitat suitability by changes in water temperature (described below).

JUVENILE DOWNSTREAM MOVEMENT

As previously discussed, juvenile spring-run Chinook salmon downstream movement (and outmigration) occurs from mid-November through June. During these months, flow decreases of 10% or more would be expected with less than a 6% probability of occurrence at both the Smartsville and Marysville gages. The minor reductions in long-term average monthly flows at the Marysville Gage under the Cumulative Condition relative to the current conditions would not result in long-term average monthly flow below the monthly minimum instream flows of Flow Schedule 1 and therefore would remain above the upper optimum flow levels. Relatively minor changes in flow at the Smartsville and Marysville gages under the Cumulative Condition relative to the current conditions would not be expected to substantively affect the spring-run Chinook salmon juvenile downstream movement (and outmigration) lifestage.

Smolt (Yearling+) Emigration

The RMT (2013) recently identified the spring-run Chinook salmon smolt (yearling+) outmigration period as extending from October through mid-May. Relatively minor reductions in long-term average monthly flows, low probabilities of flow reductions of 10% or more, and retention of flows above the optimum specified flow levels at the Marysville Gage during the smolt (yearling+) emigration period under the Cumulative Condition relative to the current conditions would not be expected to substantively affect the spring-run Chinook salmon smolt (yearling+) emigration lifestage.

Summary of Flow-Related Effects on Spring-run Chinook Salmon

Relatively minor flow changes would occur under the Cumulative Condition relative to the current conditions. In general, under the Cumulative Condition seasonal (summer) flow increases would occur upstream of Daguerre Point Dam, and seasonal (summer) flow decreases would occur downstream of Daguerre Point Dam. The foregoing evaluation of changes in flow under the Cumulative Condition relative to the current conditions indicates no substantive effects for any of the spring-run Chinook salmon lifestages in the Action Area of the lower Yuba River.

Flow-Related Effects on Steelhead

From the spatial and temporal distribution information presented in Chapter 4 of this BA, the lifestage-specific periodicities used for this evaluation of monthly mean flows for steelhead are as follows.

- Adult immigration and holding (August through March)
- Spawning (January through April)
- Embryo incubation (January through May)
- Juvenile rearing (Year-round)
- Juvenile downstream movement (April through September)
- Smolt (yearling+) emigration (October through mid-April)

ADULT IMMIGRATION AND HOLDING

The immigration of adult steelhead in the lower Yuba River occurs from August through March, with peak immigration from October through February. Overall, increases in flow during August and September and the relatively minor reductions in flow during the winter (January, February and March) at the Smartsville Gage under the Cumulative Condition relative to the current conditions: (1) would not be expected to affect the physical ability of adult steelhead to migrate through the upper portion of the Yuba River; and (2) would be expected to result in very minor differences in holding pool depth or areal extent.

Changes in flow at the Marysville Gage during July, August and September would not occur during the peak immigration period and would only be potentially relevant to a relatively small amount of the annual adult steelhead run. Also, the relatively minor changes in flow below Daguerre Point Dam would not be expected to affect the physical ability of adult steelhead to migrate through the lower portion of the Yuba River.

SPAWNING AND EMBRYO INCUBATION

During the steelhead spawning and embryo incubation period (January through May), relatively minor changes in flow at the Smartsville Gage would generally remain above those flow levels specified in Flow Schedule A and therefore remain above the corresponding optimum flow level. Consequently, monthly mean flow changes under the Cumulative Condition relative to the current conditions would not be expected to substantively affect the steelhead spawning and embryo incubation lifestage.

JUVENILE REARING

Most juvenile steelhead rearing occurs above Daguerre Point Dam. Juvenile trout (age 0 and 1+) abundances were substantially higher upstream of Daguerre Point Dam, with decreasing abundance downstream of Daguerre Point Dam (NMFS 2009). In fact, Kozlowski (2004) reported that approximately 82 percent of juvenile *O. mykiss* were observed upstream of Daguerre Point Dam. Therefore, although flow changes under the Cumulative Condition relative to the current conditions at the Smartsville Gage have the potential to affect most juvenile steelhead rearing in the lower Yuba River, the relatively minor changes in flow would not be expected to substantively affect juvenile rearing physical habitat.

Flow changes under the Cumulative Condition relative to the current conditions at the Marysville Gage would not affect most juvenile steelhead rearing in the lower Yuba River. Moreover, changes in juvenile steelhead rearing habitat under the Cumulative Condition relative to the current conditions would have the highest potential to affect habitat suitability by changes in water temperature (described below).

JUVENILE DOWNSTREAM MOVEMENT

The juvenile downstream movement (and outmigration) period extends from April through September and, therefore, flow changes at the Marysville Gage under the Cumulative Condition relative to the current conditions have the potential to affect a restricted portion of this lifestage. Moreover, RST sampling at Hallwood Boulevard over several years has not indicated a relationship between flow magnitude and the rate of juvenile steelhead outmigration *per se*. As previously discussed, some YOY *O. mykiss* are captured in RSTs during late-spring and summer, indicating movement downstream. However, the RMT's (2013) analysis of the cumulative temporal distribution of *O. mykiss* observed catch at the Hallwood Boulevard RST site revealed that most emigration generally occurred from March through July, with approximately 95 percent of the observed catch generally occurring by early August. Moreover: (1) at least some of this downstream movement may be associated with the pattern of flows in the river; (2) increases in juvenile *O. mykiss* downstream movement appear to be associated with rapid, large ramp-ups of flows; and (3) increased downstream movement is not observed during gradual ramping up of flows. Therefore, it is unlikely that downstream movement of juvenile *O. mykiss* would be substantively affected by the relatively minor reductions in flows at the Marysville Gage primarily occurring during July, August, and to some extent, during September under the Cumulative Condition relative to the current conditions.

SMOLT (YEARLING+) EMIGRATION

Relatively minor changes in flow at the Marysville Gage occur during the October through April steelhead smolt (yearling+) emigration period. Relatively minor reductions in long-term average monthly flows, low probabilities of reductions of average monthly flows of 10% or more, and retention of flows above the optimum specified flow levels at the Marysville Gage during the smolt (yearling+) emigration period under the Cumulative Condition relative to the current conditions would not be expected to substantively affect the steelhead smolt (yearling+) emigration lifestage. Changes in steelhead smolt (yearling+) emigration habitat under the Cumulative Condition relative to the current conditions would have the highest potential to affect habitat suitability by changes in water temperature (described below).

SUMMARY OF FLOW-RELATED EFFECTS ON STEELHEAD

Relatively minor flow changes would occur under the Cumulative Condition relative to the current conditions. In general, under the Cumulative Condition seasonal flow increases would occur upstream of Daguerre Point Dam, and seasonal flow decreases would occur downstream of Daguerre Point Dam. The foregoing evaluation of changes in flow under the Cumulative Condition relative to the current conditions indicates no substantive effects to any of the steelhead lifestages in the lower Yuba River.

FLOW-RELATED EFFECTS ON GREEN STURGEON

The critical habitat analysis for green sturgeon under the Cumulative Condition addresses the unique specific PCE of deepwater pool habitat - essential for the conservation of the green sturgeon in freshwater riverine systems according to NMFS (2009e). Two analyses were conducted for identified pools downstream of Daguerre Point Dam in the lower Yuba River: (1) change in depth; and (2) change in the areal extent of deepwater pool habitat. These analyses are conducted for the February through November period, which represents the potential green sturgeon adult holding, spawning and post-spawning holding periods.

Using the RMT's SRH-2D model, a total of 26 pool locations were identified between Daguerre Point Dam and the mouth of the lower Yuba River, with water depths greater than 10.0 feet deep at the nominal flow of 530 cfs at the Marysville Gage. The mean depth of deepwater pool areas ranges from approximately 12.2 feet at flows from 300 to 800 cfs, to 25.4 feet at 42,200 cfs at the Marysville Gage (see **Appendix G**). The rate of change in pool depth varies depending upon the range of flows at the Marysville Gage. The mean depth of deepwater pool areas increases by only about 0.3 inches per 100 cfs on average, when flows increase from 300 cfs to 42,200 cfs.

Examination of model output presented in Appendix G of this BA demonstrates that over the 87-year simulation period, long-term average monthly depth of deepwater pool areas below Daguerre Point Dam would be equivalent or decrease only 0.1% during any month of the February through November period under the Cumulative Condition relative to the current conditions.

For Wet and Above Normal water years, average monthly depth of deepwater pool areas changed slightly over the February through November period. The greatest average monthly depth reduction during any month of the evaluation period was -0.2% under the Cumulative Condition relative to the current conditions.

For Below Normal water years, average monthly depth of deepwater pool areas changed even less over the evaluation period, with no reductions in average monthly depth exceeding -0.1% under the Cumulative Condition relative to the current conditions.

For Dry and Critical water years, average monthly depth of deepwater pool areas did not change during any month of the entire March through November period.

Application of the RMT's SRH-2D hydraulic model resulted in estimates of the total wetted area (ft^2) of pools > 10 feet deep (i.e., deepwater pool habitat) from Daguerre Point Dam to the confluence with the lower Feather River at various flow rates ranging from 300 to 42,200 cfs at the Marysville Gage. The areal percentage of the wetted channel comprised of deepwater pools ranges from 2.6% at 300 cfs, to 10.3% at 5,000 cfs, to 44.8% at 42,200 cfs (see Appendix G).

Appendix G of this BA displays monthly exceedance curves of the areal extent of deepwater pool habitat associated with the simulated mean monthly flows at the Marysville Gage over the entire modeled hydrologic period of record (i.e., 1922 through 2008) for the Cumulative Condition and current conditions. These exceedance curves are presented monthly for the February through November period, which represents the potential green sturgeon adult holding, spawning and post-spawning holding periods.

Examination of model output presented in Appendix G demonstrates that over the 87-year simulation period, the long-term average monthly deepwater pool habitat exceedance distributions would vary only slightly during February through May, October and November, and would generally be similar during June and September. The largest differences in the monthly deepwater habitat exceedance distributions occur during July and August. However, monthly deepwater habitat exceedance distributions under the Cumulative Condition differ by less than 10% over 93-100% of the monthly distributions over the entire February through November evaluation period, relative to the current conditions. Moreover, the largest reductions in deepwater pool habitat occur during July and August when deepwater pool habitat availability remains above 300,000 square feet downstream of Daguerre Point Dam. Over the quartile of the monthly deepwater pool habitat exceedance distributions representing the lowest amounts of habitat availability, deepwater pool habitat is essentially equivalent most of the time during all months, and does not differ by 10% or more during any year of any month of the evaluation period.

Summary of Flow-Related Effects on Green Sturgeon

In summary, the relatively minor flow reductions under the Cumulative Condition relative to the current conditions would be expected to result in corresponding minor reductions in deepwater pool depth and habitat availability below Daguerre Point Dam during the February through November evaluation period. During low flow conditions, deepwater pool habitat availability under the Cumulative Condition would be essentially equivalent during all months of the evaluation period, relative to the current conditions. Minor flow-related changes to depth or areal extent of deepwater pool habitat under the

Cumulative Condition relative to the current conditions indicate no substantive effects to the unique specific PCE of deepwater pool habitat associated with green sturgeon critical habitat in the lower Yuba River.

7.5.1.2 Cumulative Effects Water Temperature Analysis

WATER TEMPERATURE AT THE SMARTSVILLE GAGE

Over the 87-year simulation period, long-term average monthly water temperatures, as well as average monthly water temperatures by water year type at the Smartsville Gage would not change or would change only very slightly under the Cumulative Condition relative to the current conditions. Changes in average monthly water temperatures over all water year types would range only from an estimated 0.1°F decrease to a 0.2°F increase under the Cumulative Condition relative to the current conditions.

Examination of monthly mean water temperature exceedance distributions over the 87-year simulation period at the Smartsville Gage indicate no or minor differences between the Cumulative Condition and the current conditions during each month of the year.

WATER TEMPERATURE AT DAGUERRE POINT DAM

Over the 87-year simulation period, the long-term average monthly water temperatures, as well as average monthly water temperatures during Wet, Above Normal and Below Normal water year types at Daguerre Point Dam would not change or would change only very slightly under the Cumulative Condition relative to the current conditions. Changes in average monthly water temperatures over these water year types would range only from a 0.1°F decrease to a 0.2°F increase under the Cumulative Condition relative to the current conditions.

For Dry and Critical water year types, average monthly water temperatures at Daguerre Point Dam change slightly during most months of the year, with no change or changes of 0.1°F occurring from October through April. However, relative to the current conditions, the Cumulative Condition results in decreases in water temperature from May through September, with the largest decreases in temperature occurring during July (0.4°F and 0.3°F during Dry and Critical years, respectively) and August (0.4°F during both Dry and Critical years).

Examination of monthly mean water temperature exceedance distributions over the 87-year simulation period at Daguerre Point Dam indicate no or minor differences between the Cumulative Condition and the current conditions from October through June. Differences in the monthly mean water temperature exceedance distributions generally occur during July and August, with the Cumulative Condition exhibiting somewhat lower water temperatures over approximately the warmest one-half of the distributions, and to a lesser extent during September.

Water Temperature at the Marysville Gage

Examination of model output presented in Appendix F of this BA demonstrates that over the 87-year simulation period, the long-term average monthly water temperatures at the Marysville Gage would increase slightly during August and September (0.4°F) and either would not change or would change only very slightly from October through July under the Cumulative Condition relative to the current conditions.

For Wet water year types, average monthly water temperatures at the Marysville Gage are changed slightly during most months of the year, with no change or changes of 0.1°F occurring from October through June. Relative to the current conditions, the Cumulative Condition results in water temperature increases during July (0.2°F), August (0.4°F) and September (0.5°F).

For Above Normal water year types, average monthly water temperatures at the Marysville Gage change slightly during most months of the year, with no change or changes of 0.1°F during seven months of the year, excluding November, February and July through September. Water temperature increases occur in November, February and July (0.2°F), August (0.6°F) and September (0.5°F) under the Cumulative Condition, relative to the current conditions.

For Below Normal water year types, average monthly water temperatures at the Marysville Gage change slightly during most months of the year, with no change or changes of 0.1°F occurring from October through April. The Cumulative Condition results in water temperature increases of 0.2°F (May through July), 0.5°F (August) and 0.4°F (September) at the Marysville Gage, relative to the current conditions.

For Dry and Critical water year types, average monthly water temperatures at the Marysville Gage change slightly during most months of the year, with changes in average monthly water temperatures during these water year types ranging from a 0.4°F decrease (July of Dry water years) to a 0.1°F increase (May, August and September in Dry water years and October, November and May in Critical water years) under the Cumulative Condition, relative to the current conditions.

Examination of monthly mean water temperature exceedance distributions over the 87-year simulation period at the Marysville Gage indicate no or minor differences between the Cumulative Condition and the current conditions from October through June. Differences in the monthly mean water temperature exceedance distributions generally would occur during July, August and September, with the Cumulative Condition exhibiting somewhat lower water temperatures over approximately the warmest one-half of the distribution during July, and generally similar water temperatures over approximately the warmest one-half of the distribution during August and September, with slightly higher temperatures over the other half of the distributions.

WATER TEMPERATURE-RELATED EFFECTS ON SPRING-RUN CHINOOK SALMON

From the spatial and temporal distribution information presented in Chapter 4 of this BA, the spring-run Chinook salmon lifestage-specific periodicities used for this evaluation of monthly mean water temperatures under the Cumulative Condition relative to the current conditions are as follows.

- Adult immigration and holding (April through September)
- Spawning (September through mid-October)
- Embryo incubation (September through February)
- Juvenile rearing and downstream movement (Year-round)[2]

[2] Water temperature suitabilities for the juvenile rearing and downstream movement lifestages are evaluated together because they have the same upper tolerance WTI.

- ❑ Smolt (yearling+) emigration (October through mid-May)

ADULT IMMIGRATION AND HOLDING

As previously discussed, adult spring-run Chinook salmon immigrate up through the lower Yuba River from early spring into July, August, and as late as September, and hold upstream and just downstream of Daguerre Point Dam until initiation of spawning during September. Examination of monthly mean water temperatures over the 87-year simulation period at the Smartsville Gage indicates that monthly mean water temperatures during the April though September adult immigration and holding time period would not approach the WTI value of 65°F at the Smartsville Gage under either the Cumulative Condition or the current conditions.

At Daguerre Point Dam, monthly mean water temperatures during April through June would not exceed the WTI value of 65°F under either the Cumulative Condition or the current conditions. From July through September water temperatures remain below the 65°F WTI value about 99% of the time under both the Cumulative Condition and the current conditions.

Relatively minor differences would occur between monthly mean water temperatures at the Marysville Gage under the Cumulative Condition and the current conditions during all months with the exception of June and July. The Cumulative Condition results in about a 9% lower probability of exceeding the 65°F index value during June, and about a 1% higher probability of exceeding the 65°F index value during July. The WTI value of 68°F would not be exceeded during October through June under either the Cumulative Condition or current conditions. The 68°F WTI value would be exceeded with the same probability (< 5%) during July, August and September at the Marysville Gage under the Cumulative Condition and the current conditions.

SPAWNING AND EMBRYO INCUBATION

During the September through December spring-run Chinook salmon spawning and embryo incubation period, mean monthly water temperatures at the Smartsville Gage would remain below the WTI value of 58°F under the Cumulative Condition and the current conditions.

Juvenile Rearing and Downstream Movement

Although the WTI value of 65°F was established for both the juvenile spring-run Chinook salmon rearing and downstream movement lifestages, the index value is applied at Smartsville and Daguerre Point Dam for rearing (year-round), and at Daguerre Point Dam and Marysville for juvenile downstream movement (Mid-November through June). Consequently, the probability of exceeding the 65°F index value is evaluated year-round for all three locations for these combined lifestages.

Examination of monthly mean water temperatures over the 87-year simulation period at the Smartsville Gage indicates that monthly mean water temperatures during the year-round juvenile rearing and downstream movement combined lifestages remain below the WTI value of 65°F at the Smartsville Gage under both the Cumulative Condition and the current conditions.

At Daguerre Point Dam, monthly mean water temperatures from October through June would not exceed the WTI value of 65°F under either the Cumulative Condition or the current conditions. From July through September, water temperatures remain below the 65°F WTI value about 99% of the time under both the Cumulative Condition and the current conditions.

At the Marysville Gage, during the (mid-)November through June downstream movement lifestage of juvenile spring-run Chinook salmon, monthly mean water temperatures remain below the WTI value of 65°F under both the Cumulative Condition and the current conditions. During June, water temperatures exceed the 65°F WTI value with an equal probability (< 5%) under both the Cumulative Condition and the current conditions.

Smolt (Yearling+) Emigration

The RMT (2013) identified the spring-run Chinook salmon smolt (yearling+) outmigration period as extending from October through mid-May in the lower Yuba River. Examination of monthly mean water temperatures over the 87-year simulation period at Daguerre Point Dam and at Marysville indicates that monthly mean water temperatures would remain below the WTI value of 68°F from October through May under both the Cumulative Condition and the current conditions.

SUMMARY OF WATER TEMPERATURE-RELATED EFFECTS ON SPRING-RUN CHINOOK SALMON

Minor water temperature changes would occur under the Cumulative Condition relative to the current conditions. The foregoing evaluation of changes in water temperatures under the Cumulative Condition relative to the current conditions indicates no substantive effects for any of the spring-run Chinook salmon lifestages in the Action Area of the lower Yuba River.

WATER TEMPERATURE-RELATED EFFECTS ON STEELHEAD

The steelhead lifestage-specific periodicities used for this evaluation of monthly mean water temperatures under the Cumulative Condition relative to the current conditions are as follows.

- Adult immigration and holding (August through March)
- Spawning (January through April)
- Embryo incubation (January through May)
- Juvenile rearing and downstream movement (Year-round)[3]
- Smolt (yearling+) emigration (October through mid-April)

ADULT IMMIGRATION AND HOLDING

The immigration of adult steelhead in the lower Yuba River occurs from August through March, with peak immigration from October through February (RMT 2013). Examination of monthly mean water temperatures over the 87-year simulation period at the Smartsville Gage indicates that monthly mean water temperatures during the August through March adult immigration and holding time period would remain below the WTI

[3] Water temperature suitabilities for the juvenile rearing and downstream movement lifestages are evaluated together because they have the same upper tolerance WTI.

value of 65°F at the Smartsville Gage under either the Cumulative Condition or the current conditions.

At Daguerre Point Dam, monthly mean water temperatures remain below the 65°F WTI value from October through March. Water temperatures remain below the 65°F and 68°F WTI values with about a 98% probability during August. During September, water temperatures remained below the 65°F WTI value with about a 98% probability, and remained below the 68°F WTI value under both the Cumulative Condition and the current conditions.

At the Marysville Gage, monthly mean water temperatures would remain below the WTI value of 65°F from October through March. The 65°F and 68°F WTI values would be exceeded with the same probability (< 5%) during August and September at the Marysville Gage under the Cumulative Condition and the current conditions.

SPAWNING AND EMBRYO INCUBATION

During the January through May steelhead spawning and embryo incubation period, mean monthly water temperatures at the Smartsville Gage remain below the WTI value of 57°F under both the Cumulative Condition and the current conditions. At Daguerre Point Dam, water temperatures remain below the 57°F WTI value during January through April under both the Cumulative Condition and the current conditions. During May, water temperatures at Daguerre Point Dam would remain below the 57°F WTI value about 97% of the time under both the Cumulative Condition and the current conditions.

JUVENILE REARING AND DOWNSTREAM MOVEMENT

Although the WTI value of 68°F was established for both the juvenile spring-run Chinook salmon rearing and downstream movement lifestages, the index value is applied at Smartsville and Daguerre Point Dam for rearing (year-round), and at Daguerre Point Dam and Marysville for juvenile downstream movement (April through September). Consequently, the probability of exceeding the 68°F index value is evaluated year-round for all three locations for these combined lifestages.

Examination of monthly mean water temperatures over the 87-year simulation period at the Smartsville Gage indicates that monthly mean water temperatures during the year-round juvenile rearing and downstream movement combined lifestages remain below the WTI value of 68°F at the Smartsville Gage under both the Cumulative Condition and the current conditions.

At Daguerre Point Dam, monthly mean water temperatures from October through June would not exceed the WTI value of 68°F under either the Cumulative Condition or the current conditions. From July through September, water temperatures remain below the 68°F WTI value about 99% of the time under both the Cumulative Condition and the current conditions.

At the Marysville Gage, during the April through September downstream movement lifestage of juvenile steelhead, monthly mean water temperatures remain below the WTI value of 68°F under both the Cumulative Condition and the current conditions from April through June. During July, August and September, water temperatures exceed the 68°F WTI value with an equal probability (< 5%) under both the Cumulative Condition and the current conditions.

SMOLT (YEARLING+) EMIGRATION

The RMT (2010b; 2013) review of all available data indicate that steelhead smolt (yearling+) emigration may extend from October through mid-April. Examination of monthly mean water temperatures over the 87-year simulation period at both Daguerre Point Dam and the Marysville Gage indicates that monthly mean water temperatures would remain below the WTI value of 55°F with about a 99-100% probability from November through April under both the Cumulative Condition and the current conditions. Water temperatures during October are essentially equivalent under the Cumulative Condition and the current conditions, and would nearly always exceed the 55°F index value.

SUMMARY OF WATER TEMPERATURE-RELATED EFFECTS ON STEELHEAD

Minor water temperature changes would occur under the Cumulative Condition relative to the current conditions. The foregoing evaluation of changes in water temperatures under the Cumulative Condition relative to the current conditions indicates no substantive effects for any of the steelhead lifestages in the Action Area of the lower Yuba River.

WATER TEMPERATURE-RELATED EFFECTS ON GREEN STURGEON

Consistent with RMT (2013), the water temperature-related assessment for green sturgeon critical habitat evaluates the differences in the probability of occurrence that water temperatures at Daguerre Point Dam and at the Marysville Gage in the lower Yuba River are outside of reported suitable ranges for each of the lifestages, under the Cumulative Condition relative to the current conditions, as follows:

- Adult immigration/holding/post-spawning holding (February through November) (44°F to 61°F)
- Adult spawning and embryo incubation (March through July) (46°F to 63°F)
- Juvenile rearing and outmigration (Year-round) (52°F to 66°F)

ADULT IMMIGRATION, HOLDING, AND POST-SPAWNING HOLDING

Water temperatures from 44°F to 61°F are used to represent the suitable range for the adult immigration, holding, and post-spawning holding lifestages. The combination of these lifestages encompasses late February through November. At Daguerre Point Dam, water temperatures remain within this range with 100% probability from February through May, and during October and November. Water temperatures would remain within this range with about 98% probability from June through September under both the Cumulative Condition and the current conditions.

At Marysville, water temperatures would remain within this range with a 100% probability from March, April, October and November, and with about 98% probability during February and May. Water temperatures would exceed the upper end of the range with about equal probability of occurrence (about 40%) during June under both the Cumulative Condition and the current conditions. Water temperatures would exceed the upper end of the range with an additional probability of occurrence under the Cumulative Condition of about 5%, 6%, and 13% during July, August and September, respectively.

SPAWNING AND EMBRYO INCUBATION

Water temperatures from 46°F to 63°F are used to represent the suitable range for the spawning and embryo incubation lifestages, which occur from March through July. At

Daguerre Point Dam, water temperatures would remain within this range with 100% probability during April and May, and would remain within this range during March, June and July with about a 98% probability.

At Marysville, water temperatures would remain at or below the upper value (63°F) of the suitability range with 100% probability during March through May under both the Cumulative Condition and the current conditions. Water temperatures would exceed the upper end of the range with about an equal probability during June under both the Cumulative Condition and the current conditions. During July, water temperatures would exceed the upper end of the range with an additional ~3% probability under the Cumulative Condition.

JUVENILE REARING AND OUTMIGRATION

The juvenile rearing and outmigration lifestages used the same WTI value range (52°F to 66°F). At Daguerre Point Dam, water temperatures would remain below the upper value of the suitability range (66°F) with a 100% probability from October through June, and with about a 98% probability from July through September under both the Cumulative Condition and the current conditions.

At Marysville, water temperatures would remain below the upper value of the suitability range (66°F) with a 100% probability from October through May. From June through September, water temperatures would remain below the upper value of the suitability range (66°F) with about a 95% probability or more under both the Cumulative Condition and the current conditions.

SUMMARY OF WATER TEMPERATURE EFFECTS ON GREEN STURGEON

Minor water temperature changes would occur under the Cumulative Condition relative to the current conditions. The foregoing evaluation of changes in water temperatures under the Cumulative Condition relative to the current conditions indicates no substantive effects for any of the green sturgeon lifestages in the lower Yuba River.

7.5.2 Other Future Non-Federal Activities

The following activities may affect flows or other conditions in the lower Yuba River. For the reasons discussed below, none of these activities is likely to have any adverse cumulative effects on any of the listed species discussed in this BA or their critical habitats.

7.5.2.1 BVID Agricultural Return Flow Recapturing Project

Browns Valley Irrigation District is planning to construct a pumping plant and a pipeline to recapture and recycle irrigation return flows that the district is discharging into Dry Creek (BVID 2011). BVID will convey recycled flows from a pumping plant on Dry Creek to rice fields presently irrigated exclusively by diversions from the lower Yuba River. The warmer reclaimed water will be delivered into BVID's Pipeline Canal and applied by its customers to rice lands where the elevated water temperature benefits rice production. Application of tailwater recaptured from Dry Creek to the agricultural lands within BVID's service area will reduce the district's demand for water diverted directly from the lower Yuba River, thus balancing the reduction in inflow to the river that results from pumping from Dry Creek with an equivalent reduction in diversion. The project is of regional significance because it will reduce diversions from the lower Yuba River (Yuba County 2007).

The project proposes to recapture up to a maximum of 10 cfs of irrigation return flow from Dry Creek during the irrigation season, which typically runs from April through October (BVID 2011). It is estimated that the influx of irrigation return flow raises Dry Creek's temperature by an average of 4–5ºC and introduces sediment, nutrients, and other constituents into the Dry Creek approximately 1.8 miles upstream of its confluence with the lower Yuba River (BVID 2009). By pumping water from Dry Creek downstream of the confluence with Little Dry Creek when Dry Creek flows are primarily comprised of return water from irrigated lands, the project is expected to improve water quality by removing some of the thermal and pollutant load from Dry Creek before it reaches the lower Yuba River. BVID will continue to meet existing minimum flow requirements with releases of cool, good quality water from Collins Lake. Any time that BVID is recapturing irrigation return water, there will be an equal and concurrent reduction in BVID's diversions from the Yuba River at its Pumpline facilities (BVID 2009). Use of the recaptured return water for the rice fields will reduce BVID diversions of cool surface water from the lower Yuba River, and this substitution will retain cool water in the lower Yuba River, which will benefit fisheries resources and aquatic habitat (BVID 2009).

7.5.2.2 The Trust for Public Lands Excelsior Project

The Excelsior Project is a collaborative conservation effort on the lower Yuba River, featuring 924 acres of wetlands, oak woodlands, gold-rush archeological remnants, and miles of critical riparian salmon spawning habitat (Excelsior Chronicles 2010). As many as 60 homes were planned along the lower Yuba River on the property once owned by the Excelsior Mining Company. The Trust for Public Lands, in collaboration with CDFW, intends to turn part of the land over to the University of California Sierra Field Research Station for salmon studies and restoration work before eventually opening it to the public (Fimrite 2009). Recently, the California Wildlife Conservation Board, in concert with the Trust for Public Lands, voted to acquire the 528-acre Yuba Narrows Ranch, ensuring that this property would be permanently protected as open space. In July of 2011, CDFW acquired the Yuba Narrows Ranch, which includes frontage along almost two miles of critical salmon spawning habitat along the lower Yuba River, and will be managed and permanently protected as open space. The conservation easement will permit access from Highway 20 into the Yuba Narrows Ranch, providing miles of hiking and acres of recreational opportunities. It is anticipated that portions of the property, including the Miner's Ditch Trail, will become open to public access. Additionally, it is anticipated the acquisition of the historic 157-acre Black Swan Ranch portion of the Excelsior property, which is located near the confluence of Deer Creek and overlooks Englebright Reservoir and the lower Yuba River, will be completed during 2013 (Excelsior Project 2013).

Beginning in the fall of 2011, conservation easements were placed on parcels of the Excelsior Ranch. The blue oak woodlands that occupy the large majority of the Excelsior Ranch will be permanently protected as open space, and managed jointly by the Ranch's steward-owners, who will also play a significant role in oversight of the Black Swan and

Yuba Narrows conservation areas. In this way, more than 870 acres (over 95%) of the Excelsior property will be permanently protected as open space.

7.5.2.3 Yuba Goldfields Sand and Gravel Mining Operations

The Yuba Goldfields area is designated and zoned "Extractive Industrial" under the Yuba County General Plan, which allows surface mining as a permitted use. Operators within and adjacent to the Yuba Goldfields currently supply construction materials, including asphaltic concrete, to projects within southern Placer and Yuba counties.

TEICHERT AGGREGATES

The Teichert Aggregate's operation mines and processes sand and gravel deposits in addition to hard rock, immediately adjacent to the Yuba Goldfields approximately five miles northeast of Marysville, California, and two miles south of the Yuba River. The mine operates on an approximately 590-acre site and mines to depths of approximately 200 feet (Placer County 2007). Mining operations use a dragline to excavate mined materials in saturated conditions (below groundwater levels). According to Placer County (2007), production is 500,000 tons per year to 1 million tons per year (mty) depending on specific market demands. For purposes of assessing cumulative effects, it was previously assumed that this facility would be operating at its maximum estimated production rate of 1 mty (Placer County 2007).

According to SMGB (2010), mineral production at Teichert Aggregate's Marysville facility was curtailed by more than 90 percent of the operation's previous maximum annual mineral production due to economic conditions in 2009. However, the operator submitted an Interim Management Plan (IMP) to the California State Mining and Geology Board (SMGB) for review and approval in 2010, and the operator indicated intent to resume surface mining operations at a future date. The SMGB recommended approval of the IMP for the Teichert Marysville Facility for a period of up to five years (SMGB 2010).

WESTERN AGGREGATES

The Western Aggregates facility mines and processes sand and gravel deposits within the Yuba Goldfields south of the Yuba River and north of Hammonton-Smartville Road

(Placer County 2007). The mine operates on approximately 2,000 acres, excavating sand and gravel deposits from previous gold dredger tailings. Mined aggregate material is hauled to an onsite processing plant that includes crushers, screeners, and a conveyor. The mitigated negative declaration for the mine (adopted March 23, 1977) estimated the mining rate to be about 600,000 tons per year (Placer County 2007).

In 2008, Western Aggregates and SYRCL, along with the Yuba River Preservation Foundation and Yuba Outdoor Adventures signed an Agreement in Principle to establish a conservation easement along three miles of river frontage of the Yuba River downstream of the Parks Bar Bridge (YubaNet 2008). The easement area, consisting of approximately 180 acres of land owned by Western Aggregates, will be used by the four signatories for habitat restoration for salmon, trout, and other native Yuba River species.

The conservation easement will prohibit development or mining on the encumbered lands (except for disturbance that may be necessary for habitat restoration), and will outline a range of potential prescriptions for habitat restoration (YubaNet 2008). The project also will incorporate pedestrian access to the lower Yuba River through several walk-through gates to be established at locations to be agreed upon at a future date.

The parties plan to implement the project in three phases. Initially, the project will protect and conserve land from vehicular damage to habitat. Concurrently, SYRCL will lead design and feasibility studies for physical habitat restoration. In the second phase, habitat for salmon and riparian wildlife will be restored through a series of projects over the encumbered lands. Finally, the project contemplates implementing long-term enhancement and monitoring of these restored habitats. The timing of the completion of the three phases is unknown at this time because of the funding needs of the project (YubaNet 2008). Western has initiated a Yuba Salmon Enhancement Fund through a "challenge grant" to SYRCL of $50,000, and Western has agreed to match SYRCL's fund-raising of the project dollar - for dollar for the first $50,000 raised by SYRCL (YubaNet 2008). The four parties to the Agreement in Principle also must obtain the consent of certain third parties who have varying interests in some of the lands contemplated for the conservation easement (YubaNet 2008).

BALDWIN CONTRACTING COMPANY AND SPRINGER FAMILY TRUST HALLWOOD AGGREGATE FACILITY

The Baldwin Contracting Company, Incorporated and Springer Family Trust has proposed to expand its aggregate mining operations in the Hallwood area of east-central Yuba County, just west of the Yuba Goldfields off SR 20 (Placer County 2007). Baldwin Contracting conducts mining operations on 275 acres and is planning a phased expansion of about 200 acres over a period of 14 to 20 years, with expansion occurring 30 acres at a time. The expansion would result in mining of an additional 500,000 tons per year to 1 million tons per year. Applications were submitted to Yuba County for a change of zone, a General Plan amendment, and a Yuba County surface mining permit, and to the California State Office of Mines and Geology for a permit amendment (Placer County 2007). The existing excavation area in the Yuba Goldfields was previously mined for aggregate and gold, and the expansion area is currently in fruit orchards and has not been mined (California RWQCB 2010). Aggregate reserves exist to a depth of approximately 75 feet in both areas (California RWQCB 2010). A Report of Waste Discharge was submitted to the Central Valley Regional Water Quality Control Board for expansion of an existing aggregate facility, which was approved in 2010.

7.5.2.4 Yuba County General Plan Update Draft EIR

The Yuba County General Plan Update Final EIR, in part, evaluated cumulative biological impacts in 2030 associated with implementing the general plan (Yuba County 2011). The cumulative effects assessment stated that past development in Yuba County, ranging from conversion of land to agricultural production to recent expansion of urban development, has resulted in a substantial loss of native habitat to other uses. This land conversion has benefited a few species, such as those adapted to agricultural, urban, and rural-scale developed uses, but the overall effect on native plants, animals, and habitat has been negative. Although many future projects and plans included in the cumulative scope of this analysis would be required to mitigate those impacts, in compliance with the CEQA, Federal ESA, California ESA, and other State, local, and Federal statutes, many types of habitats and species are provided no protection. Therefore, it can be expected that the net loss of native habitat for plants and wildlife, agricultural lands, and open space areas that support important biological resources in Yuba County and related areas will continue (Yuba County 2011). The cumulative loss of habitat for special status species, such as habitat for riparian and aquatic species (e.g., California red-legged frog, giant garter snake, and western yellow-billed cuckoo) have already resulted in drastic declines in numbers of these species (Yuba County 2011). The evaluation focused on terrestrial species and their habitats.

In Yuba County, most established riparian vegetation occurs along the largest rivers; the Feather River, Yuba River, and Bear River, and south Honcut Creek. Important riparian corridors also occur along Dry Creek and other tributaries to Honcut Creek and the Yuba River. Riparian vegetation is present in the surrounding region along the Sacramento River and in the Sutter Bypass. Agricultural, residential, and industrial water use and land development have resulted in a significant cumulative reduction in the extent of riparian habitats in the County and surrounding region. Implementing Action NR 5.3, which requires private and public projects to provide setbacks to protect riparian habitat as a condition of project approvals, is expected to substantially reduce impacts on riparian habitats, although complete avoidance may not be possible while still allowing full build out of the designated land uses. Therefore, the 2030 General Plan would have a cumulatively considerable contribution to this significant cumulative impact.

The County anticipates that implementation of the Yuba-Sutter Natural Community Conservation Plan (NCCP)/Habitat Conservation Plan (HCP) would reduce cumulative biological resources impacts. The Yuba-Sutter Regional NCCP/HCP will provide an opportunity to mitigate potential impacts to biological resources that may occur through implementation of the General Plan. The NCCP/HCP is still in draft form, but the County anticipates that it will be finalized and adopted before the 2030 General Plan is fully implemented.

7.5.2.5 Yuba-Sutter Regional Natural Community Conservation Plan/Habitat Conservation Plan

According to Yuba County et al. (2011), the Yuba-Sutter Regional NCCP/HCP will address actions associated with future urban development, irrigation improvements, local flood control projects, and road improvements within Yuba and Sutter counties. During the early planning stages, a group of independent science advisors provided recommendations in a document titled *Report of Independent Science Advisors for the Yuba and Sutter County Natural Community Conservation Plan/Habitat Conservation Plan* (Conservation Biology Institute 2006).

Fish species to be considered in the NCCP/HCP include spring-run Chinook salmon, fall-run Chinook salmon, steelhead, green sturgeon, white sturgeon, Sacramento splittail and Pacific lamprey (Conservation Biology Institute 2006). The reach of the lower Yuba River extending through and somewhat beyond the Yuba Goldfields was identified as having important Chinook salmon spawning habitat worthy of special attention in conservation, restoration, and enhancement measures. Fisheries-related recommendations included the need for additional information on the known distribution of fish species in local streams and associating these to the degree possible with information on flow regimes, known or suspected barriers, and other habitat quality variables (e.g., presence or absence of nonnative aquatic species; width and quality of riparian vegetation). This information would be used to identify potential actions that could aid in the recovery of local fish populations by removing physical passage barriers, removing water contaminants, altering the timing, duration, or magnitude of stream flows, or restoring riparian vegetation and/or adjacent upland buffering (Conservation Biology Institute 2006).

7.5.2.6 City of Wheatland, Reclamation District 2103, and Reclamation District 817 External Flood Source Flood Protection Projects

Four levee improvement alternatives have been identified as part of this project to mitigate the flooding issues associated with the City of Wheatland General Plan Area. The fourth alternative is the Reclamation District 2103 Bear River Levee Remediation, which is sponsored by local land developers and is designed to provide 200-year protection for the upper portion of the Bear River levee. This project would provide additional flood protection and management for the Upper Bear River and the City of Wheatland.

7.5.2.7 Trust for Public Land - Yuba River Acquisitions Plan

This project represents an historic opportunity to acquire three priority conservation areas along the Yuba River. The acquisition of these properties will help ensure the security of water quality in the Yuba River, protect threatened and endangered fisheries, create new recreational opportunities, and increase public access. These properties are part of the Yuba River Wildlife Area Conservation Conceptual Area Protection Plan (CAPP), which coordinates CDFW's acquisition and management activities on more than 81,000 acres of the Yuba River corridor.

Retain Flood Control Options: Protection of the project properties will increase long-term flood control options by protecting critical watershed lands in the river corridor and ensuring ownership and management patterns below and above stream of major water supply, power generation, and flood control facilities.

Restore and Protect Salmon and Steelhead Habitat: The project will protect, preserve and restore riparian and aquatic habitat for State and Federally listed Chinook salmon and steelhead trout and implement important conservation elements of the Yuba River CAPP, the Yuba River Conservancy, and the Lower Yuba Technical Work Group.

Create Habitat Connectivity: This project provides tremendous opportunities for habitat connectivity, including:

- East-West connectivity along the Yuba River. The properties included in this project will provide protection for up to 14.5 miles of Yuba River through a 21-mile corridor.
- Downstream river connectivity. Invaluable river corridor connectivity between Englebright Dam and Parks Bar necessary for the restoration of existing salmon and steelhead.
- Blue oak woodland corridor. The project also represents crucial properties in the center of a roughly twenty-mile north–south oak woodland corridor that stretches from the CDFW Daugherty Wildlife Area to the Spenceville Wildlife Area and Beale Air Force Base.

***Protect Agricultural Lands*:** The project will preserve and protect important agricultural lands, including grassland and rangelands along the river corridor that provide important wildlife habitat, riparian zones and protect sensitive aquatic environments.

7.6 Aggregate and Net Effects of the Proposed Action

In addition to determining whether the Proposed Action is likely to adversely affect any listed species or their critical habitats, this BA provides information to assist NMFS in evaluating whether the "aggregate effects" of the Proposed Action are likely to "*reduce appreciably the likelihood of both the survival and recovery*" of each listed species, or "*appreciably diminish[] the value of critical habitat.*" Under the aggregate effects assessment approach, the Environmental Baseline and the status of the species are viewed together by NMFS to determine the ability of each listed species to withstand additional stressors associated with subsequent actions without jeopardizing the continued existence of the species. Thus, an assessment is made as to whether current conditions, measured against the status of a species, leave any "cushion" to accommodate additional adverse impacts without causing jeopardy to the species. As NMFS (2009a) indicates: "*if the species' status is poor and the baseline is degraded at the time of consultation, it is more likely that any additional adverse effects caused by the proposed or continuing action will be significant.*"

As detailed in this BA, ongoing and future activities and conditions not necessarily within the control of the Corps are likely to continue to place substantial stress on the species at the ESU/DPS level. For the ESU-wide Environmental Baseline effects assessment of the spring-run Chinook salmon, NMFS (2009a) found that the entire suite of limiting factors, threats and stressors associated with the Environmental Baseline result in an unstable ESU at moderate risk of extinction. For the DPS-wide Environmental Baseline effects assessment of steelhead, NMFS (2009a) found that the entire suite of stressors associated with the Environmental Baseline result in an unstable DPS at moderate or high risk of extinction. Although NMFS (2009a) did not clearly state whether or not the green sturgeon DPS was stable, they concluded that continued operations of the CVP/SWP would be expected to have population level consequences for the single extant population in the mainstem Sacramento River, and that the stressors associated with the Environmental Baseline are likely to jeopardize the continued existence of the Southern DPS of North American green sturgeon and greatly increase the extinction risk of the species (NMFS 2009a).

In the lower Yuba River, available information regarding the current status of phenotypic spring-run Chinook salmon indicates that under the Environmental Baseline their abundance and trend considerations would correspond to low extinction risk according to NMFS criteria (Lindley et al. 2007). However, the RMT (2013) questions the applicability of any of these criteria addressing extinction risk, because lower Yuba River anadromous salmonids represent introgressive hybridization of larger Feather-Yuba river populations, with substantial contributions of hatchery-origin fish to the annual runs. Populations of steelhead and green sturgeon in the lower Yuba River are data deficient, and consequently cannot be concluded to be stable or at a specific risk of extinction.

Under the aggregate effects assessment approach, evaluation of the Environmental Baseline and the inability to conclude that populations of the listed species are stable would suggest that each listed species would not be able to withstand additional stressors associated with subsequent actions, and that it is… "*more likely that additional adverse effects caused by the proposed or continuing action will be significant*."

However, regarding spring-run Chinook salmon and steelhead, the Proposed Action will: (1) improve passage ability due to continuing to keep the fish ladder control gates open at high flow levels; and (2) improve within-ladder hydraulics and attraction flows by adjustment of within-ladder flashboards and fish ladder gated orifices; (3) improve within ladder hydraulics by removal of debris and sediment accumulation within the fish ladder bays and thereby improve passage conditions; (4) direct sheet flow that spills over the top of Daguerre Point Dam into the fish ladders, and thereby improve the ability of adult fish to locate the fish ladders and migrate upstream to spawning and rearing habitats; and (5) direct downstream migrating juvenile spring-run Chinook salmon and steelhead into the fish ladders, and thereby reduce physical injury from spilling over the dam, and potentially reduce predation due to disorientation in the plunge pool below the dam. In addition, the Proposed Action will not introduce new stressors or substantially exacerbate ongoing stressors under the Environmental Baseline to green sturgeon in the lower Yuba River. The Proposed Action is not likely to increase risks to green sturgeon.

Implementation of voluntary conservation measures would: (1) expand suitable spawning habitat in the Englebright Dam Reach and may encourage additional behavioral segregation of spawning spring-run Chinook salmon; and (2) provide additional LWM and corresponding habitat complexity and diversity (and therefore predator escape cover, velocity shelter, feeding stations) for rearing juvenile spring-run Chinook salmon and steelhead, relative to the Environmental Baseline.

The net effects of the Proposed Action would not increase the risks to spring-run Chinook salmon and steelhead because the Proposed Action will improve conditions in the Action Area of the lower Yuba River relative to the Environmental Baseline. In addition, the net effects of the Proposed Action will not increase the risks to green sturgeon because the Proposed Action will not result in increased harm to the species over Environmental Baseline conditions in the Action Area of the lower Yuba River.

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6.0 Effects Assessment Methodology

The effects assessment in this BA addresses the presence of listed species in the Action Area and includes an analysis of the likely effects of the Proposed Action on the listed species and their habitat. One of the purposes of this BA is to provide information for the Corps to determine whether the Proposed Action is "likely to adversely affect" listed species and critical habitat (USFWS and NMFS 1998).

To inform NMFS' jeopardy analysis and conclusion, population analyses are included in this BA to assist NMFS in their determination of whether the Proposed Action would reasonably be expected *"…directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species*." 50 C.F.R. §402.02; 16 U.S.C.S. §1536(a)(2). The population analysis applies the VSP concept, including considerations of abundance, productivity, spatial structure and diversity, for listed species in the appropriate ESU/DPS, as well as in the Action Area, including the lower Yuba River.

For the critical habitat effects analysis, an evaluation was conducted on the effects of the Proposed Action on the PCEs of critical habitat and, in particular, on the essential features of that critical habitat in the Action Area, by comparing the conditions of the habitat with and without the Proposed Action. In addition, for the lower Yuba River, an evaluation was conducted as to whether the Proposed Action would affect the VSP parameter of spatial structure. This BA includes information to assist the Corps as it makes its determination whether the Proposed Action is likely to adversely affect the PCEs of critical habitat. It also is anticipated that NMFS will use the Corps' analysis of potential effects to determine whether the Proposed Action would result in the destruction or adverse modification of critical habitat for each listed ESU/DPS.

6.1 Effects Assessment Framework

In conducting analyses of habitat-altering actions under Section 7 of the ESA, NMFS uses the consultation regulations and combines them with the following steps specified in the document titled *The Habitat Approach, Implementation of Section 7 of the Endangered Species Act for Actions Affecting the Habitat of Pacific Anadromous Salmonids* (NMFS 1999): "(1) *consider the status and biological requirements of the affected species; (2) evaluate the relevance of the environmental baseline in the action area to the species' current status; (3) determine the effects of the proposed or continuing action on the species; (4) consider cumulative effects; (5) determine whether the proposed action, in light of the above factors, is likely to appreciably reduce the likelihood of species survival in the wild or adversely modify its critical habitat*." According to NMFS (1999), the analytical framework described above is consistent with the ESA Consultation Handbook (USFWS and NMFS 1998) and builds upon the Handbook framework to better reflect the scientific and practical realities of salmon conservation and management on the West Coast. This BA is prepared within this analytical framework.

An Assessment Framework for Conducting Jeopardy Analyses Under Section 7 of the Endangered Species Act (NMFS 2004c) describes a nine-step approach that NMFS uses for evaluating the potential effects of a proposed action on listed species (**Figure 6-1**). This BA addresses the first seven steps of this approach. NMFS will complete steps 8 and 9 in their BO for the Proposed Action.

Using the completed description of the Proposed Action, the next step in the evaluation process is to "deconstruct" the Proposed Action (**Figure 6-2**) into its constituent parts to identify the environmental stressors (physical, chemical, or biotic stressors that are directly or indirectly caused by the Proposed Action and, for indirect effects, are "reasonably certain to occur") and any environmental subsidies (i.e., environmental changes that improve conditions for taxa that prey on, compete with, or serve as pathogens for one or more of the listed species) caused by the Proposed Action (NMFS 2004c).

The next step of the assessment framework focuses on those aspects of the Proposed Action that were conceptually identified to have potential adverse or beneficial effects, and the extent of those potential preliminary effects were then applied to identify the

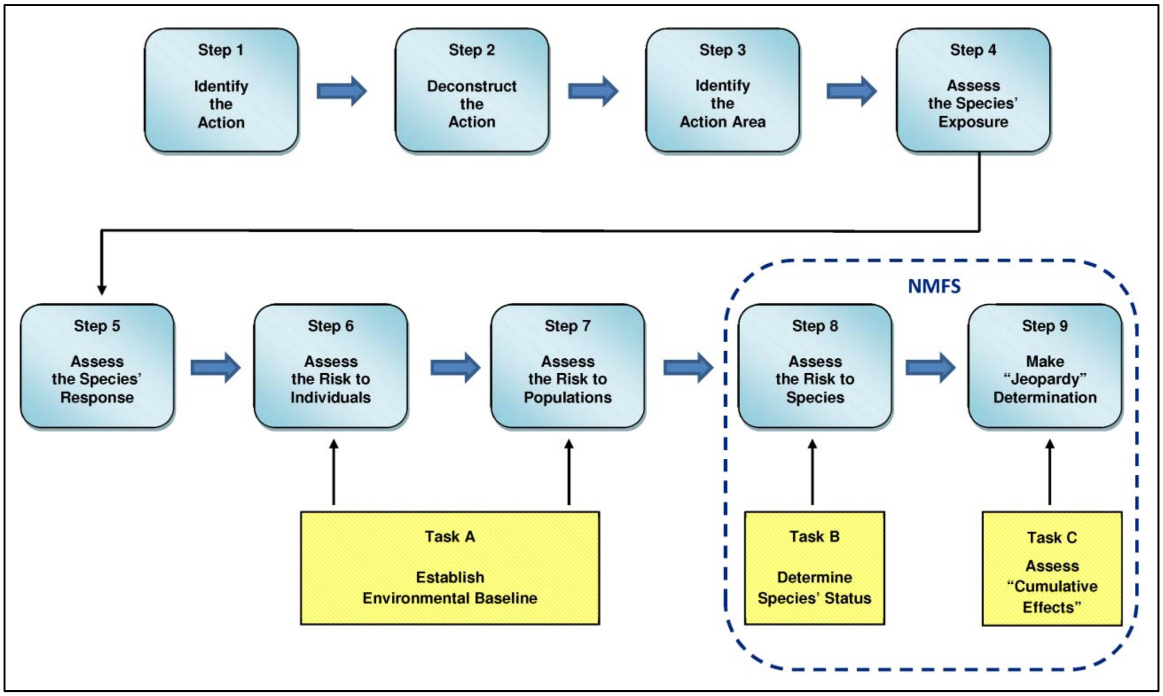

Figure 6-1. Conceptual model of the assessment framework (Modified from NMFS 2004).

Action Area for this ESA consultation. The effects assessment framework then proceeds by considering the extent of physical, chemical and biological stressors associated with the Proposed Action, the potential for species' exposure to those stressors, and species' potential responses to exposure. These assessments are conducted within the context of "aggregate effects" and "net effects" of the Proposed Action.

6.1.1 Aggregate Effects Assessment Approach and "Net Effects" Analysis

This BA examines the Proposed Action in relation to each of the listed species' current status and the effects of past, present, and reasonably certain future non-Federal projects on the species (i.e. cumulative effects). The ESA's implementing regulations define NMFS' responsibilities in consulting with another Federal agency. Among other things, NMFS must evaluate the current status of the listed species or critical habitat; evaluate the effects of the action and cumulative effects on the listed species or critical habitat; and formulate its biological opinion as to whether the action, taken together with

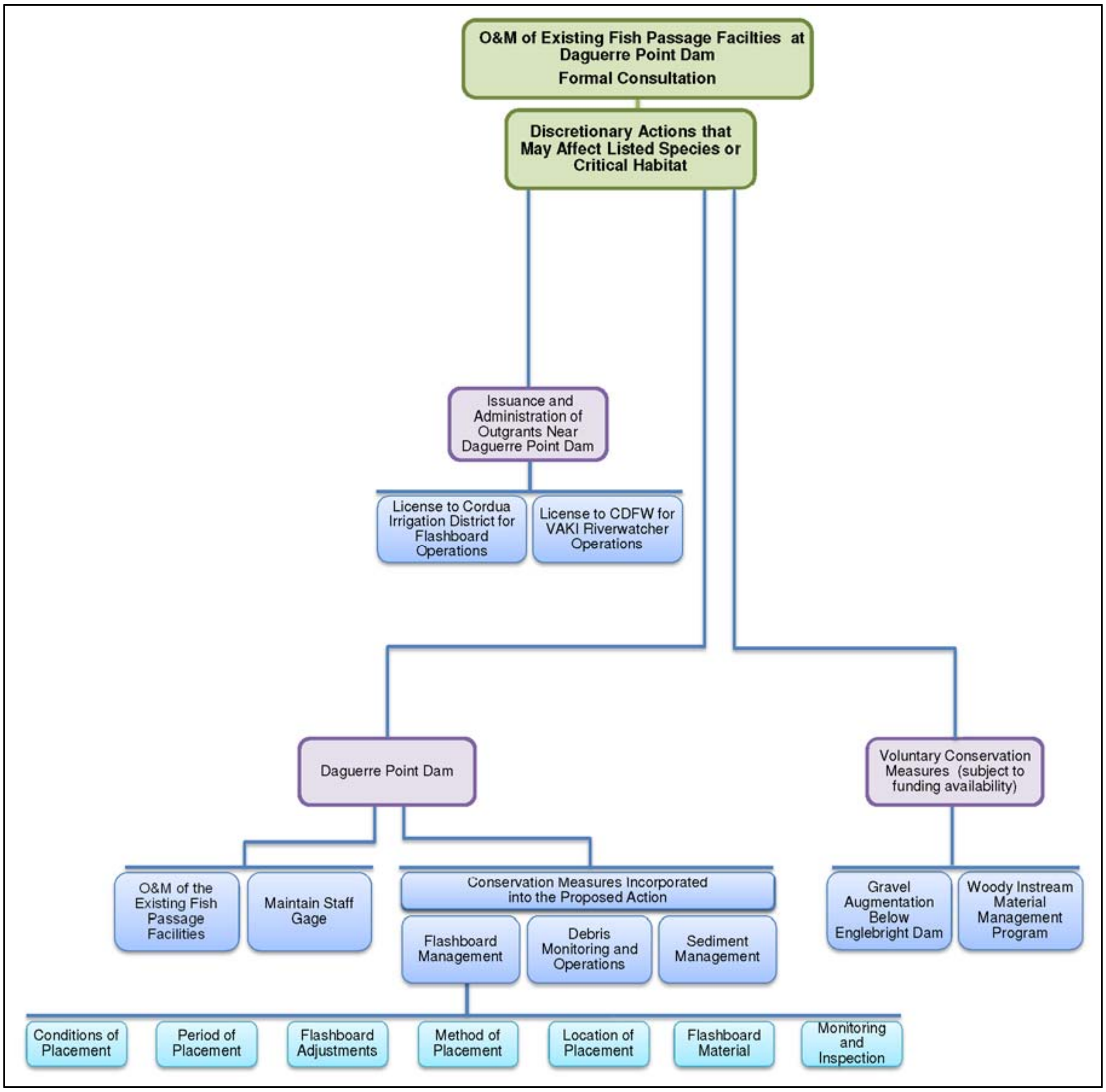

Figure 6-2. "Deconstructed" activities comprising the Proposed Action (i.e., discretionary actions that may affect listed species).

cumulative effects, is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat (50 C.F.R. §402.14(g)). Furthermore, the regulations state that the "effects of the action" refers to "*…the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline.*"

This approach addresses whether the effects of the Proposed Action (the Corps' authorized discretionary O&M activities of the fish passage facilities at Daguerre Point

Dam, administration of licenses to CDFW and Cordua Irrigation District, and specified conservation measures) viewed in context with the Environmental Baseline (including the continued presence of Daguerre Point Dam) and any cumulative effects, has the potential to adversely affect spring-run Chinook salmon, steelhead or green sturgeon or their critical habitats.

The significance of the effects of the Proposed Action will be driven in part by the current status of the species and the Environmental Baseline. As the NMFS (1999) policy document states: "[i]*f the species' status is poor and the baseline is degraded at the time of consultation, it is more likely that any additional adverse effects caused by the proposed or continuing action will be significant*".

The current status of the listed species and the stability of their populations, as presented in Chapter 4 of this BA, demonstrate that although the spring-run Chinook salmon population in the Yuba River may be stable, populations of steelhead and green sturgeon in the lower Yuba River are data deficient, and consequently cannot be concluded to be stable. Moreover, within the Central Valley Domain, the spring-run Chinook salmon ESU, the steelhead DPS and the Southern DPS of green sturgeon are not currently stable, and are subject to some risk of extinction. Therefore, additional evaluations are provided in this BA to inform NMFS' jeopardy analyses and conclusions.

The additional evaluations in this BA consist of performing a "net effects" analysis to assist NMFS in determining whether the Proposed Action will cause "…*some deterioration in the species' pre-action condition*" (*National Wildlife Federation v. NMFS, 524 F.3d 917 (9th Cir. 2008*). The net effects analysis in this BA considers guidance provided by *National Wildlife Federation v. NMFS, 524 F.3d 917, 930 (9th Cir. 2008)*, which stated **"**…*an agency's action only "jeopardize[s]" a species if it causes some new jeopardy*." The Court went on to say NMFS must "…*consider the effects of [the agency's actions] 'within the context of other existing human activities that impact the listed species'*. Most importantly, in quoting *Pacific Coast Federation of Fishermen's Associations v. U.S. Bureau of Reclamation*, 426 F.3d 1082, (9th Cir. 2005), the Court stated "…'[t]*he proper baseline analysis is not the proportional share of responsibility the federal agency bears for the decline in the species, but what jeopardy* *might result from the agency's proposed actions* *<u>in the present and future human and natural contexts.</u>*'" (emphasis in original). This approach to the evaluation of effects is consistent with the preamble in NMFS' proposed rule for interagency cooperation issued on June 29, 1983 (48 FR 29990). The preamble states:

> "*…In determining whether an action is likely to jeopardize the continued existence of a species or result in the destruction or adverse modification of critical habitat, the Director first will evaluate the status of the species or critical habitat at issue. This will involve consideration of the present environment in which the species or critical habitat exists, as well as the environment that will exist when the action is completed, in terms of the totality of factors affecting the species or critical habitat.*

To identify potential stressors affecting listed species within the Action Area, the next step in the assessment approach involves: (1) the identification of specific stressors (physical, biological, and chemical) to which individual members of listed species are exposed; (2) where exposure may occur; (3) potential pathways of exposure, including the timing, magnitude, duration and frequency of exposure; and (4) characterization of how exposure may vary depending upon the characteristics of the environment, stressor intensity and individual behavior (NMFS 2004c).

After determining whether individual members of listed species would be exposed to one or more physical, biological or chemical stressors resulting from the Proposed Action, species' responses to exposure are considered to determine how individuals would respond to the exposure, and whether the potential exposure would be sufficient to evoke particular responses (NMFS 2004c). As part of this assessment step, the analysis attempts to identify causal pathways that connect species' exposure to responses, as well as latent periods between exposure and the onset of a species' response (NMFS 2004c).

With respect to a habitat-based assessment, habitat modification represents the mechanism by which the Proposed Action has potential demographic effects on individuals or populations of listed species. Habitat modification also may serve as an indirect pathway by which listed species are exposed to potential effects of the Proposed Action (NMFS 2004c).

For each stressor identified under the Environmental Baseline or the Proposed Action, the magnitude of each stressor was ascertained by generally applying the stressor prioritization ("Very High", "High", "Medium", and "Low") used by NMFS (2009) in Appendix B (Threats Assessment) updated with information obtained since 2009 in the lower Yuba River.

For each stressor that emanates from or is exacerbated by the Proposed Action, the net effects analysis addresses the following: (1) the magnitude of effect of each stressor, to the extent possible; (2) the listed species' ability to tolerate each stressor; and (3) and the reason why each stressor will, or will not, contribute to the overall likelihood that the listed species or its critical habitat will be adversely affected by the Proposed Action. For this BA, it is recognized that incrementally assessing the magnitude of an individual stressor, or the incremental ability of the listed species to tolerate an individual stressor, is rendered problematic due to the interconnectivity of individual stressors and the inherent variation in biological response to suites of stressors. Nonetheless, to the extent possible, the net effects analysis addresses the magnitude of individual stressors associated with the Proposed Action, and evaluates whether such effects are likely to increase risks to the listed species.

6.1.1.1 Environmental Baseline Assessment

The Environmental Baseline identifies the antecedent conditions for individuals and populations before considering any new stressors associated with the Proposed Action (NMFS 2004c).

Applying steps six and seven of the assessment approach described in NMFS (2004), the Environmental Baseline assessment consists of evaluating potential risks to individuals and populations (see Task A in Figure 6-1).

Past, present, and future stressors associated with the physical presence of existing facilities are included in the Environmental Baseline for this BA, unless the Corps has authority and discretion to: (1) remove the facilities; or (2) alter the operations of the facilities in a manner that would reduce harm to listed species involved in the consultation. With the exception of stressors related to fish ladder performance associated with authorized routine maintenance activities, the Corps does not have the authority to lessen other stressors associated with Daguerre Point Dam (see Chapter 1). Therefore, stressors associated with the ongoing existence of Daguerre Point Dam are appropriately attributed to the Environmental Baseline (see Chapter 5). The Environmental Baseline has led to the current status of the species. The main difference between the Environmental Baseline and a species' status is scale. While the Environmental Baseline is limited to the Action Area, a species' status encompasses the base condition of the entire species (ESU/DPS), given the species' exposure to human activities and natural phenomena throughout their geographic distribution. NMFS determines a species' status to identify its risk of extinction (or probability of persistence) at the time of consultation even if a proposed action did not occur. As a result, a species' status provides the point of reference for jeopardy determinations in a consultation (NMFS 2004c).

The limiting factors, threats and stressors associated with the Environmental Baseline that has led to the current status of listed species, are described in detail in Chapter 4 of this BA and are listed below.

SPRING-RUN CHINOOK SALMON

ESU

- Habitat Blockage
- Water Development
- Water Conveyance and Flood Control
- Land Use Activities
- Water Quality
- Non-Native Invasive Species
- Hatchery Operations and Practices
- Disease and Predation
- Over Utilization (ocean commercial and sport harvest, inland sport harvest)
- Environmental Variation (natural environmental cycles, ocean productivity, global climate change, ocean acidification)

Lower Yuba River

- Passage Impediments/Barriers
- Harvest/Angling Impacts
- Poaching
- Physical Habitat Alteration
- Entrainment
- Predation
- Loss of Natural River Morphology and Function
- Loss of Floodplain Habitat
- Loss of Riparian Habitat and Instream Cover (riparian vegetation, instream woody material)
- Hatchery Effects (FRFH genetic considerations, straying into the lower Yuba River) and other genetic considerations

Steelhead

DPS

The aforementioned list of limiting factors and stressors pertinent to the spring-run Chinook salmon ESU also pertain to the steelhead DPS. Stressors that are unique to the steelhead DPS, or that substantially differ in the severity of a stressor for the previously described spring-run Chinook salmon ESU, include the following.

- Destruction, Modification, or Curtailment of Habitat or Range
- Overutilization for Commercial, Recreational, Scientific or Education Purposes (inland sport harvest)
- Inadequacy of Existing Regulatory Mechanisms (Federal efforts, non-Federal efforts)
- Other Natural and Man-Made Factors Affecting Its Continued Existence
- Non-Lifestage Specific Threats and Stressors (artificial propagation programs, small population size, genetic integrity and long-term climate change)

Lower Yuba River

The list of limiting factors and stressors for the spring-run Chinook salmon population in the lower Yuba River that are pertinent to the steelhead population in the lower Yuba River are not repeated here. Stressors that are unique to steelhead in the lower Yuba River, and stressors that substantially differ in severity for steelhead (see Chapter 4) include the following.

- Harvest/Angling Impacts
- Poaching
- Hatchery Effects (genetic considerations, straying into the lower Yuba River)

Green Sturgeon

DPS

- Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range (reduction in spawning habitat, alteration of habitat - flows, water temperatures, delayed or blocked migration, impaired water quality, dredging and ship traffic, ocean energy projects)
- Commercial, Recreational, Scientific or Educational Overutilization
- Disease and Predation
- Inadequacy of Existing Regulatory Mechanisms
- Other Natural and Man-Made Factors Affecting Its Continued Existence (non-native invasive species)
- Entrainment

Lower Yuba River

As previously discussed, Daguerre Point Dam is a complete barrier to upstream passage for green sturgeon because they are unable to ascend the fish ladders on the dam, or otherwise to pass over or around the structure. NMFS (2007) stated that Daguerre Point Dam prevents green sturgeon from accessing potentially suitable spawning and rearing habitat located above the dam, and therefore potentially represents a stressor to green sturgeon. However, the ongoing and future effects of Daguerre Point Dam's blockage of green sturgeon are due to the presence of the dam and configuration of the fish ladders and are an existing condition, over which the Corps does not currently have the authority to make modifications to the structure to allow for green sturgeon passage. Therefore, the dam and the fish ladder configuration are part of the Environmental Baseline. In order to accommodate green sturgeon, a major modification to the existing structure would have to be authorized by Congress.

For this BA, the assessment of the Environmental Baseline within the Action Area will consider: (1) past, present and ongoing limiting factors, threats and stressors described in Chapter 4; (2) full implementation of the Yuba Accord, which has occurred since 2008; and (3) the results of available lower Yuba River fisheries monitoring data, which are included in the characterization of the current status of each species.

According to NMFS (1999), the Environmental Baseline represents the current basal set of conditions to which the effects of the Proposed Action are added, and does not include any future discretionary Federal activities in the Action Area that have not yet undergone ESA consultation. Each listed species' current status is described in relation to the risks presented by the continuing effects of all previous actions and resource commitments that are not subject to further exercise of Federal discretion (NMFS 1999). For an ongoing Federal action (such as the Proposed Action being evaluated in this BA), the effects of the action resulting from past unalterable resource commitments are included in the Environmental Baseline, and those effects that would be caused by the continuance of the Proposed Action are then analyzed for determination of effects (NMFS 1999).

6.1.1.2 Proposed Action Effects Assessment

In this step of the effects assessment, NMFS (1999) suggests examining the anticipated direct and indirect effects of the Proposed Action on each listed species and its habitat within the context of the species' current status and the Environmental Baseline. A two-part analysis is conducted as part of this step. The first analytical component focuses on the species itself, and describes the Proposed Action's potential effects on individual fish, populations, or both – and places that effect within the context of the ESU/DPS as a whole (NMFS 1999). The second analytical component focuses on the Action Area and defines the Proposed Action's effects in terms of each species' biological and habitat requirements in that area.

Direct and Indirect Effects

To evaluate potential direct and indirect effects of the Proposed Action, the following three factors are considered: (1) identify the probable risks to the individual organisms that are likely to be exposed to the Proposed Action's effects on the environment; (2) identify whether the consequences of changing the risks to those individuals for the populations those individuals represent would be sufficient to increase extinction risk (or reduce the probability of persistence); and (3) identify whether changes in the extinction risk (or probability of persistence) of those populations would be sufficient to increase the extinction risk (or reduce the probability of persistence) of the species that those populations comprise, given the species' status (NMFS 2004c).

For each component and subcomponent of the Proposed Action, the effects assessment first describes the stressors that are expected to result from each component/subcomponent and then describes each stressor in terms of its intensity, frequency, and duration. The analysis then assesses the likely responses of each listed species to the stressors, and the potential for specific stressors to affect critical habitat. Likely species responses are based upon the timing (when) and the location (where) potential stressors would occur, compared to the lifestage-specific spatial and temporal distributions of each listed species. Likely effects on the primary constituent elements of critical habitat for each listed species are assessed by describing changes in habitat suitability (e.g., flows and water temperatures), availability and accessibility for each specific lifestage. The assessment focuses on whether any of the possible responses are likely to result in the death or injury of individuals, reduced reproductive success or capacity, or the temporary or permanent blockage or destruction of biologically significant habitats (NMFS 2005).

These analytical steps comprise the assessment of potential "exposure" of each listed species and its critical habitat to the stressors resulting from the Proposed Action. According to NMFS (2005), this assessment of exposure is necessary to assess responses of the listed species and their effects on critical habitat resulting from stressors associated with the Proposed Action, and will serve in large part as the bases of "not likely to adversely affect" or "likely to adversely affect" conclusions included in this BA.

6.1.1.3 Cumulative Effects Assessment

Cumulative effects are defined by Federal regulations as "*…those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation*" (50 CFR §402.02). Cumulative effects must be considered in the analysis of the effects of the Proposed Action (50 CFR §402.12(f)(4)).

The cumulative effects assessment in this BA addresses changes in lower Yuba River flows and water temperatures resulting from increased diversions associated with implementation of the Yuba-Wheatland In-Lieu Groundwater Recharge and Storage Project (Wheatland Project). Increased diversions associated with the Wheatland Project represent a future state or private action reasonably certain to occur. These effects are considered in the cumulative effects analysis because the Corps has no authority to regulate water diversions associated with the South Yuba/Brophy Diversion Canal and Facilities. For this BA, the cumulative effects assessment does not address changes in exposure of juvenile spring-run Chinook salmon and steelhead to impingement, entrainment and predation rates at the South Yuba/Brophy Diversion Canal and Facilities, because these effects will be evaluated in a future action requiring separate ESA consultation.

Updated 2011 demand projections indicate that water deliveries to the Wheatland Project in the future are projected to increase up to about 35,000 to 36,000 acre-feet, depending on water year type, above those demands currently in place under the Environmental Baseline (i.e., current condition demands). For effects assessment purposes in this BA, updated Wheatland Project demands are represented through modeling simulations for the future Cumulative Conditions (for additional detail, see Appendix F of this BA).

The Environmental Baseline (i.e., current conditions simulation) includes the irrigation demands of the seven YCWA Member Units that receive water from the Yuba River in amounts and flow rates that represent 2005 land use conditions, because the most recent available land use survey data are from 2005. These Member Units are Hallwood Irrigation Company, Cordua Irrigation District, BVID, and Ramirez Water District (these Member Units divert water at or just upstream of Daguerre Point Dam to lands north of the Yuba River), and Brophy Water District, South Yuba Water District and Dry Creek Mutual Water Company (these Member Units divert water at Daguerre Point Dam to lands south of the Yuba River).

The Cumulative Condition scenario includes the irrigation demands for the Member Units listed previously plus the future irrigation demands of Wheatland Water District, which began receiving surface water through a new canal extension in 2010. The monthly amounts of irrigation demand for the Member Units were derived by taking DWR 2005 land use data for irrigated lands within these Member Units, and multiplying the various land use areas by their respective crop type applied water rates as determined by DWR for Yuba County. The applied water rates for two different years are used – 1999 to represent a wet year condition and 2001 to represent a dry year condition. Wet year conditions are assumed to occur in Wet and Above Normal years, and dry conditions are assumed for Below Normal, Dry and Critical years, where the year types are defined by the Yuba River Index (YRI) of SWRCB Decision 1644. Previously, the Lower Yuba River Accord EIR/EIS (YCWA et al. 2007) irrigation demands were derived based on 1995 land use data and field-adjusted, applied water rates published in DWR's Bulletin 113-4. In the previous calculation, the differentiation of wet and dry conditions was made by reducing the Bulletin 113 applied water rates for the spring months of wet years to represent the wetter soil conditions that occur in those years.

YCWA is presently in the process of developing a daily operations model and a water temperature model as part of the FERC relicensing process for the YRDP (FERC Project No. 2246). However, at the time of preparation of this BA, daily models were not available for the Cumulative Condition.

To evaluate potential changes to listed species critical habitat under the Cumulative Condition for this BA, two scenarios were modeled to characterize monthly average flows and water temperature changes in the lower Yuba River. The modeling was conducted using two models – a water balance/operations model and a water temperature model. The water balance/operations model simulates the hydrology of the lower Yuba River and YCWA's operations of the YRDP on a monthly time step. The water temperature model predicts average monthly water temperatures at three locations in the lower Yuba River, and uses statistically derived relationships between meteorology, flow, reservoir water storage levels and resulting water temperatures. Both of these models were used in the preparation of the Lower Yuba River Accord EIR/EIS, and are documented in the modeling technical appendix to the EIR/EIS, a copy of which is included in Appendix F to this BA.

The significant attributes of the water balance/operations model are described in Appendix F. For ESA assessment purposes, three of the assumptions and modeling conditions used for the Lower Yuba River Accord EIR/EIS (YCWA et al. 2007) were modified in this BA. These modifications are: (1) the maximum release capacity of Colgate Powerhouse, which is the primary release point for New Bullards Bar Reservoir, has been corrected to be 3,430 cfs whereas previously it was modeled as 3,700 cfs; (2) the hydrologic period of record used for the simulations evaluated in this BA has been extended to encompass Water Year (WY) 1922 to WY 2008, in contrast to the period extending from WY 1922 through WY 2005 that was previously used in the Lower Yuba River Accord EIR/EIS; and (3) the irrigation diversion demands were changed as described below and in Appendix F.

For the cumulative effects analysis of flows and water temperatures in the lower Yuba River in this BA, the two scenarios of the "Environmental Baseline" and "Cumulative Condition" were modeled. Only one simulation element – the irrigation diversion demand at Daguerre Point Dam – was varied between the two modeled scenarios.

Flow modeling output is provided at two locations in the lower Yuba River: (1) the Smartsville Gage, which is located a short distance downstream of Englebright Dam and represents flows in the lower Yuba River above Daguerre Point Dam; and (2) the Marysville Gage, located 5.6 miles upstream from the mouth of the lower Yuba River and represents flows in the lower Yuba River below the diversions at Daguerre Point Dam.

The long-term average flows, by month, occurring over the 1922 through 2008 simulation period under the Environmental Baseline and the Cumulative Condition were calculated. This 87-year period of record was used for cumulative effects assessment because that was the model output available at the time of preparation of this BA. Average monthly simulated flows also were calculated by water year type, as defined by the YRI, for the Environmental Baseline and the Cumulative Condition. Presented in tabular format, the data tables for the long-term average flows by month, and the average flows by water year type demonstrate the changes that could be expected to occur under the Cumulative Condition.

In addition, monthly flow exceedance curves were developed for the 1922 through 2008 simulation period and illustrate the distribution of simulated flows under the Cumulative Condition and the Environmental Baseline. The flow exceedance curves were developed utilizing the Weibull method (Weibull 1939), which historically has been used by hydrologists in the United States for plotting flow-duration and flood-frequency curves. In general, flow exceedance curves represent the probability, as a percent of time that modeled flow values would be met or exceeded at an indicator location during a certain time period. Therefore, exceedance curves demonstrate the cumulative probabilistic distribution of flows for each month at a given river location under a given simulation.

Water temperature assessments were conducted using outputs from the water temperature model, comprised of monthly average water temperatures occurring over the 1922 – 2008 simulation period. Simulated average monthly water temperatures are provided for the following locations: (1) the Smartsville Gage; (2) Daguerre Point Dam; and (3) the Marysville Gage. Although a monthly water temperature model is not able to assess day-to-day water temperature variability or diurnal water temperature fluctuations, a more discrete time-step water temperature model is not presently available for the Cumulative Condition.

Monthly water temperature cumulative probability distributions represent the probability, as a percent of time, that modeled water temperature values would be met or exceeded at a given location.

SPRING-RUN CHINOOK SALMON AND STEELHEAD

Changes in river flows and water temperatures during certain periods of the year have the potential to affect specific lifestages of each listed species. Therefore, changes in monthly mean river flows and water temperatures are used as impact indicators for months when specific lifestages of each listed fish species occur in the lower Yuba River.

Lifestage periodicities for spring-run Chinook salmon and steelhead were developed through review of previously conducted studies, as well as recent and currently ongoing data collection activities of the Yuba Accord M&E Program. The resultant lifestage periodicities encompass the majority of activity for a particular lifestage, and are not intended to be inclusive of every individual in the population. The lifestage-specific periodicities for spring-run Chinook salmon and steelhead, which are applied to evaluate potential effects on critical habitat in this BA, were obtained from RMT (2013) and are presented in **Table 6-1**.

Table 6-1. Lifestage-specific periodicities for spring-run Chinook salmon and steelhead in the lower Yuba River.

Lifestage	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Spring-run Chinook Salmon																								
Adult Immigration & Holding							X	X	X	X	X	X	X	X	X	X	X	X						
Spawning																	X	X	X					
Embryo Incubation																	X	X	X	X	X	X	X	X
Fry Rearing	X	X	X																			X	X	X
Juvenile Rearing	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Juvenile Downstream Movement	X	X	X	X	X	X	X	X	X	X	X	X										X	X	X
Smolt (Yearling+) Emigration	X	X	X	X	X	X	X	X	X										X	X	X	X	X	X
Steelhead																								
Adult Immigration & Holding	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X
Spawning	X	X	X	X	X	X	X	X																
Embryo Incubation	X	X	X	X	X	X	X	X	X	X														
Fry Rearing							X	X	X	X	X	X	X	X										
Juvenile Rearing	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Juvenile Downstream Movement							X	X	X	X	X	X	X	X	X	X	X	X						
Smolt (Yearling+) Emigration	X	X	X	X	X	X	X												X	X	X	X	X	X

For the spring-run Chinook salmon and steelhead flow-related critical habitat assessments, changes in flows under the Cumulative Condition relative to the Environmental Baseline are examined in three steps.

First, long-term monthly average flows, monthly average flows by water year type, and monthly flow exceedance distributions under the Cumulative Condition relative to the Environmental Baseline are compared to the monthly minimum flows contained in the Yuba Accord flow schedules developed by the Yuba Accord Technical Team. Situations are identified where the Cumulative Condition results in average monthly flows less than the corresponding flow schedule achieved under the Environmental Baseline. Particular emphasis is placed on potential flow differences that would lead to decreases below the flow rates specified in Flow Schedules 1 and 2 (see Chapter 5), which represent the range of optimal flow conditions.

Second, the analyses consider individual monthly changes in flow of 10% or greater over the 1922-2008 simulation period under the Cumulative Condition relative to the Environmental Baseline. A decrease in monthly flow of 10% or greater has been previously identified by various environmental documents as an appropriate criterion to evaluate flow changes. For example, in the Trinity River Mainstem Fishery Restoration Draft EIS/EIR (USFWS et al. 1999), the USFWS identified reductions in flow of 10% or greater as changes that could be sufficient to reduce habitat quantity or quality to an extent that could significantly affect fish. The Trinity River EIS/EIR further states, "*…[t]his assumption [is] very conservative…[i]t is likely that reductions in streamflows much greater than 10 percent would be necessary to significantly (and quantifiably) reduce habitat quality and quantity to an extent detrimental to fishery resources*." Conversely, the Trinity River EIS/EIR considers increases in streamflow of 10% or greater, relative to the basis of comparison, to be "beneficial" to fish species.

In addition to the USFWS et al. (1999) criteria, the *San Joaquin River Agreement EIS/EIR* (Reclamation and SJRGA 1999) utilized USGS 1977 criteria thresholds, which were derived based on the ability to accurately measure stream flow discharges to ±10%. The criterion used to determine impacts associated with implementation of the San Joaquin Agreement was based on average percentage changes to stream flow relative to the basis of comparison. The *San Joaquin River Agreement EIS/EIR* considered flow changes of less than ±10% to be insignificant (Reclamation and SJRGA 1999).

The *Freeport Regional Water Project Draft EIS/EIR* (JSA 2003) used a similar rationale as the USGS documentation for selecting criteria to evaluate changes in flow. The Freeport EIS/EIR states: "*Relative to the base case, a meaningful change in habitat is assumed to occur when the change in flow equals or exceeds approximately 10 percent. The 10 percent criterion is based on the assumption that changes in flow less than 10 percent are generally not within the accuracy of flow measurements, and will not result in measurable changes to fish habitat area*."

The *Lower Yuba River Accord Draft EIR/EIS* (YCWA et al. 2007) also used a 10% change in flow as an indicator of potential impact.

These documents apparently have resulted in consensus in the use of 10% when evaluating the potential effects of flow changes on fish and aquatic habitat. Accordingly, the spring-run Chinook salmon and steelhead effects assessment in this BA relies on previously established information and, therefore, evaluates changes of 10% or greater in monthly mean flows under the Cumulative Condition relative to the Environmental Baseline.

Third, exceedance curves are particularly useful for examining flow changes occurring at lower flow levels. Because physical habitat simulation models oftentimes indicate that rearing habitat area tends to reach maximum abundance at low flows that inundate most of the channel area in a river (JSA 2003), estimates of rearing habitat area can decline as flows increase, primarily in response to increased average velocity. Because juvenile Chinook salmon and steelhead fry generally prefer low velocity areas, increasing flows can lead to reductions in estimated habitat area. However, this flow-habitat relationship may be misleading because it may not adequately reflect local habitat conditions (i.e., availability of low velocity) or the importance of flow-related habitat attributes (e.g., water temperature conditions or cover and prey availability). Given the vagaries of flow-habitat relationships associated with anadromous salmonid rearing, the effects assessment also includes specific evaluations of changes in low flow conditions. In accordance with the selected flow criteria (i.e., ≥ 10% change) described above, a change in the lowest quartile distribution (i.e., 25th percentile) of 10% or greater is considered in relation to the magnitude of flows under the Environmental Baseline. This approach is consistent with the methodology included in previous environmental documentation, including the Freeport Regional Water Project Draft EIS/EIR (JSA 2003) and the Lower Yuba River Accord Draft EIR/EIS (YCWA et al. 2007).

In summary, the spring-run Chinook salmon and steelhead flow-related effects assessment evaluates whether changes in mean monthly flow at the Smartsville and Marysville gages under the Cumulative Condition relative to the Environmental Baseline are of sufficient magnitude and frequency to appreciably diminish the value of critical habitat. Evaluation indicators used in the assessment include: (1) changes in monthly mean flows that would result in monthly mean flows less than the corresponding flow schedule achieved under the Environmental Baseline; (2) changes in monthly mean flows equal to or greater than 10%; and (3) changes in flows equal to or greater than 10% during low flow conditions (i.e., when flows are in the lowest 25% of the cumulative flow distribution).

In addition to flow-related assessments, water temperature-related effects also are evaluated. For this BA, the monthly cumulative probability distributions are examined to identify the probability that specified water temperature index values would be exceeded for the individual months within the identified lifestages, at given locations, for spring-run Chinook salmon and steelhead. A comprehensive review and compilation of available literature was conducted to identify water temperature index values for water temperature-related critical habitat assessment for spring-run Chinook salmon and steelhead, by lifestage, in the lower Yuba River. The thermal requirements of Chinook salmon and steelhead have been extensively studied in California and elsewhere and, therefore, allow a detailed and specific determination of desired water temperature index values for each lifestage (YCWA et al. 2007). Identification of water temperature index values is largely based on information provided in the Lower Yuba River Accord Draft EIR/EIS (YCWA et al. 2007), Appendix B to the Upper Yuba River Studies Program Technical Report (DWR 2007), Attachment A to the Yuba Accord River Management Team Water Temperature Objectives Technical Memorandum (RMT 2010b), additional updated information provided in Bratovich et al. (2012) and in RMT (2013).

These documents present the results of literature reviews that were conducted to: (1) interpret the literature on the effects of water temperature on the various lifestages of Chinook salmon and steelhead; (2) consider the impacts of short-term and long-term exposure to constant or fluctuating temperatures; and (3) establish water temperature index (WTI) values to be used as guidelines for evaluation. Previous efforts presented both the upper optimum and upper tolerable WTI values to examine water temperature suitabilities by lifestage for target species. More recent efforts including the RMT Interim Monitoring and Evaluation Report (RMT 2013) and the YRDP FERC Relicensing BA have focused on comparing water temperature (model outputs as well as monitoring) to lifestage-specific upper tolerance WTIs for impact assessment purposes. Specifically, this present evaluation adopts the same approach for water temperature-related effects assessment for listed species in the lower Yuba River. Use of WTI values in the impacts assessments are not meant to be significance thresholds, but instead provide a mechanism by which to compare the suitability of the water temperature regimes associated with the Cumulative Condition. Spring-run Chinook salmon lifestage-specific upper tolerance WTI values are provided in **Table 6-2**, and in **Table 6-3** for steelhead. The lifestages and periodicities presented in Table 6-2 and Table 6-3 differ from those presented in Table 6-1 due to specific lifestages that have the same or distinct upper tolerable WTI values, and/or the same or distinct geographic application.

Water temperature index values were determined by placing emphasis on the results of laboratory experiments and field studies that examined how water temperature affects spring-run Chinook salmon and steelhead, as well as by considering regulatory documents and other BOs from NMFS. Studies on fish from outside the Central Valley were used to establish index values when local studies were unavailable. To avoid unwarranted specificity, only whole numbers (°F) were selected as index values.

The water temperature-related critical habitat assessment for this BA is based upon comparing the probability of exceeding the lifestage-specific (month and location) selected water temperature index values under the Cumulative Condition with the Environmental Baseline.

Table 6-2. Spring-run Chinook salmon lifestage-specific upper tolerance water temperature index values.

Lifestage	Upper Tolerance WTI	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult Migration	68°F				■	■	■	■	■	■			
Adult Holding	65°F				■	■	■	■	■	■			
Spawning	58°F									■	■ (1st half)		
Embryo Incubation	58°F									■	■	■	■
Juvenile Rearing and Downstream Movement	65°F	■	■	■	■	■	■	■	■	■	■	■	■
Smolt (Yearling+) Emigration	68°F	■	■	■	■	■ (1st half)					■	■	■

Table 6-3. Steelhead lifestage-specific upper tolerance water temperature index values.

Lifestage	Upper Tolerance WTI	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult Migration	68°F	■	■	■					■	■	■	■	■
Adult Holding	65°F	■	■	■					■	■	■	■	■
Spawning	57°F	■	■	■	■								
Embryo Incubation	57°F	■	■	■	■	■							
Juvenile Rearing and Downstream Movement	68°F	■	■	■	■	■	■	■	■	■	■	■	■
Smolt (Yearling+) Emigration	55°F	■	■	■	■ (1st half)						■	■	■

SPRING-RUN CHINOOK SALMON

- Adult immigration (April through September) – Smartsville, Daguerre Point Dam, and Marysville
- Adult holding (April through September) – Smartsville and Daguerre Point Dam
- Spawning (September through mid-October) – Smartsville
- Embryo incubation (September through December) – Smartsville
- Juvenile rearing (Year-round) – Smartsville and Daguerre Point Dam

- Juvenile downstream movement (Mid-November through June) – Daguerre Point Dam and Marysville
- Smolt (Yearling+) emigration (October through mid-May) – Daguerre Point Dam and Marysville

STEELHEAD

- Adult immigration (August through March) – Smartsville, Daguerre Point Dam, and Marysville
- Adult holding (August through March) – Smartsville and Daguerre Point Dam
- Spawning (January through April) – Smartsville and Daguerre Point Dam
- Embryo incubation (January through May) – Smartsville and Daguerre Point Dam
- Juvenile rearing (Year-round) – Smartsville and Daguerre Point Dam
- Juvenile downstream movement (April through September) – Daguerre Point Dam and Marysville
- Smolt (Yearling+) emigration (October through mid-April) – Daguerre Point Dam and Marysville

GREEN STURGEON

The Technical Team developed the Yuba Accord flow schedules based primarily on available information for spring-run Chinook salmon, steelhead, and fall-run Chinook salmon. Other fish species including green sturgeon were considered, but ultimately were not included in the stressor prioritization process. At the time of development of the Yuba Accord flow schedules, green sturgeon were neither listed nor proposed for listing. Hence, the green sturgeon flow-related critical habitat effects assessment cannot rely on reference to the Yuba Accord flow schedules, and is conducted in this BA as follows.

The critical habitat analysis for green sturgeon under the Cumulative Condition and the Environmental Baseline in the lower Yuba River addresses a unique specific PCE essential for the conservation of the Southern DPS of North American green sturgeon in freshwater riverine systems according to the document titled *Designation of Critical*

Habitat for the Threatened Southern Distinct Population Segment of North American Green Sturgeon - Final Biological Report (NMFS 2009e). According to NMFS (2009e), deep (≥ 5 m) holding pools for both upstream and downstream holding of adult or subadult green sturgeon, with adequate water quality and flow, are necessary to maintain the physiological needs of the holding adult or subadult fish. According to NMFS (2009e), deep pools of ≥ 5 meters depth with complex hydraulic features and upwelling are critical for adult green sturgeon spawning and for summer holding within the Sacramento River (Vogel 2008; Poytress et al. 2009). Adult green sturgeon in the Klamath and Rogue rivers also occupy deep holding pools for extended periods of time, presumably for feeding and/or energy conservation (Erickson et al. 2002; Benson et al. 2007).

According to NMFS (2009e), earlier papers suggested that spawning most likely occurs in fast, deep water (> 3 m deep) over substrates ranging from clean sand to bedrock, with preferences for cobble substrates (Emmett et al. 1991; Moyle et al. 1995). Recent studies have provided additional information. Monitoring of green sturgeon and behavior data in the Rogue River suggests spawning occurs in sites at the base of riffles or rapids, where depths immediately increase from shallow to about 5 to 10 meters, water flow consists of moderate to deep turbulent or eddying water, and the bottom type is made up of cobble to boulder substrates (D. Erickson, ODFW, pers. comm. September 3, 2008 as cited in NMFS 2009e). For the Sacramento River, NMFS (2009a) reports that adult green sturgeon prefer deep holes (≥ 5 m depth) at the mouths of tributary streams, where they spawn and rest on the bottom.

As previously discussed, over the many years of sampling and monitoring in the lower Yuba River, only one sighting of an adult green sturgeon was confirmed before 2011. A memorandum dated June 7, 2011 by Cramer Fish Sciences (2011) stated that they observed what they believed were 4–5 green sturgeon near the center of the channel at the edge of the bubble curtain below Daguerre Point Dam. The sturgeon were observed either on a gravel bar approximately 1.5 meters deep, or in a pool approximately 4 meters deep immediately adjacent to the gravel bar.

Given the extremely infrequent sightings, the lack of green sturgeon life history information for the lower Yuba River, and potential changes in PCEs associated with the Cumulative Condition, the critical habitat analysis for green sturgeon in this BA addresses the PCE of water depth in pools for both pre- and post-spawning and subadult holding of adult or subadult green sturgeon. Because the lower Yuba River is smaller than the Sacramento River or other rivers citing a depth criterion of >5 meters (16.4 feet), use of that criterion may be overly restrictive and not account for local opportunistic habitat utilization by green sturgeon. Therefore, to provide a more rigorous and inclusive analysis, water depth is evaluated by identifying all pools located downstream of Daguerre Point Dam characterized by water depths of >10.0 feet over the general range of flow conditions where changes in monthly mean flows were observed in the lower Yuba River between the Cumulative Condition and the Environmental Baseline. These pools were identified by application of the RMT's SRH2D 2-dimensional (SRH-2D) model.

Deepwater habitats were identified downstream of Daguerre Point Dam in ArcGIS. Polygons were constructed of deepwater habitats greater than 10.0 feet in depth in the Yuba River downstream of Daguerre Point Dam at a baseflow of 530 cfs at the Marysville Gage, which represents the baseflow[1] used to delineate morphological units in the geomorphologic investigations conducted for the Yuba River downstream of Englebright Dam. Deepwater habitat polygons, with a minimum inter-nodal spacing of 5 feet, were developed by YCWA through application of the DEM and the SRH-2D model.

[1] The final baseflow regime used in the report titled *Landforms of the Lower Yuba River* (Wyrick and Pasternack 2012) was the condition with a Smartsville Gage flow of 880 cfs, no discharge out of Deer Creek (whose outflow tends to be 0-5 cfs in the absence of rain or upstream reservoir maintenance), no discharge out of Dry Creek (whose outflow tends to be 0-5 cfs in the absence of rain or upstream reservoir maintenance), and an agricultural withdrawal of 350 cfs at Daguerre Point Dam, yielding a Marysville Gage flow of 530 cfs.

Identified deepwater pools downstream of Daguerre Point Dam were further analyzed using the following flows (cfs) at the Marysville Gage.[2]

- 300
- 350
- 400
- 450
- 530
- 600
- 622
- 700
- 800
- 880
- 930
- 1,000
- 1,300
- 1,500
- 1,700
- 2,000
- 2,500
- 3,000
- 4,000
- 5,000
- 7,500
- 10,000
- 15,000
- 21,100
- 30,000
- 42,200

The areal extent of the deepwater pools was calculated for each of the above-specified flows by calculating the difference between the DEM and the SRH-2D model results in ArcGIS, consistent with the methodology employed in Technical Memorandum 7-10, *Instream Flow Downstream of Englebright Dam* for the YRDP FERC Relicensing process.

[2] The relationship between the areal extent of deepwater pool habitat and flow was not based on flows exceeding 42,200 cfs at the Marysville Gage. At flows higher than 42,200 cfs, specifically at the flows of 84,400 and 110,400 cfs specified in YCWA's Study 7.10, *Instream Flow Downstream of Englebright Dam*, the lower portion of the river spills far out onto the floodplain, and the necessary topographic data to map and model these flows are not currently available (G. Pasternack, pers. comm. 2012). For the analyses of the areal extent of deepwater pools in the lower portion of the river over the evaluation period (WY 1970 through WY 2010) for the "Base Case" (see Technical Memorandum 2-2, *Water Balance/Operations Model*), the areal extent of deepwater pool habitat at flows exceeding 42,200 cfs was assumed to equal the extent at that flow level.

Estimates of the areal extent of the deepwater pools were subsequently calculated for the modeled mean monthly flows under the Environmental Baseline simulation for each individual month from February through November (over the entire simulation period from WY 1922 through WY 2008) using linear interpolation between the flow values specified above and the associated areas of deepwater pool habitat. The period of February through November represents the months when adult green sturgeon may potentially be holding, including the pre-spawning holding, spawning, and post-spawning periods (Adams et al. 2002; Klimley et al. 2007).

Based on the estimated deepwater pool habitat areas calculated for each mean daily flow of the simulated hydrologic period of record for the Environmental Baseline, deepwater adult holding habitat duration curves were developed for each month of the evaluation period (i.e., February through November). The deepwater adult holding habitat duration curves were constructed in the same manner as a flow duration curve, but used estimates of deepwater adult holding habitat availability instead of flows as the ordered data. The product of the deepwater adult holding habitat duration analysis served as a record of mean monthly deepwater habitat availability in acres, presented as an exceedance curve, for each month of the year over the hydrologic period of record. The duration analysis also included generating deepwater habitat availability duration metrics.

In addition to areal extent of deepwater pool habitat availability, analyses were conducted to examine the change in depth of pools downstream of Daguerre Point Dam associated with change in flow at the Marysville Gage. The average and maximum change in water depth of the pools associated with change in discharge were normalized and expressed as inches per 100 cfs between each specified flow.

In addition to flow-related effects assessments, water temperature-related effects also are evaluated for green sturgeon. The evaluation of water temperature-related effects on critical habitat for green sturgeon in this BA utilizes water temperature index values identified by Yuba Accord RMT (2013). The following discussion regarding water temperature requirements for the various lifestages of green sturgeon is taken from Yuba Accord RMT (2010b).

The habitat requirements of green sturgeon are not well known. In the Klamath River, the water temperature tolerance of immigrating adult green sturgeon reportedly ranges from 44.4°F to 60.8°F. Reportedly, no green sturgeon were found in areas of the river outside this surface water temperature range (USFWS 1995a).

Green sturgeon reportedly tolerate spawning water temperatures ranging from 50°F to 70°F (CDFG 2001). Water temperatures tolerances for green sturgeon during spawning and egg incubation also have been reported to range between 46° to 57°F (NMFS 2009c), although eggs have been artificially incubated at temperatures as high as 60°F (Deng 2000 as cited in NMFS 2009c). Suitable water temperatures for egg incubation in green sturgeon reportedly ranges between 52°F and 63°F (optimally between 57-61°F) with lethal temperatures approaching 73°F (Van Eenennaam et al. 2005). Water temperatures above 68°F are reportedly lethal to North American green sturgeon embryos (Cech et al. 2000; Beamesderfer and Webb 2002).

Water temperatures not exceeding 62.6°F have been reported to permit normal North American green sturgeon larval development (Van Eenennaam et al. 2005 as cited in Heublein et al. 2009). Werner et al. (2007) suggests temperatures remain below 68°F for larval development. Temperatures of about 59°F are believed to be optimal for larval growth, whereas temperatures below about 52°F or above about 66°F may be detrimental for growth (Cech et al. 2000).

NMFS (2009c) reports optimal water temperatures for the development of green sturgeon egg, larval, and juvenile lifestages ranging between 52°F and 66°F. Growth of juvenile green sturgeon is reportedly optimal at 59°F and reduced at both 51.8°F and 66.2°F (Cech et al. 2000). According to NMFS (2009c) suitable water temperatures for juvenile green sturgeon should be below about 75°F. At temperatures above about 75°F, juvenile green sturgeon exhibit decreased swimming performance (Mayfield and Cech 2004) and increased cellular stress (Allen et al. 2006).

Consistent with Yuba Accord RMT (2013), the water temperature-related assessment for green sturgeon critical habitat evaluates the differences in the probability of occurrence that water temperatures at Daguerre Point Dam and at the Marysville Gage in the lower

Yuba River are within reported suitable ranges for each of the lifestages (**Table 6-4**), under the Cumulative Condition relative to the Environmental Baseline.

Table 6-4. Green sturgeon lifestage-specific water temperature index value ranges and associated periodicities.

Lifestage	Water Temperature Range	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Adult Immigration and Holding	44°F – 61°F				■	■	■	■	■																
Spawning and Embryo Incubation	46°F – 63°F					■	■	■	■	■	■	■	■	■	■										
Post-Spawning Holding	44°F – 61°F					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Juvenile Rearing and Outmigration	52°F – 66°F	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Other Future Non-Federal Activities

The cumulative effects assessment includes identification of other future non-Federal activities that are reasonably certain to occur in the Action Area, with particular reference to the lower Yuba River. Identified activities will be evaluated as to whether they have the potential to affect listed species or their critical habitat including any effects related to instream flows and water temperatures.

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5.0 Environmental Baseline

The regulations governing ESA consultations (50 CFR §402.02) define "*Environmental Baseline" as follows: "The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process*." The ESA Consultation Handbook explains that the Environmental Baseline should provide an… "*analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem, within the action area*" (USFWS and NMFS 1998). While the Environmental Baseline includes ongoing effects, it does not include the future effects of the Proposed Action under review. The assessment of "future" effects of the Proposed Action is included in Chapter 7.0 of this BA.

The Environmental Baseline for this BA adopts the NMFS (2005) Recommendations for the Contents of Biological Assessments and Biological Evaluations pertinent to the Environmental Baseline. The Environmental Baseline analysis in this BA therefore:

- ❑ Provides information on past, present and future state, local, private, or tribal activities in the action area – specifically, the positive or negative impacts those activities have had on the species or habitat in the area in terms of abundance, reproduction, distribution, diversity, and habitat quality or function.
- ❑ Includes the impacts of past and present Federal actions.
- ❑ Describes the impacts of the past existence and operation of the action under consultation (for continuing actions).
- ❑ Presents all known and relative effects on the population (e.g., fish stocking, fishing, hunting, other recreation, illegal collecting, private wells, development, grazing, local trust programs).

- Includes impacts to the listed and proposed species in the action area that are occurring, and that are unrelated to the Proposed Action (e.g., poaching, road kills from off-road vehicle use, trespass).

The purpose of this Environmental Baseline chapter is to use the best available science to summarize the status of the species and critical habitat, and analyze the effects of factors affecting the species and critical habitat within the Action Area of the lower Yuba River. The species' current status is described in relation to the risks presented by the continuing effects of all previous actions and resource commitments that are not subject to further exercise of Federal discretion (WSDOT 2013). For projects that may affect designated critical habitat, the environmental baseline should include a detailed description of the current functional condition of the individual PCEs within the action area. The condition of the environmental baseline will influence the effects analysis in that the effects on the critical habitat in the action area to the proposed action will depend, in part, on existing environmental conditions (WSDOT 2013).

Because previous ESA consultations related to the Corps' activities have intermingled effects of the Proposed Action with potential stressors and impacts of the Environmental Baseline, the analysis provided in this BA attempts to more clearly distinguish between the potential effects to listed fish species that are attributable to the Environmental Baseline, compared to those that are expected to occur as a result of the Proposed Action (see Chapter 7.0). Additionally, because the scope of the Action Area has changed, relative to earlier consultations, some areas that may have previously been associated with Environmental Baseline effects are now described in the Status of the Species (see Chapter 4). Specifically, because the most upstream extent of the Action Area for this BA is located immediatedly downstream of the Narrows II Powerhouse, which corresponds with the gravel augmentation component of the Proposed Action, Englebright Dam is not included in the Action Area and therefore is not included in the Environmental Baseline. As stated in WSDOT (2013), "*The baseline discussion should summarize the actions that have (and continue to) occur <u>in the action area</u> and describe how these actions have influenced environmental conditions and the status of the species <u>in the action area</u>* [emphasis added]."

USFWS and NMFS (1998) explain that the Environmental Baseline should provide an "*analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem*, *within the action area*." While the Environmental Baseline includes ongoing effects, it does not include the future effects of the Proposed Action under review.

Distinguishing between the effects of an ongoing action and the environmental baseline can be a complex task for many ongoing water projects. The ESA presents different challenges for civil works projects that have already been constructed and that are now being operated and maintained by the Corps. Many of those projects were planned, designed, and built before the ESA was enacted in 1973, and sometimes the listed species or designated critical habitats were not present in the area until after the Corps' projects were built.

The Corps' responsibilities, as well as its ability to conduct activities at Daguerre Point Dam on the lower Yuba River, are primarily governed by the facilities' respective authorized purposes (see Appendix A regarding Corps' Authorities). Consequently, the Corps' actions that are proposed and evaluated in this BA and that could potentially affect (positively or negatively) listed fish species or critical habitat in the Action Area of the lower Yuba River are limited.

Due to the Corps' limited authority and discretion regarding the operations of facilities associated with this Proposed Action, distinguishing between effects of the Proposed Action and effects of the Environmental Baseline in this BA is not overly complex. Future effects to listed species that are solely attributable to the presence of pre-existing facilities that the Corps does not have authority to change should be included in the Environmental Baseline. USFWS and NMFS (1998) explain in detail how future effects from an existing dam are considered part of the environmental baseline when the USFWS and NMFS consult on later, related actions.

According to USFWS and NMFS (1998)… "*Ongoing effects of an existing dam are already included in the Environmental Baseline and would not be considered an effect of the proposed action under consultation*." This applies to the effects of the physical structure of the dam and the effects of past operations, but not to the future activities over which the action agency has discretion.

With the possible exception of effects of fish ladder performance that are associated with discretionary routine operations and maintenance activities, the Corps does not have the ability to lessen other stressors associated with at Dagurre Point Dam. Therefore, it is appropriate that most of the ongoing effects from the stressors attributable to the presence of Daguerre Point Dam and the non-discretionary operations and maintenance activitities to maintain the dam are associated with the Environmental Baseline that has led to the current status of the species.

5.1 2012 NMFS BO RPA and RPMs

NMFS issued three different BOs (two final and one interim) regarding the Corps' activities at Englebright and Daguerre Point dams between March 2002 and November 2007. All three BOs concluded that the Corps' activities in operating and maintaining the two dams did not jeopardize listed fish species in the lower Yuba River. The third BO, issued on November 21, 2007, ultimately prompted litigation that was adjudicated before another court in the Eastern District. Following that decision, the Corps voluntarily reinitiated formal consultation with NMFS during October 2011 on the Corps' ongoing operation and maintenance of Englebright Dam and Daguerre Point Dam and associated facilities. During January 2012, a Final BA (referred to herein as the 2012 BA) was prepared to, among other things, analyze the effects of that action on listed species and designated critical habitat. NMFS issued its Final BO (2012 BO) and jeopardy opinion on February 29, 2012 regarding the effects of Englebright Dam and Daguerre Point Dam on the Yuba River in Yuba and Nevada Counties, California on threatened Central Valley spring-run Chinook salmon, threatened Central Valley steelhead, the threatened Southern DPS of North American green sturgeon, and their designated critical habitat.

According to the August 12, 2013 Memorandum and Order of the United States District Court, Eastern District of California, in Case No. 2:13-cv-00042-MCE-CKD, unlike its predecessors, the 2012 NMFS BO concluded that the Corps' 2012 Proposed Action adversely affected the concerned fish because it blocked access to suitable habitat above

Englebright Dam for spring-run Chinook salmon and steelhead. The 2012 NMFS BO concluded that continued inaccessiblity to upstream habitat would likely jeopardize the continued existance of those listed species. The 2012 BO included an RPA that modified the Proposed Action to avoid jeopardizing the species and adversely modifying their critical habitat. The RPA was divided into eight categories containing almost 60 specific actions to be implemented by the Corps.

As discussed in Chapter 1, the Corps sent a letter to NMFS on July 3, 2012 acknowledging receipt of the 2012 BO (see Appendix B). Although the Corps conditionally accepted the RPA described in the BO, the Corps expressed serious concerns about various aspects of the BO that needed to be resolved. The Corps determined it could not implement certain actions in the RPA. Also, according to the ESA Consultation Handbook (USFWS and NMFS 1998), when characterizing the environmental baseline, an agency action can be removed from the environmental baseline analysis if "*a Biological Opinion for the proposed action (not an ongoing action) is no longer valid because reinitiation of consultation is required and the action agency has been so informed in writing by the Services, or has requested that the Services reinitiate consultation.*" The Corps formally requested reinitiation of consultation proceedings under Section 7 of the ESA on February 26, 2013. For these reasons, the actions specified in the 2012 BO are not included in the Environmental Baseline for this BA.

5.2 Characterization of the Environmental Baseline

The Environmental Baseline is characterized by the existing physical features and habitat conditions in the Action Area. Because the construction and the continued existence of Daguerre Point Dam have resulted in effects that have contributed to the current status of the species within the Action Area, these effects are considered to be part of the Environmental Baseline. The existing status of listed species in the Action Area associated with the Environmental Baseline is described in Chapter 4.0 of this BA.

5.2.1 Physical Features

5.2.1.1 Daguerre Point Dam

The Rivers and Harbor Act of June 13, 1902 authorized the construction of the Yuba River Debris Control Project, of which Daguerre Point Dam is a part (Corps 2001). Construction of Daguerre Point Dam was funded through a 50/50 cost share between the California Debris Commission and the State of California.

The original purpose of the Daguerre Point Dam was to create a basin for the storage of debris originating from the operation of hydraulic equipment for gold mining in the Yuba River watershed. Since the cessation of hydraulic mining operations, Daguerre Point Dam has retained the debris stored behind the dam and prevented it from being washed into the Feather and Sacramento Rivers to the detriment of associated navigation and flood control facilities. The dam was not intended for, nor does it provide for, the control of floods (Corps 2001).

HISTORY/BACKGROUND

Hydraulic mining in the Yuba River watershed during the mid-1800s contributed large quantities of sediment to the river. About 600 million cubic yards of material exposed by hydraulic mining had entered the Yuba River between 1849 and 1909 (Hagwood 1981). The sediment deposited in the channel raised the channel bed to the point that in 1868 it was higher than the streets in Marysville. Subsequent flooding of Marysville in the late 1800s led to attempts to mitigate the adverse effects of hydraulic mining (Corps 2005).

Efforts to control sediment came together with a project known as the “1898 Project”. This project involved controlling sediment with several small dams and building gravel berms to confine the low-water channel (Ayers 1997 as cited in DWR and Corps 2003a). In 1901, the California Debris Commission approved a plan to construct four barrier dams, build a settling basin, and build training walls. The plan was authorized by the Rivers and Harbor Act of 1902 (Hagwood 1981).

The major features of the "1898 Project" included: (1) storage of the mining debris within the bed of the Yuba River; (2) control of the low water channel within well-defined limits; and (3) the erection of several barriers of modest size across the bed of the river, specifically: (a) Barriers No. 1 and No. 2 to be located about 3 miles east of the mouth of Dry Creek; (b) a barrier to be built just below the mouth of Dry Creek; (c) a barrier to be placed at Daguerre Point; (d) construction of a settling basin about 3 miles by 1½ miles wide on the south side of the river; and (e) the building of gravel berms below the basin to confine the river channel within well-defined limits (Hagwood 1981).

The first attempt to constrain mine tailings and debris in the lower Yuba River was made using a structure referred to as Barrier No. 1, located about 1 mile downstream of the Parks Bar Bridge and 4.5 miles upstream of Daguerre Point (Hunerlack et al. 2004; Sumner and Smith 1939 as cited in Hagwood 1981). Work on Barrier No. 2, located about a half mile above Barrier No. 1, was initiated during September 1903, and work on Barrier No. 1 commenced shortly thereafter (Hagwood 1981). Unusually high water came down the Yuba River in November 1903, and destroyed much of the work completed. Barrier No. 1, re-constructed in 1905, was 14 feet high and constrained 1,690,000 cubic yards of gravel that were transported in the river channel during the winter and spring of 1906 (Gilbert 1917 as cited in Yoshiyama et al. 2001). Of this total, 920,000 cubic yards were constrained upstream of the barrier during the January 1906 flood alone. Barrier No. 1 probably hindered salmon upstream movement until it failed the following year when floods destroyed it during March 1907 (Sumner and Smith 1939 as cited in Hagwood 1981). Many acres of farmlands were repeatedly destroyed by flooding and silting in the Yuba River watershed, and properties in the cities of Marysville were threatened frequently by the rise of the riverbed (Hunerlack et al. 2004). When the flood subsided, the engineers decided to cease construction at the Barrier No. 1 site, and instead proposed to complete a barrier at Daguerre Point (the fourth dam of the original proposal) and the settling basin immediately below. The gravel berms below the Daguerre Point cut also were to be completed. The gravel berms built on the south side of the river were completed by the Yuba Consolidated Gold Fields and the Marysville Gold Dredging Company as part of their gold dredging operations. Finally, the Yuba Consolidated Gold Fields Company also built a rock levee which took the place of Barriers No. 1 and No. 2 (Hagwood 1981). In other words, the "1898 Project" was revised so as to concentrate the Commission's effort at and near Daguerre Point (Hagwood 1981).

The California Debris Commission constructed the original Daguerre Point Dam in 1906 as part of the later Yuba River Debris Control Project (Corps 2001). Daguerre Point Dam was constructed in a cut above and to the north of the original Yuba River channel. The bedrock under Daguerre Point Dam is a portion of the Daguerre Point Terrace, a feature that facilitated the construction of a low dam at a relatively low cost. Over the next few years, the cut through Daguerre Point was completed and a concrete inlet wall, or spillway, was constructed. Gravel berms extending about 12,000 feet on each side of the river below the cut were built. The entrance gates to the settling basin were constructed, most of its enclosing levees were built, and the outlet works were practically completed when this part of the project was found no longer necessary and was abandoned under authority of the River and Harbor Act of June 25, 1910. The settling basin itself was never constructed. The land acquired for the settling basin, together with the intake and outlet works, was then sold (Hagwood 1981).

Daguerre Point Dam was completed in May of 1906, but the river was not diverted over the dam until 1910 (Corps 2007). Daguerre Point Dam rapidly filled to capacity with sediment and debris that moved downstream during flooding in 1911 (Hunerlach et al. 2004). The "1898 Project", as modified, was completed in 1935 (Hagwood 1981). By that time, three gravel berms existed, having a total length of approximately 85,100 feet which provided two 500-foot channels. The result of the work on the Yuba River in and around Daguerre Point has held back millions of cubic yards of mining debris in the Yuba River which would otherwise have passed into the navigable channels of the Feather and Sacramento Rivers (Hagwood 1981).

After its construction, Daguerre Point Dam was reported to be a partial or complete barrier to salmon and steelhead for many years because of the lack of functional fish ladders (Mitchell 2010). However, although the dam made it difficult for spawning Chinook salmon and steelhead to migrate upstream, salmon reportedly did surmount that dam in occasional years because they were observed in large numbers in the North Yuba River at Bullards Bar during the early 1920s (Yoshiyama et al. 2001). Two fishways, one for low water and the other for high water, were constructed at Daguerre Point Dam prior to the floods of 1927-1928 (Clark 1929; CDFG 1991a), the fish ladders were destroyed, and were not replaced until 1938, leaving a 10-year period when upstream fish passage at

Daguerre Point Dam was blocked (CDFG 1991). That 10-year period coincided with the drought of 1928 through 1934, which raised water temperatures below Daguerre Point Dam much higher than those tolerated by Chinook salmon (Mitchell 1992 as cited in NMFS 2012). These conditions probably caused the extirpation of spring-run Chinook salmon from the lower Yuba River (Mitchell 1992 as cited in NMFS 2012). On the southern end of the dam, a fish ladder was constructed in 1938 and consisted of 8- by 10-foot bays arranged in steps with about 1 foot of difference in elevation between steps. However, it was generally ineffective (Sumner and Smith 1939). Two functional fish ladders were installed in 1951 by the State of California and it was stated that "*With ladders at both ends, the fish have no difficulty negotiating this barrier at any water stage*" (CDFG 1953).

Precipitation regimes in the region are highly variable in timing and quantity, with unpredictable autumn rainfall and occasional winter deluges producing a considerable part of the average annual runoff (USGS gage data 1858-2009). The flood of February 1963, estimated at about 120,000 cfs, washed out a section of Daguerre Point Dam between the mid-stream stations. During the summer of 1964, the Corps met with the USFWS and CDFG to develop criteria for the reconstruction and modification of the existing fishways at Daguerre Point Dam. Repairs were made in 1964 to Daguerre Point Dam and to the southern fish ladder, but before modifications could be made to the northern ladder, the flood of December 1964 washed out a portion of the dam that had not been reconstructed and eroded the underlying rock foundation to an estimated depth of 15 to 25 feet (Corps 2007). The floods of 1964 also washed out nearly all of the sediments and debris that had accumulated behind the dam up to that time. The flood of December 1964, estimated at about 180,000 cfs, also washed out the retaining walls of the Hallwood-Cordua diversion structure, completely destroyed the fish ladder headwork on the north as well as a large part of the original fish ladder, but the portion of the fish ladder completed with the rehabilitation from the 1963 floods of the dam was still intact (Dettmer, Memo For Record, 1964). Temporary repairs of the damage were made in February and March 1965. Extensions to the fish ladders were added, and slide gates, which also permit the passage of fish, were added to both upstream ends of the ladders in 1965 (Corps 2007). "*Permanent repair of Daguerre Point Dam abutment and fish* *facilities was completed in October 1965 at a cost of $447,808 with Federal and required State contributed funds on a matching basis*." (ERDC 2008).

PHYSICAL FACILITIES DESCRIPTION

The current configuration of Daguerre Point Dam is a reinforced, overflow concrete ogee ("s-shaped") spillway with concrete apron and concrete abutments. The ogee spillway section is 575 feet wide and 25 feet tall (NMFS 2007).

There is no reservoir associated with Daguerre Point Dam. The dam is a low-head dam across the Yuba River. In addition to the dam structure, there are two fish ladders, each with a control gate. The two fish ladders utilize the hydraulic head created by the dam due to the influence of the dam preventing additional channel incision above the dam. The purpose of these two fish ladders is to permit salmon and steelhead access upriver to the seasonal spawning areas. There are no recreation facilities located at Daguerre Point Dam.

Daguerre Point Dam is the primary diversion point for water entering the Hallwood-Cordua Canal and the South Canal, which supply the water districts located north and south of the lower Yuba River, respectively. Water levels in the Hallwood-Cordua and South canals are manually controlled year-round using board weirs. Minimum water levels are maintained to ensure there is enough pressure for any user to divert water when needed (R. McDaniel, pers. comm. 2006 in YCWA et. al. 2007). While water elevations in these primary conveyances remain constant, the flow rates through these conveyances may change with changes in agricultural demands. The amounts of groundwater pumping by farmers have no effects on surface water levels in the primary conveyances. Even during seasons when farmers are implementing groundwater conjunctive use measures, water levels are maintained in the primary conveyances for those districts or farmers that are not participating in the conjunctive use programs.

FISH LADDERS AND FISH PASSAGE

Under the Environmental Baseline, there are numerous issues associated with anadromous fish passage at Daguerre Point Dam. NMFS (2007) stated that passage conditions at Daguerre Point Dam are considered to be inadequate for Chinook salmon and steelhead throughout much of the year due to the design of the existing ladders.

When high flow conditions occur during winter and spring, adult spring-run Chinook salmon and steelhead reportedly can experience difficulty in finding the entrances to the ladders because of the relatively low amount of attraction flows exiting the fish ladders, compared to the magnitude of the sheet-flow spilling over the top of Daguerre Point Dam. In addition, the NMFS (2007) stated that the angles of the fish ladder entrance orifices and their proximities to the plunge pool also increase the difficulty for fish to find the entrances to the ladders.

As previously described in this BA, other configuration and design features of the fish ladders and passage facilities that reportedly could either delay or impede anadromous salmonid access to spawning and rearing areas above the dam include: (1) the control gate, acting as a submerged orifice, is only passable at low flows (actual flow data are unavailable) during the summer and fall; (2) the ladders become clogged with debris; (3) insufficient attraction flows during non-overflow operational conditions; (4) unfavorable within-bay hydraulic characteristics, particularly associated with debris collection; (5) unfavorable fish ladder geometric configurations; and (6) sedimentation and unfavorable habitat conditions associated with egress from the fish ladders.

The Corps installed locking metal grates on 33 unscreened bays of the Daguerre Point Dam fish ladders in response to the Interim Remedy Order issued by the Court on July 25, 2011. Because the fish ladder bays are not uniformly sized, each metal grate needed to be custom fabricated by hand (**Figure 5-1**). Due to concerns expressed by both NMFS and CDFW, the Court then reconsidered the requirement to put grates over the bays on the lowermost section of the south fish ladder at Daguerre Point Dam. Consequently, grates were not installed over the lower eight bays of the south fish ladder at Daguerre Point Dam.

NMFS (2007) suggested that the biological consequences to anadromous salmonids of blockage or passage delays include changes in spawning distribution, increased adult prespawning mortality, and decreased egg viability, which may result in the reduction of the abundance and productivity of the listed species.

However, DWR and Corps (2003) stated that there is no direct evidence that holding below the dam when the fish ladders are not fully functional affects the condition of salmon during their migration, except that repeated attempts to pass over the dam probably result in injury from contact with the rough concrete surface of the dam face. Moreover, short-term delays in spawning migration are not inherently problematic, and salmon and steelhead health and/or egg viability may not be adversely affected by short-term delays (DWR and Corps 2003). It has been suggested that water temperatures in the pool below Daguerre Point Dam may be higher than optimum for all salmonids during the warmer parts of the year, especially during low flow conditions in late summer, and that water temperature effects may adversely impact egg viability (DWR and Corps 2003). However, the RMT recently evaluated the potential effects of water temperatures on spring-run Chinook salmon, fall-run Chinook salmon and steelhead, by lifestage, using the mean monthly water temperature modeling conducted for the 2007 Lower Yuba River Accord EIR/EIS and water temperature monitoring data conducted from 2006 - 2012. The RMT (2013) included evaluation of water temperatures at Daguerre Point Dam during the spring-run Chinook salmon adult upstream immigration and holding lifestage, which addressed considerations regarding both water temperature effects to pre-spawning adults and egg viability, characterized as extending from April through August, and concluded that water temperatures were suitable.

Concern has been expressed that if emigrating salmon and steelhead juveniles encounter high water temperatures in the reach below Daguerre Point Dam, they cannot return to the lower-temperature habitat upstream because their passage is blocked by the dam (DWR and Corps 2003). However, this concern was raised prior to implementation of the Yuba Accord minimum flow schedules and associated water temperatures (initiated as Pilot Programs in 2006 and 2007, and now being implemented through the permanent changes made to YCWA's water-right permits in 2008). The RMT (2013) also included an evaluation of water temperatures at Daguerre Point Dam and at the Marysville Gage on the lower Yuba River during the year-round juvenile rearing period for spring-run Chinook salmon and steelhead, and found that water temperatures remained at suitable levels.

Figure 5-1. Installation of metal grates on the Daguerre Point Dam fish ladder bays during August 2011 (Corps 2011).

NMFS (2007) and other documents (NMFS 2002; CALFED and YCWA 2005) suggest that juvenile salmonids may be adversely affected by Daguerre Point Dam on their downstream migrations, because Daguerre Point Dam creates a large plunge pool at its base, which provides ambush habitat for predatory fish in an area where emigrating juvenile salmonids may be disoriented after plunging over the face of the dam into the deep pool below. The introduced predatory striped bass and American shad have been observed in this pool (CALFED and YCWA 2005). It has been suggested that the rates of predation of juvenile salmonids passing over dams in general, and Daguerre Point Dam in particular, may be unnaturally high (NMFS 2007). However, DWR and Corps (2003) stated that there is no substantial evidence of predation on emigrating juvenile salmon by warmwater fish, and that temperature and habitat conditions in the lower Yuba River are not conducive to the establishment of significant populations of such fish, except perhaps in the Marysville area. Daguerre Point Dam may influence predation rates on emigrant juvenile anadromous salmonids, although DWR and Corps (2003) stated that there are no data indicating that such predation is significant, whether predation at the dam is offset by lower predation rates downstream, or even what percentage of juvenile salmonids are taken by predators. Presently, there are limited studies or data regarding predation rates on juvenile anadromous salmonids in the vicinity of Daguerre Point Dam relative to elsewhere in the lower Yuba River.

An additional issue associated with fish passage at Daguerre Point Dam relates to the abundance and distribution of rearing juvenile anadromous salmonids relative to predators. Most juvenile Chinook salmon and steelhead rearing has been reported to occur above Daguerre Point Dam (Beak 1989; CDFG 1991; SWRI et al. 2000). Kozlowski (2004) observed age-0 *O. mykiss* throughout the entire study area, with highest densities in upstream habitats and declining densities with increasing distance downstream from the Narrows. Approximately 82% of juvenile *O. mykiss* were observed upstream of Daguerre Point Dam. Kozlowski (2004) suggested that the distribution of age-0 *O. mykiss* appeared to be related to the distribution of spawning adults. The higher abundance of juvenile salmonids above Daguerre Point Dam may be due to larger numbers of spawners, greater amounts of more complex, high-quality cover, and lower densities of predators such as striped bass and American shad, which reportedly are generally restricted to areas below the dam (YCWA et al. 2007).

The population viability assessments, which addressed population abundance and productivity of the listed species, were previously presented in Chapter 4 of this BA. It is uncertain the extent to which the design, operational and maintenance activities have incrementally contributed to the current status of the species, including their viabilities and extinction risks. However, potential effects on the populations associated with Daguerre Point Dam passage considerations were inherently included in the viability assessments.

Daguerre Point Dam was not designed for green sturgeon and is therefore a complete barrier to upstream passage because green sturgeon are unable to ascend the fish ladders on the dam, or otherwise pass over or around the structure. The scarcity of information on green sturgeon in the lower Yuba River makes it difficult to determine how these fish are utilizing the habitat in the river, or for what purpose green sturgeon are entering the river.

According to NMFS (2007), it is possible that the plunge pool below Daguerre Point Dam or other deep holes downstream of the dam provide suitable habitat for green sturgeon spawning. It is unlikely that any green sturgeon alive today could have been spawned above Daguerre Point Dam, and are attempting to return to their natal spawning habitat above the dam, because the dam has been in place longer than the expected maximum life span (60 to 70 years (Moyle 2002)) of green sturgeon.

At the time that the Daguerre Point Dam fish ladders were reconstructed in 1965, the fish passage facility and ladder design were developed following USFWS and CDFG provided criteria. If the ladders were to be reconstructed today, the Corps anticipates that the design would be considerably different, given the advances in fisheries biology, engineering, and technology that have occurred over the past 48 years, as well as changes in fisheries management objectives resulting from new species listings (e.g., green sturgeon) under the ESA.

In this BA, a distinction is made between effects on listed species attributable to designs of facilities that have been operational since 1965, and effects associated with the Corps authorized activities associated with the fish ladders. The Corps has the authority and discretion to lessen adverse effects associated with O&M of the fish ladders and sediment removal upstream of Daguerre Point Dam, removal of sediment and woody debris from the fish ladders themselves, and minor adjustments to the hydraulic performance of the ladders. Therefore, effects to listed species associated specifically with these activities are characterized as effects of the Proposed Action. All other effects associated with design of the ladders and the facilities are part of the Environmental Baseline.

Operations and Maintenance Activities

The Corps past operational criteria required that the fish ladders be physically closed when water elevations reached 130 feet, or when flows were slightly less than 10,000 cfs (SWRCB 2003), and to keep them closed until the water receded to an elevation of 127 feet (CALFED and YCWA 2005). However, current operation of the fish ladder gates differs from past operations in that the Corps coordinates with NMFS and CDFW to keep the gates open at all flow levels.

In 2003, the Corps first installed a log boom at the north ladder exit to divert debris away from the ladder. In June 2010, CDFW installed flashboards in the lower bays of the south fish ladder in an effort to improve attraction flows to the south ladder (Grothe 2011). Since completing this work, CDFW reported that the number of fish moving through the south ladder increased compared to numbers recorded prior to installation of the flashboards.

On October 20, 2010, CDFW advised the Corps that staff from the Pacific States Marine Fisheries Commission (PSMFC) had documented as many as a dozen fall-run Chinook salmon that had jumped out of the south fish ladder over the previous 4 to 6 weeks. That same day, Corps staff placed plywood boards over the bay from which the fish reportedly jumped as a temporary measure to prevent any more fish from escaping the ladder. By email dated November 5, 2010, Duane Massa, a project manager for PSMFC, provided additional information to the Corps regarding the incident. According to Mr. Massa, PSMFC maintenance logs indicated that six fall-run Chinook salmon carcasses were observed outside the south fish ladder over a period of four weeks (September 27, 2010 – October 26, 2010) rather than one dozen as initially reported. No further incidences of fish escaping the ladder were reported during 2010 (D. Massa, PSMFC, pers. comm. 2010). More recently, in response to the Interim Remedy Order issued by the Court on July 25, 2011, during the summer of 2011, the Corps proceeded with installation of locking metal grates on 33 unscreened bays. Due to concerns expressed by both NMFS and CDFW, the Court then reconsidered the requirement to put grates over the bays on the lowermost section of the south fish ladder at Daguerre Point Dam (**Figure 5-2 and Figure 5-3**). Consequently, grates were not installed over the lower eight bays of the south fish ladder at Daguerre Point Dam.

The fish ladder upstream exit periodically becomes ineffective due to sediment buildup in the channel, which acts as a barrier that prevents upstream fish migration. As an example of the maintenance activities typically conducted, CDFW observed fall-run Chinook salmon migration problems resulting from a clogged channel at the north fish ladder upstream exit during fall of 1999. The Corps, in co-operation with CDFW, excavated the entire area just upstream from the ogee spillway, as well as two deeper channels running diagonally from each ladder upstream toward the middle of the river channel. The gravel bar that blocked access from the south ladder also was cleared to allow access to the river channel (Corps 2001). During 2009, the Corps dredged the upstream side of Daguerre Point Dam to provide egress from the fish ladders and continued fish passage opportunity.

Gravel buildup can itself block fish passage, as well as further reduce attraction flows in the fish ladders at Daguerre Point Dam. As discussed in the July 8, 2010 Order of the United States District Court, Eastern District of California, in Case No. Civ. S-06-2845 LKK/JFM, the Corps has implemented a plan to ensure that a minimum 30 foot wide by 3 foot deep channel remains open to facilitate fish passage and avoid blocking attraction flows.

Figure 5-2. North fish ladders at Daguerre Point Dam (Corps 2012c).

Figure 5-3. South fish ladders at Daguerre Point Dam (Corps 2012c).

In late August 2010, the Corps removed sediment that had accumulated on the north side of the channel upstream of Daguerre Point Dam (Grothe 2011), and the material that was removed was disposed of above the ordinary high water mark. Again during August 2011, the Corps removed sediment that had accumulated upstream of Daguerre Point Dam and placed that excavated material above the ordinary high water mark. The Corps also inspected the sediment depth upstream from Daguerre Point Dam and cleared sediment and gravel from the channels upstream of the dam and along the upstream face of the dam on August 7, 2012. Because the Yuba River was too deep at that time, the gravel was moved to the downstream gravel bar in late October 2012 (D. Grothe, Corps, pers. comm. 2013).

DAGUERRE POINT DAM FISH PASSAGE IMPROVEMENT STUDIES

In 1994, the Yuba River Technical Working Group and the USFWS identified fish passage issues at Daguerre Point Dam (DWR and Corps 2003). As a result, a preliminary evaluation of measures and alternative concepts to improve fish passage was conducted by the Corps and others.

Initiated by the State Legislature and the California Bay-Delta Program agencies in 1999, the Fish Passage Improvement Program (FPIP), an element of the ERP, is a partnership-building effort to improve and enhance fish passage in Central Valley rivers and streams (DWR 2005a). The program works with other local, State, and Federal agencies and stakeholders to plan and implement projects to remove barriers that impede migration and spawning of anadromous fish. FPIP does not provide for screening diversions.

In 1999, CALFED established the Upper Yuba River Studies Program, a stakeholder-driven collaborative process to discuss fish passage. Also in 1999, the AFRP funded a project to develop fish screen and diversion bypass feasibility alternatives at the Hallwood-Cordura Irrigation District Diversion.

In 1999, USFWS funded a Corps Preliminary Fish Passage Improvement Study of fish passage alternatives at Daguerre Point Dam (Corps 2001). Initiated in 2001, DWR and the Corps undertook the preparation of a joint Draft EIR/EIS to evaluate the Daguerre Point Dam Fish Passage Improvement Project on the Yuba River.

According to CALFED and YCWA (2005), the USFWS Fish Passage Improvement Study identified the following concerns with Daguerre Point Dam's fishways for upstream migration of adult fish:

- The fish ladder control gate entrance, acting as a submerged orifice, is more passable at low flows during summer and fall rather than at high flows during winter and spring
- The fish ladder exit sometimes becomes unusable due to clogging by woody and non-woody debris
- Fish may have difficulty finding the orifice during high flows
- The fish ladders are narrow and have low flow capacities

The passage study also identified the following concerns for emigration of juvenile anadromous fish:

- Emigration may be impeded during low flows
- Pools immediately upstream and downstream harbor piscivorous fish
- Fish may be injured or killed by passing over the dam
- Water diversion operations may trap fish

The Daguerre Point Dam Fish Passage Improvement Project aims to improve upstream and downstream passage for all lifestages of native anadromous fish, while keeping water interests whole and with no increase in downstream flood risks (DWR 2011). Historically, DWR has had a cost sharing agreement with the Corps on any fish passage improvement or studies regarding Daguerre Point Dam. Stakeholders and partner agencies were developing a restoration prioritization plan, and implementing other actions to improve habitat conditions in the lower Yuba, including separate actions implemented through the Lower Yuba River Accord.

Several documents related to the Daguerre Point Dam Fish Passage Improvement Project have been completed. These documents include: (1) a draft of the Daguerre Point Dam Fish Passage Improvement Project Alternative Concepts Evaluation, released in September 2003; (2) a stakeholder review draft of the Analysis of Potential Benefits to

Salmon and Steelhead from Improved Fish Passage at Daguerre Point Dam released in March 2003; and (3) a stakeholder review draft of the Daguerre Point Dam Fish Passage Improvement Project 2002 Water Resources Study for DWR and the Corps, released in June 2003 (DWR 2011).

In 2008, NMFS awarded a contract to evaluate options for fish passage in the Yuba River (DWR 2011). The main goal of that study was to identify and describe potential fish passage facilities for the reintroduction of spring-run Chinook salmon and steelhead in the upper Yuba River watershed. The study included fish passage option considerations at Daguerre Point Dam (NMFS 2010).

DIVERSIONS IN THE VICINITY OF DAGUERRE POINT DAM

As development intensified within the Yuba River Basin during the early 1950s, the lower Yuba River and Daguerre Point Dam took on a new purpose. The people of Yuba and Sutter counties recognized the demand for securing, utilizing, and distributing available water resources for the impending domestic and agricultural development. The function of Daguerre Point Dam subsequently evolved to provide additional benefits for water supply purposes (DWR and Corps 2003b). There are three water diversions associated with Daguerre Point Dam, which utilize the elevated head[1] created by the dam, or the influence of the dam in the prevention of additional river channel incision, to gravity-feed their canals. The three diversions are the Hallwood-Cordua diversion, the South Yuba/Brophy diversion, and the Browns Valley Irrigation District (BVID) diversion (**Figure 5-4**).

Diverters using these facilities divert water under their own water rights, purchase water from YCWA, or do both. YCWA has contractual agreements to deliver water to these irrigation districts, and the three diversions have a combined capacity of 1,085 cfs. As with the Yuba River Development Project, the Corps does not regulate water right diversions or control: (1) whether or not water is diverted from the lower Yuba River

[1] The "elevated head" at Daguerre Point Dam is created by the hydraulic conditions associated with water being impounded behind (i.e., upstream) of the dam. The Corps has no control over the in-river flows, and has no discretionay control over the "head" for local water users in the vicinity of Daguerre Point Dam.

through the three agricultural diversions near Daguerre Point Dam (i.e., Hallwood-Cordua, South Yuba-Brophy, and BVID); (2)_the quantity and timing of those diversions; or (3) the ultimate use of the water once diverted (Corps 2012b). From the primary conveyances, the irrigation districts use smaller ditches to supply water to their customers according to the following seasonal considerations:

- Irrigation Season, April 1 through October 15
- Waterfowl/Straw Management Season, October 15 through January 31
- Maintenance Season, January 31 through April 1

The Corps is not responsible for continued operations and maintenance of these three facilities. The Proposed Action does not include operation or maintenance of the irrigation diversion facilities located at or in the vicinity of Daguerre Point Dam. Operation and maintenance responsibilities associated with each of the diversion facilities are, and will remain, the responsibility of each of the respective individual non-Federal irrigation districts.

HALLWOOD-CORDUA NORTH CANAL

Hallwood Irrigation Company and Cordua Irrigation District divert water from the Hallwood-Cordua Diversion (also referred to as the "North Canal") under pre-1914 and post-1914 appropriative water rights and contracts with YCWA. The license issued by the Secretary of War to the Hallwood Irrigation Company and the Cordua Irrigation District (formerly the Stall Ditch Company) in 1911 allow Hallwood and Cordua to continue their diversions of water from the Yuba River, which pre-dated the construction of Daguerre Point Dam.

Cordua Irrigation District is located in an area covering approximately 11,400 acres. Cordua Irrigation District's first surface water deliveries from the lower Yuba River began in the late 1890s, with receipt of water deliveries under the YCWA contract beginning in October 1971 (YCWA 2008). Rice is the primary crop, which is irrigated primarily by surface water diverted under a combination of water rights (totaling 60,000 acre-feet per year) and under a contract with YCWA (for 12,000 acre-feet per year), for an annual surface water supply of up to 72,000 acre-feet.

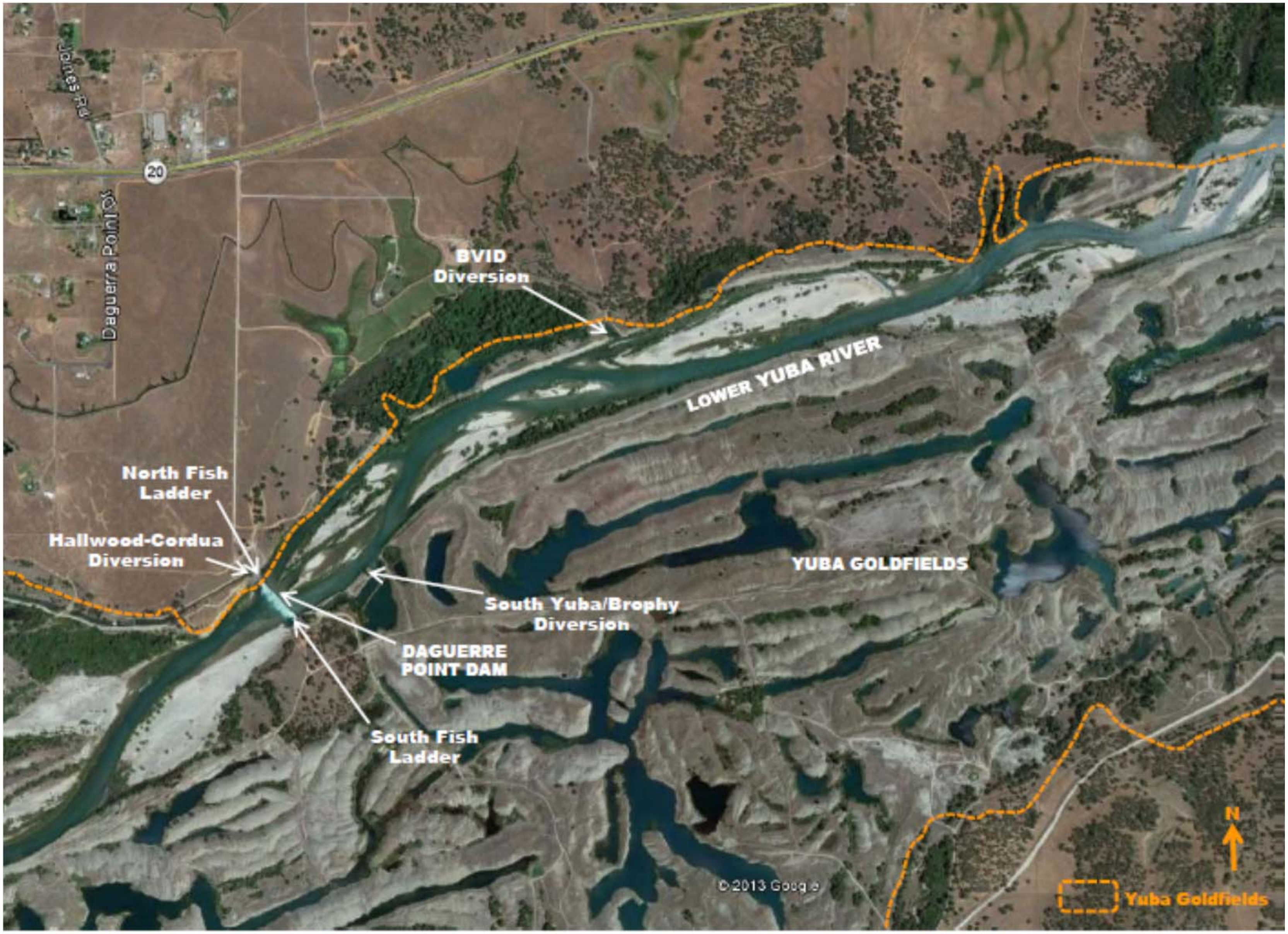

Figure 5-4. Non-Federal water diversion facilities in the vicinity of Daguerre Point Dam on the lower Yuba River.

The Hallwood-Cordua Diversion (**Figure 5-5**), a gravity flow diversion facility located on the north bank of the lower Yuba River at Daguerre Point Dam, has a diversion capacity of 625 cfs (SWRCB 2001). The diversion was originally screened in 1972, and later modified in 1977 (CALFED and YCWA 2005). The Hallwood-Cordua fish screen located in the North Canal utilized a V-shaped perforated plate screen constructed, operated and maintained by CDFW. A bypass system diverted fish captured by the screen into a collection tank, and collected fish were returned to the river either through a pipeline or by truck (SWRCB 2001). CDFW initially operated the fish screen in the North Canal, located approximately one-quarter mile down the canal from the river, for intermittent periods during the Chinook salmon juvenile emigration period of April through June (SWRI et al. 2000).

The original design and operation of the Hallwood-Cordua fish screen resulted in the losses of significant numbers of fish (SWRCB 2001). During some years, the fish screen was not operated at all, which resulted in occasions when reportedly up to a million juvenile salmonids were entrained in the diversion (CALFED and YCWA 2005). When operational, the CDFW screen was reported to be effective in preventing the entrainment and impingement of juvenile salmonids, but salmonid losses reportedly did occur as a result of predation in the intake channel between Daguerre Point Dam and the CDFW fish screen. In addition, predation resulted from the removal of the screen by CDFW during the emigration period of juvenile steelhead (YCWA et al. 2000).

Figure 5-5. Hallwood-Cordua Diversion. Image on the left shows the control gate headworks on the north abutment of Daguerre Point Dam. Image on the right shows the current v-shaped screen (Source: YCWA 2013b).

According to SWRCB (2001), the number of Chinook salmon entrained at a diversion facility is related to the percent of river flow that is diverted. SWRCB (2001) reported that an analysis of the daily North Canal fish screen trap records for 1972 to 1991 by the USFWS showed that the number of juvenile salmonids entering the trap was directly related to the percent of river flow diverted. Fish losses also occurred at the fish trapping facility that returned fish from the diversion canal to the river. The long distance between the diversion channel intake and the fish screen, low bypass flows, and excessive handling of the fish stopped by the screen all contributed to the loss of salmonids at the Hallwood-Cordua fish screen (SWRCB 2001).

In 1999, CDFW began an outmigration study of juvenile salmonids using a rotary screw trap located in the lower Yuba River near Hallwood Boulevard. CDFW reported that significant numbers of juvenile Chinook salmon, including spring-run Chinook salmon, were captured in the traps, and recently emerged steelhead also were present throughout the summer months (SWRCB 2001). Steelhead as small as 24 mm were observed in July, with 27 and 37 mm fish observed during August and September. Based on the size and numbers of juvenile steelhead and Chinook salmon present throughout the year, it was determined that large numbers of fish were vulnerable to entrainment at the Hallwood-Cordua Diversion. In addition, CDFW stated that the 5/32 inch mesh size of the Hallwood-Cordua fish screen was much larger than the 3/32 inch mesh recommended by CDFW and NMFS (SWRCB 2001). The ineffectiveness of the screen in salvaging fry-size fish was evident when comparing catches at the screen with catches in the rotary screw trap during the same period. During periods when catches of fry-size fish were still high in the rotary screw trap, the fish screen was capturing no fish in that size range. In addition, the approach velocities at approximately 25% of the screen area exceeded approach velocities that were, and still are, recommended by NMFS and CDFW. CDFW recommended installation of a fish screen at the Hallwood-Cordua diversion that meets the criteria established by NMFS and CDFW for protection of juvenile Chinook salmon and steelhead (SWRCB 2001).

Consequently, the Hallwood-Cordua fish screen was replaced with a screen that more closely conforms to CDFW and NMFS criteria in 2001. This screen is at the same location, but has appropriate openings and sweeping and approach velocities to facilitate direct return of screened fish back to the river below Daguerre Point Dam. Addionally, the fish screen is operated for the entire diversion season (NMFS 2002). Although this fish screen does not meet all of CDFW and NMFS criteria, the rehabilitation efforts included the installation of the proper-sized screening material and have allowed continuous operation of the screen throughout the irrigation season along with the direct return of screened fish back to the river below the dam (NMFS 2007). The Corps was not involved in the 2001 Hallwood-Cordua fish screen replacement, nor does the Corps operate or maintain the fish screen facility or have discretionary control over it. Therefore, the effects of operation and maintenance of the fish screen facility at the Hallwood-Cordua diversion location at Daguerre Point Dam is not part of the Proposed Action and is therefore included as part of the Environmental Baseline.

SOUTH YUBA/BROPHY DIVERSION CANAL AND FACILITIES

Approximately 1,000 feet upstream of Daguerre Point Dam on the south side of the river, the South Yuba/Brophy Diversion Canal and Facilities divert water through an excavated channel from the Yuba River's south bank. The South Yuba/Brophy diversion facility includes a 450-foot long porous rock weir fitted with a fine-mesh barrier (geotextile cloth) within the weir, intended to protect juvenile fish from becoming entrained into the canal (Corps 2007).

The South Yuba/Brophy Diversion Canal and Facilities was constructed in the mid-1980s. Prior to construction of the diversion headworks, the rate at which water could be diverted was limited by flows in the lower Yuba River and the percolation rate through the dredge spoil gravel mounds (USFWS 1990).

The South Yuba Water District encompasses about 9,800 acres of land, with the primary crops consisting of rice and pasture (YCWA 2008). The South Yuba Water District began receiving surface water jointly with Brophy Water District in 1983.

Brophy Water District serves approximately 17,200 acres of land, with rice being the dominant irrigated crop, distantly followed by pasture and field crops (YCWA 2008).

Since 1985, all water from the lower Yuba River used by the Brophy Water District has been delivered through the South Canal under contract with YCWA.

The South Yuba/Brophy diversion headworks are located above Daguerre Point Dam on the Yuba River, adjacent to the Yuba Goldfields, roughly 9 miles northeast of Marysville, California (Demko and Cramer 2000a). The diversion headworks consist of an intake channel and bypass channel (collectively called the diversion channel), a porous rock gabion, a diversion pond behind the rock gabion and an irrigation canal existing at the diversion pond (**Figure 5-6**). The South Yuba/Brophy Diversion Canal and Facilities (or the South Canal) is a gravity flow diversion with a current diversion capacity of 380 cfs (SWRCB 2001), and it is authorized to divert water at a rate of up to 600 cfs (DWR and Corps 2003).

Water flows from the mainstem of the lower Yuba River into the diversion channel (side channel of the Yuba River) where it percolates through the porous rock gabion and surrounding gravel deposits into the diversion pond (Corps 2001).

Figure 5-6. Diversion headworks area for the South Yuba/Brophy Diversion Canal and Facilities.

The pond has a surface area of about 3 acres. The rock gabion consists of cobble size rock, and is roughly 400 feet long, ranging in width from roughly 30 feet at the base to 10 feet at the top. A fine-meshed, geotextile fabric was placed a few feet inside the river-side of the rock gabion during construction to prevent juvenile salmonids from passing through the rock gabion (Corps 2001).

At the far south end of the pond into which water percolates (approximately 300 feet away from the rock gabion) three 5-feet diameter pipes withdraw water from the pond to the main irrigation canal (Demko and Cramer 2000a).

Gates at the entrance of each pipe allow the flow of water to be controlled manually (Corps 2001). The pipes extend underground approximately 450 feet from the southwest corner of the diversion pond to the head of the main irrigation canal. Water can also enter the main irrigation canal by natural seepage. At times when water demand in the irrigation districts is low, the demand can be met entirely from seepage (around 100 cfs) into the canal (Demko and Cramer 2000a). The diversion channel and the head control structure require regular maintenance to remove accumulated gravel and debris deposited during high flows (USFWS 1990).

Some of the water that enters the diversion channel remains in the channel as it passes the rock gabion and flows back to the lower Yuba River through a lower portion of the diversion channel referred to as the bypass channel. The bypass channel extends roughly 450 feet from the downstream end of the rock gabion to the box culvert, which is located about 270 feet upstream of Daguerre Point Dam.

The diversion system and the percolation water outfall system are directly connected at an eight foot culvert and check structure located in a dredge pond near the river diversion facility (USFWS 1990). During the irrigation season (April-November), headboards are placed in the check structure to increase pond storage and capture percolation flows for conveyance. The headboards are pulled during the non-irrigation season to reduce pond storage and allow percolation water to return to the river via the culvert and outfall. The Corps has no involvement in these activities. As of 1990, USFWS (1990) reported that a seasonal dam located near the culvert protects the culvert structure during high winter flow conditions. When percolation flows exceed the capacity of the culvert, the seasonal dam was designed to blow-out and allow the high flows to bypass the culvert and return to the lower Yuba River via the outfall channel. This seasonal dam and blow-out feature also provided for winter-time flood protection of the various structures and activities occurring in the Goldfields Area (USFWS 1990).

Although the diversion structure addressed CDFW fish screening requirements at the time of construction in 1985, fish screening requirements have changed over time and the diversion structure does not meet current NMFS and CDFW screening criteria. Screening criteria issues associated with the diversion structure include potential non-compliance with: (1) screen space size (i.e., 3/32 inch mesh size); (2) screen porosity; (3) uniformity of approach velocity; (4) sweeping flow; and (5) cleaning frequency. Additional issues associated with the diversion structure include predation in the channel that leads to the diversion and at the face of the rock weir, and overtopping of the weir and subsequent entrainment of juvenile salmonids behind the weir.

The interstitial spaces between the rocks of the levee are larger than the maximum 3/32 inches required by NMFS fish screening criteria (CALFED and YCWA 2005). The fine mesh barrier imbedded within the rock gabion was designed to prevent fry or juvenile salmonids from passing through the gabion. However, it has been suggested that flows, at times, reportedly are not sufficient to sweep fry along the face of the rock gabion and, as a result, fry may become impinged or entrained into the diversion (CALFED and YCWA 2005).

NMFS (2007) also discussed the effects on salmonids of the South Yuba/Brophy Diversion Canal and Facilities, and stated that the fine-meshed, geotextile fabric buried within the rock gabion weir at this diversion "*may meet the opening size criteria (if it is still intact) but there is obviously no sweeping flow along the face of this fabric inside of the weir and therefore any fry which encounter this mesh, instead of being swept along the face of the fabric, would be more likely to become impinged on the fabric and perish*." NMFS (2007) also noted that several studies have suggested that the structure does not exclude juvenile salmonids from being entrained into this diversion.

By agreement with CDFW, at least 10% of the water diverted into the diversion channel is required to bypass the rock gabion and flow back to the river, to allow migrant fish entering the diversion channel to return to the river. However, it has been reported that the 10% bypass flow has not always been met historically (NMFS 2002). In September 2010, YCWA replaced the two 48-inch culverts located at the downstream terminus of the bypass channel with a concrete box culvert and then restored the site. YCWA undertook the project to improve water flow at various river stages, reduce debris loading, and reduce maintenance. Installation of the concrete box culvert also was necessary to efficiently accommodate new flow metering equipment to measure the flow returning to the Yuba River from the diversion channel. YCWA installed a downlooking acoustic Doppler flow meter was installed in the access port in the box culvert, and the flow meter was connected to the data monitoring and communication equipment located in the concrete building at the south abutment of Daguerre Point Dam. These improvements were made to ensure that the 10% return flows occur in the future pursuant to the stipulated settlement and order in the SYRCL v. NMFS case. High flows during the winter and spring of 2010/2011 resulted in the deposition of sediment and debris requiring clearance and maintenance of the box culvert and immediate vicinity, prior to the installation of the flow monitoring equipment.

In addition, predation of juvenile anadromous salmonids in the pool located within the diversion channel in front of the porous rock gabion has been raised as an issue by CDFW and NMFS. Construction of the porous rock gabion has resulted in a relatively wide, deep pool directly in front of the rock gabion characterized by reduced water velocities, which potentially could delay the continued downstream migration of juvenile salmonids (NMFS 2002). The pool also reportedly provides holding and ambush habitat for predatory fish such as Sacramento pikeminnow (NMFS 2002).

The issues of predation, impingement, and entrainment at the South Yuba/Brophy Diversion Canal and Facilities have been the subject of numerous evaluations over the past many years. A brief summary of the various studies and resultant findings is presented in chronological order hereas follows.

Pursuant to the 1984 Agreements between the South Yuba Water District and the Brophy Water District and CDFW, South Yuba/Brophy built Alternative No. 4, which stipulated additional criteria including "*c. A return diversion will provide for returning at least 10%*

of the quantity diverted back into the river." In 1988, CDFG (1988a) conducted a mark-recapture study to: (1) evaluate the effectiveness of the rock gabion; and (2) determine whether bypass flows were at least 10% of the diverted quantity.

The mark-recapture survey was conducted using a fyke net located in the upstream portion of the diversion channel, and two additional fyke nets located near the downstream terminous of the bypass channel. During the first treatment period, which began on May 11, 1988, a total of 4,746 salmon were captured in the upstream fyke net, whereas a total of 2,684 salmon were captured during the second treatment period (CDFG 1988a). The recapture rate at the downstream fyke nets after 72 hours approached zero. According to CDFG (1988a), the results of this mark-recapture study showed that less than 95% of the marked fish made it through the bypass canal, potentially because of the large predator (Sacramento pikeminnow) populations that existed in the diversion channel. CDFG (1988a) suggested that losses of juvenile salmonids at the South Yuba/Brophy diversion were between 40 and 60%. However, Cramer (1992) used the observed capture efficiency estimates to expand the number of marked fish recovered by CDFG (1988a) and found that estimated survival from the mouth of the diversion channel all of the way to the bypass exit was substantially higher than the estimates given by CDFG (1988a) and likely exceeded the 95% survival criterion stipulated by CDFW. During this study, Sacramento pikeminnow were observed feeding on juvenile salmonids as they attempted to migrate out of the diversion channel (CDFG 1988a). Flow measurements were taken by a SWRCB engineer, with assistance from CDFW and USFWS, at the following locations: (1) the inflow to South Yuba/Brophy Diversion Canal and Facilities (downstream of the intake fyke); and (2) the return flow to the lower Yuba River in the bypass canal (just downstream of the upper bypass fyke). Bypass flows exceeded 10% of the diverted flows of water during both treatment periods (CDFG 1988a).

Juvenile salmonids have been collected behind the rock gabion. These fish either passed through the mesh barrier or were washed over the top of the rock gabion during high flows (NMFS 2002). Juvenile sampling surveys have had mixed results in capturing salmon behind the rock gabion fish screen (USFWS 1990). An electrofishing survey of the diversion pond was conducted by CDFW in March 1987. Although juvenile salmonids were found in the pond behind the rock gabion prior to this study, salmonids were not captured when the pond was electrofished (CDFG 1988a). However, Preston (1987 as cited in CDFG 1988a) stated that three juvenile Chinook salmon were captured behind the gabion prior to diversions from the river. In that year, flows in the lower Yuba River reportedly did not exceed 2,000 cfs that could over-top the present height of the gabion, and allow for fish to pass over the gabion (USFWS 1990).

In April 1989, USFWS seined 31 juvenile Chinook salmon ranging in size from 46 to 70 mm fork length in the diversion pond area behind the rock gabion (USFWS 1990; SWRCB 2001). These fish reportedly had become trapped in the pond prior to any diversion. Although this was the only date USFWS seined the diversion pond, USFWS also observed several hundred juvenile salmonids feeding in the same area on May 5, 1989. After diversions began about May 10, 1989, USFWS (1990) did not observe any Chinook salmon in the diversion pond.

The entire back side of the rock gabion fish screen was observed during a scuba dive survey on May 11, 1989 (USFWS 1990). Water depth at the base of the gabion was approximately 20 feet with water visibility about 6 feet. The rock material was consistent in size and placement along the entire screen face. USFWS (1990) did not observe any unusually large sized openings that would allow for unimpeded flow through the gabion. An unknown amount of water was being diverted from the river through the gabion, and this diversion did not create any noticeable head differential between the pool in front of the gabion and the pool behind. The gabion appeared to be fairly fish tight (USFWS 1990). USFWS (1990) concluded that the salmon collected in 1989 behind the gabion most likely were washed into the pond during early March when river flows exceeded 20,000 cfs and over-topped the gabion structure. Although USFWS (1990) did not directly observe the flooding of the gabion, based on the accumulation of woody debris and dead leaves in small shrubs along the top of the gabion, it appeared that about 1 to 2 feet of water flowed over the north end of the structure. Flow measurements at Marysville from 1969 to 1989 indicate that flows that overtop the levee (exceeding 20,000 cfs) have occurred numerous times in eight of those 20 years (SWRCB 2001).

To determine whether juvenile fish were passing through the rock gabion, Demko and Cramer (1992 as cited in Corps 2001) installed a fyke net on the outfall of the diversion pipe that enters the South Yuba/ Brophy irrigation canal. They sampled continuously whenever water was diverted, from the day water diversions began on May 7 through July 22, and captured 17 juvenile Chinook and 2 steelhead fry during the sampling period. However, all Chinook salmon caught in the irrigation canal were substantially larger than those migrating down the river at the same time, and Demko and Cramer (1993) concluded that the large juvenile Chinook could not have passed through the interstitial spaces in the rock gabion at the time they were captured. They deduced, as did the USFWS in the 1988 study (USFWS 1990), that fish were not passing through the porous dyke, but rather that a small number of fish passed into the diversion pond during winter during times of high flows that over-topped the rock gabion (Corps 2001). However, CDFW suggested that the fyke net, constructed of 1/8 inch mesh, used in the study may not have been efficient for small salmonids and SWRCB (2001) suggested that the number of small juvenile steelhead entering the irrigation canal, therefore, may have been significantly underestimated. Regardless of the manner in which fish entered the diversion pond, SWRCB (2001) suggested that fish, including listed species, continued to be lost from the lower Yuba River fishery at the rock gabion.

In August 1993, Demko and Cramer (1993) observed nineteen 20 cm and larger pikeminnow in the diversion channel that were large enough to be predators of juvenile Chinook salmon. However, Cramer (2000 as cited in Corps 2001) reviewed all studies performed at the South Yuba/Brophy diversion, and found that none of the research by USFWS, CDFW or fisheries consultants had indicated that juvenile Chinook became disoriented upon entering the diversion channel, or that abnormally high predation on juvenile Chinook salmon occurred in the diversion channel.

SWRCB (2001) stated that during the 2000 SWRCB hearing, USFWS presented data showing that bypass flows in the return channel were at times less than 10% of the water diverted, and recommended that higher bypass flows be maintained. SWRCB (2001) also stated that because there was no way to prevent water from entering the diversion channel when water was not being diverted into the South Canal for irrigation, losses at the diversion facilities due to predation and other factors occur even when no water is being diverted for beneficial use (SWRCB 2001). USFWS presented evidence to the SWRCB that deposition and accumulation of gravel and debris in the diversion channel as a result of floods or other events can adversely affect flow and migration of juvenile salmon through the diversion facility (SWRCB 2001).

On July 8, 2004, representatives of CDFW and NMFS made a series of water velocity measurements along the face of the permeable rock gabion that separates the lower Yuba River from the headgates for the South Yuba/Brophy diversion. The purpose of the flow measurements was to characterize the flow conditions along the upstream face of the rock gabion. The flow along the upstream face of the rock gabion appeared to be irregular and complex in all three components of the velocity measurements (NAFWB 2004). According to NAFWB (2004), this was probably due to roughness of the gravel/cobble surface, irregularities in the rock gabion profile, differences in the permeability along the length of the rock gabion, and variations in the plugging of the upstream face of the rock gabion. Approach velocities varied from -0.054 feet per second (fps) to 0.686 fps with mean velocity of 0.052 fps. One approach velocity measurement exceeded 0.33 fps. Sweeping velocities varied from -0.167 fps to 1.034 fps with mean velocity of 0.260 fps. Two sweeping velocity measurements exceeded 0.67 fps. The head loss across the rock gabion was approximately 0.9 feet on the day of the measurements (NAFWB 2004).

On August 30, 2011, PSFMC personnel and YCWA representatives conducted a reconnaissance survey to investigate the presence/absence of predatory fish in the South Yuba/Brophy diversion channel. A jet boat was used to navigate through the diversion channel, initially entering from the upstream point of the diversion channel and drifting downstream to the box culvert at the lower end of the diversion channel (Figure 5-6). During the first pass, six fish, preliminarily identified as pikeminnow, ranging from approximately 16 to 20 inches in length were observed at about the mid-way point of the diversion channel. Three additional pikeminnow also approximately 16 to 20 inches in length were observed during a second pass, which was taken in an upstream direction from the box culvert crossing to the upstream point of the diversion channel. The jet boat then drifted down to the lower portion of the diversion channel and then slowly powered upstream. At approximately the mid-point of the diversion channel, pikeminnow were observed darting ahead of the boat and continued to do so until 13 pikeminnow were observed darting ahead of the boat into a relatively deep, fast flowing section at the upstream end of the diversion channel.

During May and June of 2012, field studies were conducted to investigate potential sources of juvenile Chinook salmon and steelhead mortality associated with the South Yuba/Brophy Diversion Canal and Facilities, including: (1) predation due to a concentration of predators in the diversion canal; and (2) entrainment or impingement caused by fish becoming trapped in the permeable rock gabion.

The data suggest that the diversion channel does not support a unique concentration of predators (Bergman et al. 2013). Adult pikeminnow densities were not significantly different between the diversion channel and the mainstem lower Yuba River adjacent to the diversion. Similarly, previous snorkeling surveys conducted in the diversion channel found relatively low abundances of adult Sacramento pikeminnow, with only 12 fish observed in 1988 (CDFG 1988a) and 19 in 1993 (Demko and Cramer 1993).

According to Bergman et al. (2013), approach velocities (perpendicular) and sweeping velocities (parallel) varied along the upstream side of the permeable rock gabion, and ranged from -0.15 to 0.17 meters per second (m/s) and -0.15 to 0.31 m/s, respectively (**Figure 5-7**). Although variable along the face of the rock gabion, approach velocities were relatively low, with only 15 of 147 locations having approach velocities above 0.06 m/s, and 0.17 m/s being the highest velocity observed. Sweeping velocities were lower at the up-river and down-river ends of the rock gabion (-0.14 to 0 m/s) and consistently higher in the middle of the gabion. The observed variability is likely due to the roughness of the gravel/cobble substrate, irregularities in the gabion profile, and differences in the permeability along the rock gabion, as was previously concluded by CDFG (2004, as cited in Bergman et al. 2013).

Bergman et al. (2013) concluded that present operations at the diversion facility provide adequate bypass flows to create positive sweeping velocities along the rock gabion, and measured approach velocities satisfied NMFS approach velocity standards except at a

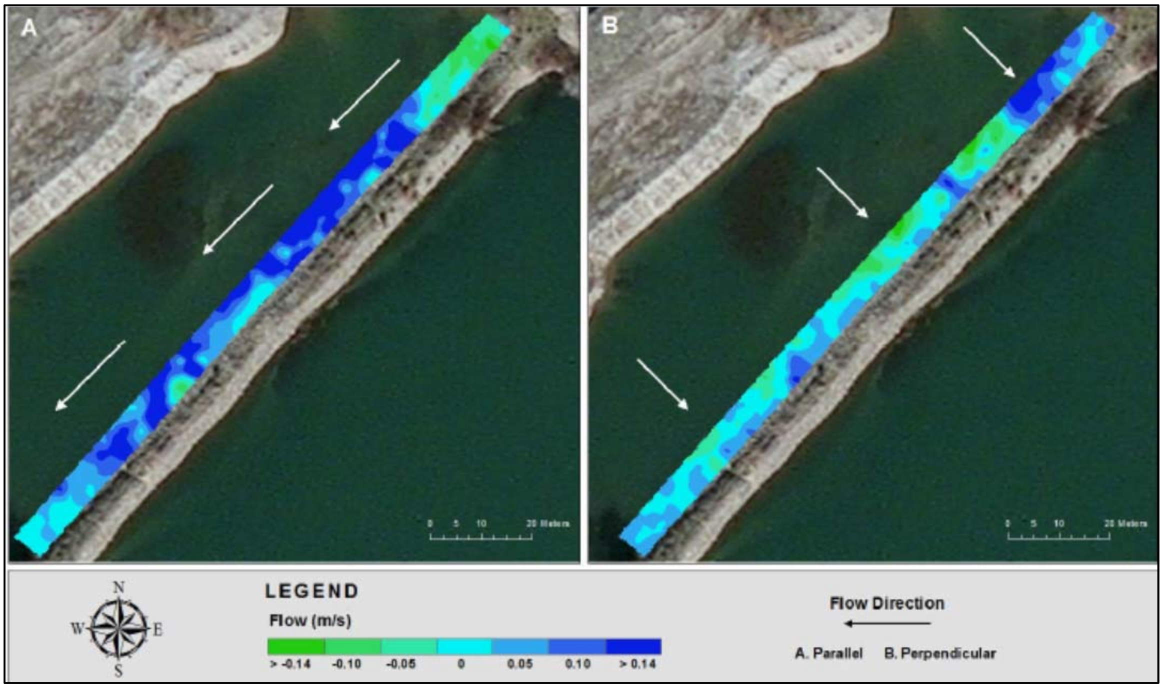

Figure 5-7. Gradient of sweeping velocities (parallel to the rock gabion) and approach velocities (perpendicular to the rock gabion) measured along the permeable face of the gabion on June 28, 2012 (Bergman et al. 2013).

bend at the upstream end of the rock gabion, where an eddy draws water up-river (Bergman et al. 2013). The end of the gabion where an eddy draws water up-river was identified because this anomalous area of higher approach velocities did not meet the NMFS (2011d) criteria of providing "nearly uniform" flow distribution along the face of a screen and, thus, may increase susceptibility of juvenile salmonids to impingement or entrainment. To improve these conditions, Bergman et al. (2013) state that re-grading the upstream entry into the diversion channel by "smoothing out" the pronounced bend could provide more uniform flow distribution along the face of the rock gabion.

Underwater video showed no evidence for impingement or entrainment risk to juvenile salmonids along the permeable rock gabion, and little risk even to larval fish much smaller than the juvenile samonids. The interstitial spaces along the rock gabion and the back side of cobbles were used as temporary cover by juvenile salmonids. Bergman et al. (2013) also observed that juvenile salmonids moved freely along the river bottom between cobbles, without indication of being drawn into the interstices within the rock gabion.

Daily bypass flows measured during 2012 were consistently above 10% of the diverted flow, and bypass flows ranged from 40 to 80 cfs (Bergman et al. 2013). According to Bergman et al. (2013), present operations provide adequate bypass flows to create positive sweeping velocities along the rock gabion.

Wheatland Project

The Wheatland Water District (WWD) is located in Yuba County in the southeastern portion of the South Yuba Basin, with much of the district located between Best Slough and Dry Creek, east of Highway 65 (YCWA 2008). Wheatland's service area contains about 10,400 acres, which are dominated by orchards, pasture, and rice. Historically, agricultural water demands were met with groundwater. The intense groundwater use in this area resulted in declining groundwater levels and deteriorating groundwater quality, forcing the abandonment of several wells. The project was jointly financed by YCWA, WWD and a grant from DWR. Completed in 2010, a canal was built to enable YCWA to provide water from the South Canal to WWD. Providing surface water in-lieu of groundwater pumping is intended to improve local groundwater conditions within the district and the surrounding areas, including the City of Wheatland, which is currently entirely dependent on groundwater (YCWA 2008).

The Yuba Wheatland In-Lieu Groundwater Recharge and Storage Project (Wheatland Project) supplies surface water from the YCWA South Canal to agricultural lands within the WWD and the Brophy Water District in southern Yuba County (YCWA 2012a). This surface water supply is intended to improve the water quality and water supply reliability to farmers who mainly rely on groundwater to grow crops such as fruit, nuts, rice and pasture for cattle. The project also is intended to recharge depleted groundwater aquifers and provide opportunities for conjunctive use of surface and groundwater supplies to enhance the reliability of YCWA's water system (YCWA 2012a).

YCWA diverts water from the lower Yuba River through the South Yuba/Brophy diversion structure located near Daguerre Point Dam and conveyed via the South Canal to the WWD's service area in southern Yuba County. Many of the ongoing effects associated with the existence of the South Yuba/Brophy Diversion Canal and Facilities may appropriately be considered stressors under the Environmental Baseline. Updated demand projections indicate that annual water deliveries to the Wheatland Project in the future are projected to increase up to about 35,000 to 36,000 acre-feet, depending on water year type. Projected future Wheatland Project demands are represented in modeling simulations for future Cumulative Conditions (for additional detail, see Chapter 7 and **Appendix F**).

Through a separate environmental process, YCWA is developing a fisheries improvement project at the South Yuba/Brophy Diversion Canal and Facilities that is investigating and addressing potential NMFS and CDFG fisheries compliance issues. Potential construction-related effects to listed species and their critical habitats in the lower Yuba River associated with YCWA's proposed fisheries improvement project at the South Yuba/Brophy Diversion Canal and Facilities will be evaluated and addressed through a separate ESA consultation process. The Corps is not responsible for the operations or maintenance of the diversion facility or any appurtenant facilities, and the Corps will not be responsible for these activities in the future.

Browns Valley Irrigation District Diversion

Formed in 1888, BVID is an agricultural water purveyor that delivers water to over 1,300 agricultural water users encompassing about 55,000 acres of land along the Sierra Nevada foothills and the eastern edge of the Sacramento Valley floor (YCWA 2008). In addition to other water sources, BVID has a contract with YCWA authorizing diversions of 9,500 acre-feet per year from the lower Yuba River at BVID's Pumpline Diversion Facility (Pumpline Facility) to supplement BVID's water rights diversions. BVID has received deliveries from YCWA since October 1971 (YCWA 2008). BVID may divert up to 25,687 acre-feet annually.

In 1964, BVID built the Pumpline Facility (**Figure 5-8**) on the north bank of the lower Yuba River about 0.75 mile upstream (i.e., 4,200 feet) of Daguerre Point Dam (SWRI 2003). The Pumpline Facility has a diversion capacity of 80.2 cfs (CALFED and YCWA 2005). In 1990, BVID ceased diversions from the Yuba River at locations other than the Pumpline Facility. For many years, the (Pumpline Facility) was unscreened until a new fish screen was completed in 1999.

Figure 5-8. BVID diversion facility, including the fish screen and diversion forebay (Source: YCWA 2013b).

Inflow to the canal depends on sufficient head at the point of diversion. The presence of Daguerre Point Dam serves to prevent additional down-cutting, or incision, of the Yuba River and therefore contributes to the maintenance of sufficient head at the BVID point of diversion. Diverted water enters an excavated side channel, passes through the fish screen described in the following paragraph and is then pumped up into the canal supplying the BVID service area. The Pumpline Facility diversion uses pumps located on the north bank of the river to divert water through an excavated side channel and up into the canal at rates estimated up to 100 cfs. Water bypassing the fish screen continues through the side channel and reenters the lower Yuba River upstream of Daguerre Point Dam.

In 1999, a new state-of-the-art fish screen was installed at the Pumpline Facility that meets NMFS and CDFW screening criteria (SWRCB 2001; NMFS 2002; CALFED and YCWA 2005). Funding for design and construction of the screen was obtained from DWR, the Reclamation's CVPIA Anadromous Fish Screen Program, the California Urban Water Agencies Category III Account, PG&E, and YCWA. BVID contributed manpower and equipment to the construction and assumed the obligation to operate and maintain the fish screen (SWRCB 2001). The SWRCB (2001) determined that the new fish screen at the Browns Valley Pumpline Diversion Facility provided adequate protection for juvenile salmonids, and that BVID should continue to operate and maintain the new fish screen in compliance with NMFS and CDFW criteria.

The BVID diversion is not licensed by the Corps, and it has no direct physical link to Corps property. Although there is no apparent nexus with the Corps, BVID's Browns Valley Pumpline Diversion Facility was either included in the project description or discussed under effects of the Proposed Action in the 2000 Corps BA, 2002 NMFS BO, 2007 Corps BA, and 2007 NFMS BO. However, because the BVID diversion is not licensed by the Corps and it has no direct physical link to Corps property, there are no permits, licenses, or easements associated with the Corps' operation and maintenance of Daguerre Point Dam. Therefore, the Browns Valley Pumpline Diversion Facility and associated effects of diversion on the listed species and their habitat ithe lower Yuba River are included in the Environmental Baseline, and not in the Proposed Action.

5.3 Physical Habitat

During the period of hydraulic gold mining in the 1800s, vast quantities of sand, gravel, and cobble entered the Yuba River (Gilbert 1917 as cited in Yoshiyama et al. 2001) and deposited throughout the system. This human impact completely transformed the river. Daguerre Point Dam was constructed at the downstream end of an enormous gravel deposit, and about 16 miles of "gravel berms" were erected to channelize the river by piling gravel on both the north and south banks, as well as down the center of the river in some places to create two channels. These activities were two of the major features of the "1898 Project", which was completed in 1935 (Hagwood 1981). By that time, three gravel berms existed, having a total length of 85,100 feet which provided two 500-foot-wide channels. In 1944, the California Debris Commission issued a permit to the Yuba Consolidated Gold Fields to dredge a 600-foot-wide channel and build gravel berms to take the place of the pair of 500-foot-wide channels completed in 1935 (Hagwood 1981). The effect of the gravel berms was to keep the river from spreading in its floodplain and to turn this stretch of the lower Yuba River into a channel that conveys water downstream to serve agricultural and municipal users (Gustaitis 2009). Downstream of Daguerre Point Dam, the Yuba River has resumed a meandering course through the fluvial tailings.

Down-cutting of the streambed downstream of Daguerre Point Dam has exposed the bedrock of Daguerre Point (Hunerlach et al. 2004).

The Corps has not issued any permits, licenses, or easements to other parties, and does not conduct inspection or maintenance activities associated with the gravel berms (R. Olsen, Corps, pers. comm. 2011). Consequently, the Corps is not responsible for operations and maintenance of the gravel berms along the lower Yuba River. Because the Corps does not have the ability to lessen any effects on listed species habitat availability associated with dynamic fluvial/geomorphologic processes in the floodplain of the lower Yuba River located between the gravel berms, and because the Corps is not proposing any actions pertaining to the gravel berms, any such effects are appropriately considered part of the Environmental Baseline and not the Proposed Action.

5.3.1 Fluvial Geomorphology

Fluvial geomorphologic processes in the lower Yuba River downstream of Englebright Dam continue to represent adjustments to the tremendous influx of hydraulic mining debris, and the construction of Englebright Dam. Since the construction of Englebright Dam, the lower Yuba River continues to incise and landform adjustments continue to occur - as illustrated by Pasternack (2008), who estimated that about 605,000 yds^3 of sediment (primarily gravel and cobble) were exported out of Timbuctoo Bend from 1999 to 2006. The lower Yuba River is adjusting toward its historical geomorphic condition, by going back to the pre-existing state prior to hydraulic gold mining (Pasternack 2010).

The lower Yuba River has been subjected to additional in-channel human activities such as: (1) the formation of the approximately 10,000-acre Yuba Goldfields in the ancestral migration belt; (2) the relocation of the river to the Yuba Goldfield's northern edge and its isolation from most of the Goldfields by large "gravel berms" of piled-up dredger spoils; (3) mechanized gold mining facilitated by bulldozers beginning in about 1960 in the vicinity of the confluence with Deer Creek, changing the lower Yuba River geomorphology (Pasternack et al. 2010); (4) bulldozer debris constricting the channel significantly and inducing abrupt hydraulic transitioning; and (5) mining operations combined with the 1997 flood which caused angular hillside rocks and “shot rock” debris to be deposited on top of the hydraulic-mining alluvium in the canyon (Pasternack 2010).

All of these activities have influenced physical habitat conditions in the lower Yuba River downstream of Englebright Dam. Physical conditions related to fisheries habitat in the lower Yuba River have been studied over many years. With respect to the spawning lifestage, Fulton (2008) found spawning habitat conditions to be very poor to nonexistent in the Englebright Dam Reach. Spring-run Chinook salmon individuals immigrating into the Yuba River each year attempt to spawn in the Englebright Dam Reach, which historically was characterized by a paucity of suitable spawning gravels. However, gravel augmentation funded by the Corps in the Englebright Dam Reach over the past several years has spurred spawning activity and Chinook salmon redd construction in this reach (see Chapter 2 for additional discussion). The net result is an increase in the spatial distribution of spawning habitat availability in the river, particularly for early spawning (presumably spring-run) Chinook salmon (RMT 2013). Farther downstream, spawning habitat does not appear to be limited by an inadequate supply of gravel in the lower Yuba River due to ample storage of mining sediments in the banks, bars, and dredger-spoil gravel berms (RMT 2013).

According to NMFS (2009), river channelization and confinement has led to a decrease in riverine habitat complexity and a decrease in the quantity and quality of juvenile rearing habitat. Also according to NMFS (2009), attenuated peak flows and controlled flow regimes have altered the lower Yuba River’s geomorphology and have affected the natural meandering of the river downstream of Englebright Dam.

As reported by RMT (2013), the Yuba River downstream of Englebright Dam has complex river morphological characteristics. Evaluation of the morphological units in the Yuba River as part of the spatial structure analyses indicates that, in general, the sequence and organization of morphological units is non-random, indicating that the channel has been self-sustaining of sufficient duration to establish an ordered spatial structure (RMT 2013). In addition, the Yuba River downstream of Englebright Dam exhibits: (1) lateral variability in its form-process associations; (2) complex channel geomorphology; and (3) a complex and diverse suite of morphological units. The complexity in the landforms creates diversity in the flow hydraulics which, in turn, contributes to a diversity in habitats available for all riverine lifestages of anadromous salmonids in the Yuba River downstream of Englebright Dam (RMT 2013).

NMFS (2009) further stated that in the lower Yuba River, controlled flows and decreases in peak flows has reduced the frequency of floodplain inundation resulting in a separation of the river channel from its natural floodplain. However, as reported by RMT (2013), despite some flow regulation the channel and floodplain in the lower Yuba River are highly connected, with floods spilling out onto the floodplain more frequently than commonly occurs for unregulated semi-arid rivers. Some locations exhibit overbank flow well below 5,000 cfs, while others require somewhat more than that. In any given year, there is an 82% chance the river will spill out of its bankfull channel and a 40% chance that the floodway will be fully inundated. These results demonstrate that floodplain inundation occurs with a relatively high frequency in the lower Yuba River compared to other Central Valley streams which, in turn, contributes to a diversity in habitats available for anadromous salmonids (RMT 2013).

5.3.2 Waterway 13 and the Yuba Goldfields Fish Barrier Project

Located along the Yuba River near Daguerre Point Dam, the Yuba Goldfields consist of more than 8,000 acres of dredged landscape and represent one of the largest tracts of mining debris in northern California (Hunerlach et al. 2004). Historical records from the Yuba Goldfields indicate that dredging near Daguerre Point Dam took place on a nearly continuous basis from 1904 through 1968. Since 1904, dredging has been the principal form of mining in the Yuba Goldfields. Mining company records indicate that extensive areas were re-dredged as technology improved, allowing deeper digging. The area of the present Yuba River channel upstream of Daguerre Point Dam was dredged primarily during 1916-1934. Water flowing through the gravels creates large tracts of ponds throughout the mined landscape (Hunerlach et al. 2004).

As a result of the high permeability of the Goldfield's rocky soil, water from the Yuba River freely migrates into and through the Goldfields, forming interconnected ponds and