RUSSIAN RIVER BIOLOGICAL ASSESSMENT

INTERIM REPORT 5:
CHANNEL MAINTENANCE

Prepared for:

U.S. ARMY CORPS OF ENGINEERS
San Francisco District
San Francisco, California

and

SONOMA COUNTY WATER AGENCY
Santa Rosa, California

Prepared by:

ENTRIX, INC.
Walnut Creek, California

May 11, 2001

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Page

Page

Page

The Sonoma County Water Agency (SCWA), the U.S. Army Corps of Engineers (USACE) and the Mendocino County Russian River Flood Control and Water Conservation Improvement District (MCRRFCD) are undertaking a Section 7 Consultation under the federal Endangered Species Act (ESA) with the National Marine Fisheries Service (NMFS) to evaluate effects of operations and maintenance activities on listed species and their critical habitat. The Russian River watershed is designated as critical habitat for threatened stocks of coho salmon, steelhead, and chinook salmon. SCWA, USACE and MCRRFCD operate and/or maintain facilities and conduct activities related to flood control, channel maintenance, water diversion and storage, hydroelectric power generation, and fish production and passage.

Federal agencies such as USACE are required under the ESA to consult with the Secretary of Commerce to insure that their actions are not likely to jeopardize the continued existence of listed species or adversely modify or destroy critical habitat. As part of the Section 7 Consultation, USACE and SCWA will submit to NMFS a biological assessment (BA) that will provide the basis for NMFS to prepare a biological opinion (BO) that will evaluate project operations. The BA will integrate a number of interim reports on various project operations. This interim report addresses channel maintenance operations, including activities on the mainstem Russian River, Dry Creek, and the Mark West Creek Watershed area. Included is the Laguna de Santa Rosa Watershed, which drains to Mark West Creek.

Potential effects on protected coho salmon, steelhead, and chinook salmon and their designated critical habitat in the Russian River basin that may arise from channel maintenance activities were evaluated. SCWA's scope of responsibilities include channel maintenance activities in the Central Sonoma Watershed Project, the Mark West Creek Watershed, and activities related to USACE dams on the East Fork Russian River (Coyote Valley Dam) and Dry Creek (Warm Springs Dam). SCWA's activities in the Santa Rosa area covered under a National Pollutant Discharge Elimination System (NPDES) storm water discharge permit were evaluated.

Four general types of channel maintenance activities are addressed:

1. Sediment maintenance
2. Channel clearing (debris removal)
3. Vegetation maintenance
4. Bank stabilization

Short-term, direct effects related to direct injury or mortality to fish and long-term changes to critical habitat were evaluated for each type of activity. Key findings are summarized in Table E-1. Where an effect is identified, an assessment is made as to the degree or extent that effect presents a risk to the overall population of listed fish species. These effects are discussed in the following sections and then they are synthesized to indicate the overall risk to listed fish species and their habitat.

Table E-1 Summary List of Adverse and Beneficial Effects Related to Maintenance Activities

Maintenance Activity	Significance and Nature of Effect	Risk to Population	Species Affected*
Sediment Maintenance			
Direct, short-term effects	No negative direct effect from sediment input or direct fish injury in flood control or natural channels.	None	
Long-term, habitat effects	Negative effect on migration in constructed flood control channels.	Moderate	St, Co, Ch
	Negative effect on rearing habitat in Todd Creek and Laguna de Santa Rosa.	Low	St, Co, Ch
	Negative effect from SCWA activities in Russian River by reducing pool habitat formation and loss of high-flow refuge.	High	St, Ch
	Negative effect from MCRRFCD activities on Russian River by reducing pool habitat formation and loss of high-flow refuge.	High	St, Ch
	Negative effects in natural channels (other than Russian River) in association with bank stabilization activities following catastrophic flood events.	Low	St, Co, Ch
Vegetation Maintenance			
Direct, short-term effects	No negative direct effect from vegetation control practices.	None	
Long-term, habitat effects	No negative effect on constructed flood control channels with current vegetation maintenance practices. Future maintenance practices may be modified, with potential for negative effects to populations.	None	

Table E-1 Summary List of Adverse and Beneficial Effects Related to Maintenance Activities –Continued–

Maintenance Activity	Significance and Nature of Effect	Risk to Population	Species Affected*
	Negative effect on natural channels by reducing streambank and instream vegetation in important rearing/spawning streams, with loss of high-flow refuge, shade canopy and cover.	Low	St, Co, Ch
	Negative effect from extensive SCWA obligations to USACE in Dry Creek and the mainstem Russian River, Sonoma County. Effects include loss of high-flow refuge, reduction in cover, and potential increases in water temperature.	High	St, Co, Ch
	Negative effect from extensive MCRRFCD obligations to USACE in the mainstem Russian River, Mendocino County. Effects include loss of high-flow refuge, reduction in cover, and potential increases in water temperature.	High	St, Ch
LWD Removal			
Long-term, habitat effects	Negative effects associated with LWD removal in constructed flood control channels and flood control reservoirs. Reduction of cover or scour.	Low	St, Co, Ch
Bank Stabilization			
Direct, short-term effects	Negative effects from maintenance of bank stabilization structures and levees in Mark West Creek Watershed, Dry Creek, and Russian River that involve repair of rip-rap and levees, and re-grading eroding banks in wetted channels.	Low	St, Co, Ch

Table E-1 Summary List of Adverse and Beneficial Effects Related to Maintenance Activities –Continued–

Maintenance Activity	Significance and Nature of Effect	Risk to Population	Species Affected*
Long-term, habitat effects	Negative effects associated with USACE obligations at existing bank stabilization and levee sites on both the Russian River and Dry Creek. Removal of riparian vegetation at multiple sites reduces cover and shading.	Moderate	St, Co, Ch
Flood Control Reservoirs			
Direct, short-term effects	Negative effect due to risk of entrapment of salmonids into Spring Lake.	Low	St, Co
Long-term, habitat effects	Negative effect from predation. Release of predators from Spring Lake during high flow events may help maintain established populations in Santa Rosa Creek.	Low	St, Co
	Negative effect from decrease or delay of downstream flow on Matanzas Creek due to reservoir flood capacity may affect early part of coho salmon spawning and early winter rearing habitat.	Low	St, Co
	Negative effect from retention of spawning gravel in Matanzas Creek Reservoir that may affect downstream spawning habitat. Spawning habitat may also be affected by other issues unrelated to reservoir function such as channel geomorphology.	Low	St, Co
NPDES Permit Activities			
Long-term, habitat effects	No negative effect. Implementation of SWMP monitoring indicates low toxicity of storm water runoff.	None	

*If no species is listed, then effect of maintenance activity is not considered to be an adverse impact
*St = Steelhead, Co = Coho salmon, Ch = Chinook salmon

Sediment Maintenance

Sediment maintenance activities are performed in constructed flood control channels in the Central Sonoma and the Mark West Creek watersheds, and in Dry Creek and the Russian River mainstem under obligation to the USACE related to operation of Warm Springs and Coyote Valley dams. They are also performed in natural channels in conjunction with bank stabilization work at landowner request. Sediment maintenance activities involve removal or redistribution of sediments in a stream or channel to maintain hydraulic capacity and reduce streambank erosion. Constructed flood control channels are widened and straightened waterways that have been altered based on flood control criteria. Natural channels have not been modified for flood control purposes by SCWA or USACE. As salmonids use natural channels for migration, rearing, and spawning, and constructed flood control channels primarily for migration, potential effects to protected species and their critical habitat could occur in either type of channel.

Without adequate controls, direct, short-term effects from sediment maintenance activities could potentially include an increase in sediment input to the channel and a risk for direct injury or mortality to fish. Current maintenance practices limit streambed and streambank disturbance and reduce the frequency and amount of channel work that is performed. As sediment removal on flood control channels is performed during the summer or fall, potential direct effects are limited to rearing and some migrating juvenile steelhead and coho salmon. Sediment removal activities are often performed in dry channels, limiting the risk of direct effects to protected species and their habitat. Effective BMPs keep streambank disturbance to a minimum and control sediment input to the channel. There is a potential for direct injury to rearing salmonids when equipment performs work in a wetted channel. However, SCWA staff biologists routinely identify areas where salmonids may be utilizing habitat, and if protected species are present, fish rescues are conducted. Because sediment removal activities performed in constructed flood control channels that contain poor quality rearing habitat for listed species, few, if any, fish are exposed. Therefore, the risk of direct injury to protected fish species is low.

Long-term, habitat-altering effects from sediment removal activities in flood control channels include a widening of the channel bottom that reduces flow depths. This substantially diminishes the amount of time flows are suitable for passage, and therefore has a negative effect on coho salmon, steelhead and chinook salmon migration. Since all flood control channels are potentially migration corridors, all channels that are subject to sediment excavation may be affected. The most extensive sediment removal activities occur in the channels draining the Rohnert Park area.

Summer rearing habitat is rarely available in the majority of flood control channels that are subject to sediment excavation (due to low-gradient, lack of streamflow, and warm water temperatures). Therefore, effects to rearing habitat are not substantial. However, there are two channels subject to sediment maintenance work that have been identified as potentially supporting rearing habitat, Laguna de Santa Rosa and Todd Creek. Potential loss of rearing habitat associated with reduced pool availability, lack of instream cover, canopy cover, habitat complexity and hydraulic complexity due to sediment excavation is a significant effect on these streams. Steelhead, chinook salmon and coho salmon may be affected.

Since the most extensive maintenance work is primarily done in channels where habitat has already been degraded by sediment deposition, and these flood control channels are not considered to provide good rearing habitat or to support spawning habitat, the overall risk to listed fish species is considered to be low. Reduction of sediment input to flood control channels is related to land use activities in the watershed. SCWA restoration and conservation actions to reduce sediment loads are discussed in *Interim Report 6: Restoration and Conservation Actions*.

Sediment maintenance to control bank erosion is a USACE obligation for the SCWA on Dry Creek and the lower Russian River, and the MCRRFCD on the upper Russian River in Mendocino County. While the obligations are similar, SCWA has not conducted these activities in recent years. MCRRFCD conducts sediment maintenance activities every year.

The sediment maintenance work is performed in conjunction with vegetation maintenance activities, whereby gravel bars are graded and vegetation is removed from the gravel bars during the grading procedure. There are no short-term direct effects associated with impairment of water quality or direct injury to fish associated with this work based on the best management practices and erosion/sedimentation control methods that are employed. Sediments and gravels are not removed from the Russian River by MCRRFCD as part of their maintenance practices. Therefore, there are no habitat-altering effects related to the supply or transport of spawning gravels. SCWA does occasionally remove sediments from the Russian River, and this work is usually contracted out with firms that perform gravel extraction (pers. comm., Bob Oller, SCWA). Gravel removal can alter sediment transport characteristics of the river, resulting in changes to channel geomorphology (such as channel incision) and changes to aquatic habitat. The specific nature of such changes associated with gravel removal on the Russian River are not known.

Sediment maintenance activities practiced by SCWA and the MCRRFCD have a substantial effect on critical habitat for steelhead and chinook salmon. The sediment maintenance activities potentially alter channel geomorphology by inhibiting the development of stable gravel bars. This practice tends to reduce channel sinuosity that has a significant negative effect on habitat conditions. The habitat effects include reduced potential for pool development on the outside of meander bends, and reduced high-flow refugia due to the loss of the bedform topography created by stable bars with established vegetation that provide velocity breaks and resting areas. There is also a general loss of hydraulic and associated aquatic habitat complexity.

Sediment removal is occasionally required in natural channels when landowners request SCWA to remediate problems associated with reduced channel flood capacity and bank erosion that threatens property or infrastructure. SCWA does not perform routine sediment removal activities in natural channels. In the past, sediment excavation has almost always been related to landslides or following significant storm events. It is estimated based on past activities, that sediment removal in natural channels occurs about once in every 10 years (Bob Oller, SCWA, pers. comm. 2000). Sediment removal in natural channels could be requested by a landowner on almost any stream in the Russian River basin. Any of the ESA-listed fish species may or may not be present in the stream, and habitat conditions may vary widely.

Sediment removal activities in natural channels occur on a very limited and infrequent basis. SCWA has developed best management practices and other guidelines for planning and implementing sediment removal and bank stabilization work performed in natural channels in order to protect listed species and to minimize significant habitat alterations. Negative habitat alterations could occur from installation of rip-rap (reduction in riparian vegetation), removal of sediments, or alteration of channel morphology. However, given the infrequent need for maintenance activities in natural channels, the prescriptions for limiting the size of any project to 1,000 ft, and the guidelines for incorporating bio-engineering, revegetation, and fish habitat elements into bank stabilization work, the potential for substantial habitat altering effects associated with sediment maintenance activities on natural channels is small. Therefore the risk to listed fish species is low.

Debris Clearing

Woody debris removal is performed only in constructed flood control channels, flood control reservoirs, and to a very limited extent in natural channels associated with emergency sediment maintenance and bank stabilization activities. Debris clearing in flood control reservoirs is discussed in the flood control reservoir section below.

In recent years, SCWA has coordinated with NMFS and CDFG to limit removal of large woody debris (LWD) or other important fish habitat structures to situations when there is a serious flood threat or bank stability problem. LWD is allowed to remain in flood control channels if it does not threaten bank stability or the flow capacity of structures such as bridges and culverts. LWD does not play a significant role in providing aquatic habitat structure in constructed flood control channels since there are very limited tree sources in the riparian corridor (flood control channels are not located in forested areas) and limited opportunity for recruitment process (*i.e.*, stable bank design with minor bank erosion). Therefore, LWD removal in constructed flood control channels results in reduction of a small amount of cover or scour, but the overall effect on the population is low.

In natural channels, LWD is removed only in conjunction with emergency sediment maintenance and bank stabilization activities. LWD is removed if it threatens streambank stability that would result in loss of property or infrastructure. Given that this type of maintenance work is performed infrequently and at a small scale (projects are limited to no more than 1,000 linear feet in size based on SCWA guidelines), LWD maintenance practices will not negatively affect salmonid habitat.

Vegetation Maintenance

Vegetation maintenance practices are performed in order to maintain flood capacity and to reduce the potential for streambank erosion. Vegetation maintenance practices differ between natural and constructed flood control channels in the Mark West Creek Watershed. Natural waterways maintained by SCWA are listed in Table 1-2, and include 13 miles along Dry Creek and 22 miles along the mainstem Russian River. Current vegetation maintenance methods retain canopy cover as much as possible, and are a dramatic improvement compared with past practices that resulted in more widespread removal of riparian vegetation.

Since 1987, heavy equipment has not been used in the bottom of natural channels; rather, hand labor is used. This practice has reduced disturbance in the channel and on the banks. Herbicides are used in natural and flood control channels, to control in-stream vegetation such as tules, cattails, and blackberries. This practice has become more important in urbanized areas where return flows support vegetative growth throughout the summer, reducing flood capacity. Only Rodeo, an aquatic contact herbicide, is used, and this substantially reduces the risk to protected species and aquatic invertebrates that support them. Roads are mowed and sprayed with Rodeo, but care is taken to spray in only a narrow width on the streamside, and to not spray the herbicide too close to the edge of channels. Limited use of herbicides approved for aquatic use avoids direct injury to fish.

Constructed flood control channels were historically cleared to maintain hydraulic capacity and reduce fire dangers. Current practices call for removal of understory vegetation in the lower third of the channel bank, including the base of the channel bank, only as needed, by hand, and leaving native riparian species wherever possible. An emphasis is placed on allowing native trees to establish a shade canopy. There will be an increase in the riparian corridor over time as these trees mature and could potentially reduce vegetation removal activities in the understory. Approximately one-third of the constructed flood control channels have some portions with developing tree canopies. The other two-thirds of the flood control channels are dominated by willows, blackberries, cattails and tules.

SCWA also has vegetation maintenance responsibilities on a section of Santa Rosa Creek for the Prince Memorial Greenway restoration project and for a restoration project on the lower reaches of Brush Creek. In general these responsibilities include maintaining vegetation that has been planted along the streambanks for each of these projects (on Brush Creek vegetation is not cut on the lower one-third of the streambank), so that there is no loss of the riparian canopy. SCWA is also responsible for maintaining the hydraulic capacity of these restored flood control channels. Since these projects require no greater removal or trimming of vegetation than is already practiced for other constructed flood control channels, there are no negative effects to habitat conditions associated with these vegetation maintenance responsibilities.

With current maintenance practices in flood control channels, a moderate amount of vegetation is removed (from between 25% up to 50% of the channel cross-section). Since most of the flood control channels provide no or very limited rearing habitat, and primarily function as migration corridors, current maintenance practices do not significantly alter critical habitat conditions in flood control channels.

Present-day vegetation maintenance practices in constructed flood control channels are currently being reviewed by SCWA in order to determine the influence on channel flood capacity. Because SCWA has an obligation to maintain flood capacity, it is possible that the current maintenance practices may need to be modified in the future. As vegetative growth on the streambanks becomes more dense and mature, channel capacity could be significantly reduced, and flooding could occur. At this time the nature and extent of modification to existing vegetation maintenance practices, if necessary at all, is unknown.

If it is necessary for SCWA to revert to prior maintenance practices, then only some vegetation near the top of the bankfull channel and set back from the top of bank would likely be allowed to establish. This would represent about a 75% or greater reduction in vegetation within the channel cross-section, which would have a potentially significant effect. For the flood control channels supporting migration habitat, the risk to the overall population of steelhead, coho salmon and chinook salmon would be relatively small since few individuals are likely using these flood control channels. Effects would be of greater significance to the population as a whole for those flood control channels that support rearing and/or spawning habitat. There are eight flood control channels identified that potentially support spawning and/or rearing habitat:

- Crane Creek
- Paulin Creek
- Todd Creek
- Laguna de Santa Rosa
- Rinconada
- Brush Creek
- Oakmont
- Santa Rosa Creek

Potential vegetation removal on these channels under more aggressive maintenance practices may potentially result in increased water temperatures that could be detrimental to salmonids. Removal of understory vegetation may result in a decrease in cover for salmonids and invertebrates on which they feed.

Alternatively, other vegetation maintenance practice scenarios may be developed, if needed. An estimate of the long-term indirect effects on habitat depends on the extent of vegetation removal practices. Any maintenance practice that requires between 50% and 75% removal of vegetation would be considered to have a substantial effect. For the flood control channels that do not support rearing or spawning habitat, there is not expected to be a significant effect on habitat conditions. However, for those 8 channels (above) designated as providing potential rearing and/or spawning habitat, the effect is of greater importance and would therefore be considered a significant habitat alteration.

Under obligations to the USACE, SCWA is required to provide vegetation maintenance activities to maintain flood capacity and to prevent bank destabilization and erosion in Dry Creek and the lower Russian River. The MCRRFCD is also under obligation to the USACE to conduct vegetation maintenance activities on the upper Russian River. In Dry Creek, estimates of greater than 50% reduction in vegetation, and in the Russian River, estimates of greater than 25% reduction indicate that vegetation maintenance activities are likely to have a substantial effect. Given the multiple life history stages of listed species supported by the Russian River, and relatively large linear extent of vegetation clearing that is likely to be necessary over time (both SCWA and the MCRRFCD have obligations over a combined total area of 58 miles), this practice is considered to be a substantial habitat alteration. Steelhead and chinook salmon critical habitat would be negatively affected, and there would be a high risk to the population as a whole.

The habitat-altering effects are similar to those discussed for sediment maintenance activities in the Russian River and Dry Creek. Vegetation removal potentially alters channel geomorphology by inhibiting the development of stable gravel bars. This practice tends to reduce channel sinuosity and has a substantial effect on habitat conditions. The habitat effects include reduced potential for pool development on the outside of meander bends, and reduced high-flow refugia due to the loss of the bedform topography created by stable bars with established vegetation that provide velocity breaks and resting areas. In addition, reduced shading from loss of riparian vegetation (particularly near the thalweg in the summer) will increase water temperatures and reduce cover. Overall, there is a general loss of hydraulic and associated aquatic habitat complexity.

The MCRRFCD has planted and maintained riparian vegetation a two-mile stretch in the upper Russian River. Furthermore, MCRRFCD has supported the Ukiah Rod and Gun Club's Spawning Habitat Channel installed on the West Fork of the Russian River. Restoration activities are likely to improve habitat for steelhead and chinook salmon.

For the natural channels (other than Dry Creek and Russian River) where vegetation removal may occur (Table 1-2), SCWA does not have routine or regularly implemented maintenance obligations. SCWA will remove vegetation on these natural channels only where there are site-specific problems with flood capacity. Therefore, the length of vegetation removal is limited to small projects. Most projects are about 300-600 ft in length (pers. comm. Bob Oller, SCWA). When willows are removed from gravel bars, winter refugia could be reduced for coho salmon and steelhead. Since SCWA practices in natural channels call for underbrush removal and retention of a shade canopy over stream channels, it is reasonably estimated that no more than 25% of the in-channel vegetation is removed. Given the small scale of current vegetation removal activities, there is a relatively low risk to populations from long-term habitat-altering effects (particularly coho salmon and steelhead and possibly chinook salmon) in natural streams.

Bank Stabilization

Mark West Creek Watershed, Dry Creek, and Russian River

Current bank stabilization activities by SCWA involve maintenance of existing structures. No new structures are being constructed. Maintenance of bank stabilization structures and levees in the Mark West Creek Watershed generally involves the repair of rip-rap. A significant amount of work is required under obligations to the USACE on 15 bank stabilization sites in Dry Creek. The largest projects are in a 22-mile stretch along the upper Russian River between Cloverdale and Healdsburg, including both non-federal and federal levees and bank stabilization structures. All three listed fish species use Dry Creek and the upper mainstem Russian River. Steelhead, coho salmon, and chinook salmon use streams and constructed flood control channels in the Mark West Creek Watershed.

The most extensive short-term direct effects would occur from maintenance methods that involve repair of rip-rap and levees, regrading banks where they are eroding or landslides have occurred, and re-alignment of the channel. Other bank stabilization methods are likely to have localized effects that are smaller in scale. Increased turbidity may affect rearing salmonids. Erosion control BMPs, such as installation of a gravel berm to reduce sediment input from the construction area, are routinely used to control potential increases in turbidity or sedimentation. Re-grading a bank and re-aligning a channel section could potentially result in a high level of disturbance to the bank, but by using effective erosion control methods and by scheduling the work in the summer, sediment input to the stream is minimized.

Because there is no bypass, rescue, or escape provided during construction activities, there is a risk of direct injury or mortality to juvenile salmonids. This risk is due to construction equipment that is in contact with the channel bed in a wetted stream channel where listed species are present. However, since work within the wetted stream channel is infrequent and focused on site-specific locations, the overall risk to populations is low.

Habitat is negatively affected on Dry Creek and the Russian River in association with bank stabilization work required under obligations to the USACE. Much of this work requires vegetation removal, tree trimming, and rip-rap on unstable banks and levees at multiple sites. Where rip-rap is used, growth of new vegetation can be inhibited. At least one site on the Russian River has been recommended for re-alignment to reduce bank erosion. In combination, the federal and non-federal obligations to maintain levees and bank erosion control structures on the Russian River would be a substantial habitat altering effect, with an overall moderate effect on the populations of ESA-listed species.

The MCRRFCD and SCWA grade gravel bars in the channel that are determined to be threatening bank stability and/or dividing a single channel into multiple channels. The gravel is moved to the side of the channel and vegetation growing on the gravel bars is removed. MCRRFCD moves the willows that are growing on the bars to the banks, where they may take root and provide improved bank stabilization. SCWA removes the willows from the channel. Approximately one-third of the upper Russian River in Mendocino County is maintained each year. SCWA has not performed this type of work in the Russian River since 1993, but remains under obligation to the USACE.

Since the MCRRFCD and SCWA bank stabilization work is performed using sediment and vegetation maintenance practices, the summary evaluation of habitat-altering effects is discussed separately in the sediment maintenance and vegetation maintenance sections above.

Central Sonoma Watershed Project Flood Control Reservoirs

Four Central Sonoma Watershed Project flood control reservoirs and a diversion on Spring Creek operate passively to reduce flooding in the Santa Rosa Area. The Santa Rosa Creek Reservoir (Spring Lake) is located offstream while the other reservoirs (Brush, Paulin, and Matanzas reservoirs) and the Spring Creek diversion are located onstream. The onstream structures are impassable to anadromous salmonids.

Direct Effects from Maintenance Activities

Maintenance work on the flood control reservoirs includes removing sediments to restore flood control capacity or removing noxious pondweeds. Small amounts of vegetation and sediments are removed from the outlets. Sediments are also removed from inlet structures at diversion facilities. Potential effects evaluated include changes in downstream water temperatures and flow when reservoirs are drained, changes in turbidity, injury to fish, and reduction in vegetation.

Sediment removal or weed removal from flood control reservoirs does not increase turbidity or cause downstream sedimentation, because there is no flow from the work area. There is no injury to listed fish species because there are no anadromous runs of salmonids past the structures on Brush, Paulin, Matanzas or Spring creeks. Anadromous fish trapped in Spring Lake are considered lost to the anadromous population, and this effect is discussed separately. Desiltation and vegetation removal on the outfalls of the reservoirs are done when the outfalls are dry, so there are no immediate effects on fish or their habitat. The areas affected are so small there are no long-term effects on salmonid habitat.

When the large, shallow Spring Lake is drained to Santa Rosa Creek before maintenance work, effects to water quality are likely to be minimal. Because Spring Lake is a large, shallow lake, lake stratification is not likely to occur, and therefore low dissolved oxygen water is not likely to be released. Water is pumped, not released from a low-flow outlet, so there is not likely to be an increase in fine sediment input to the creek. There is a potential to increase water temperatures in the creek. It may take four to six weeks to drain the reservoir, and this activity may occur about once every twelve years. Spring Lake is drained as early as possible during the spring season while water temperatures are cooler and creek flows are higher to avoid increasing water temperatures above threshold limits for salmonids.

In general, maintenance activities on the flood control reservoirs are not likely to negatively affect salmonids. While there is likely to be an increase in Santa Rosa Creek water temperature when Spring Lake is drained, this effect is minimized because water is released as early as possible in the spring.

Direct Effects to Salmonids and Indirect Habitat Alteration Effects from Passive Operation of Flood Control Reservoirs

The flood control reservoirs and diversion facilities operate passively. Potential long-term effects evaluated include changes to salmonid habitat, including increase in downstream water temperature and a reduction of sediment and LWD transport from upstream areas. By capturing stream flow in detention storage until they fill and spill, on-stream reservoirs can alter the magnitude and timing of downstream flow. The release of predators to Santa Rosa Creek from Spring Lake was also evaluated. A direct effect of passive operation of Spring Lake is that downstream migrants may be trapped in the reservoir during high flood flows.

Attenuation of peak floods is not likely to negatively affect downstream channel geomorphology through alteration of channel maintenance flows. Only a small drainage area is captured by the Brush Creek, Piner Reservoir and Spring Creek diversion facilities, so effects are not likely to be substantial. Matanzas Creek Reservoir generally fills and spills after mid-December, so channel maintaining peak flow events are likely to pass to the natural downstream reach later in the year. Because most of Santa Rosa Creek downstream of Spring Lake has been altered for flood control, attenuation of peak flows is not likely to negatively affect the geomorphology of the creek.

There is no outflow from these reservoirs during the summer so downstream water temperatures are not altered in these streams.

During the time the onstream reservoirs (Matanzas, Brush and Piner) refill in the rainy season, downstream flows are reduced. Brush and Piner reservoirs are small and are located fairly high in the watershed, so the reduction of flow to downstream habitat is not likely to be substantial.

Sediment and LWD retention on Brush Creek, Piner Reservoir and the diversion on Spring Creek are low because these facilities are small, so effects to downstream habitat are likely to be minimal. The sediments removed from the Spring Lake diversion on Santa Rosa Creek usually contain finer rather than coarser sediments, and the diversion of some small amounts of gravel is not likely to affect the availability of spawning habitat in this reach of Santa Rosa Creek. LWD is only rarely trapped in Spring Lake, and if it is removed it is likely to be used in revetment work elsewhere. LWD has not been removed from Matanzas Creek Reservoir in the past so it appears that it is generally not recruited there.

Matanzas Creek Reservoir has a larger capacity and affects a larger drainage area than the structures on Brush, Paulin and Spring Creeks. It may have some effect on downstream flow and on retention of spawning gravel. Matanzas Creek reservoir generally begins to spill in mid-December, so flows during the early portion of the coho salmon spawning season (December through mid-February) may be affected. However, this affects only about 20% of the coho salmon spawning season, so while some fish may be affected, the overall population effect is low. Sediments entrained or removed from Matanzas Creek reservoir are not recruited to downstream areas and this may contribute to a loss of spawning gravel. However, loss of spawning gravel could be affected by other issues related to the geomorphology of the downstream channel, for example high water velocities may contribute to the lack of suitable spawning gravel. Although there may be a negative effect to spawning habitat from the loss of some spawning gravel, the overall population effect is considered to be low.

Spring Lake provides warmwater habitat and a source population of predators. Predators are established in Santa Rosa Creek and warm summer water temperatures favor predators while they can stress salmonids. When predators from Spring Lake are released during high flow events they do not introduce a new risk, but they may help to maintain the local population of predators.

The most significant effect of the flood control reservoirs is the potential to trap salmonids into Spring Lake. Anadromous salmonids face a risk of entrapment into Spring Lake during high flow events about once every 1.5 years. Storm events that result in flows high enough for diversion of water into Spring Lake generally occur in January and February. After March, flows are generally lower and the risk of entrapment is reduced. While juvenile steelhead are sometimes trapped, their migration period occurs after February, so the risk is not high. Juvenile coho salmon face a higher risk of entrapment because their migration period extends from February through mid-May. Because good quality spawning and rearing habitat occurs upstream of the diversion, it is expected that some individual steelhead and coho salmon may be trapped. However, there is not a long overlap between juvenile salmonid migration periods and the time high flow events result in water spills to Spring Lake, and water spills to Spring Lake on average only once every 1.5 years. Therefore, the risk to the populations of coho salmon and steelhead is low.

NPDES Permit Activities

SCWA has entered into an interagency agreement with the City of Santa Rosa and the County of Sonoma for coverage under an NPDES permit for storm water discharges (RWQCB 1981). The NPDES Permit includes a storm water management program (SWMP), a monitoring plan, and an assessment plan (Plans) for managing discharges from the storm drain system within the Permit boundary.

Overall, the permittees have determined that the Plans and associated activities have been effective. Chemical and biological monitoring results since 1998 indicate that there have been no consistent trends or specific water quality constituents of concern identified (City of Santa Rosa, Sonoma County Water Agency, County of Sonoma, 1998, 1999, 2000). Bioassay results indicate very low toxicity of storm water from sampled runoff events. Indirect indicators, including the number of inspection and enforcement actions, amount of educational materials distributed, and amounts of pollutants removed through maintenance, spill response, and implementation of BMPs, indicate that the SWMP has been successful to-date. NPDES Plan activities likely have a beneficial effect on listed species and their critical habitat.

Synthesis of Effects

Multiple maintenance activities are likely to overlap in time and in space. Both natural and constructed flood control channels are affected by the combination of maintenance activities. Effects of multiple maintenance activities on critical habitat conditions can become more substantial, persist over longer time periods, or extend over larger areas, than if only one type of maintenance activity is implemented. This section discusses the syntheses of multiple maintenance activities on critical habitat and populations of the ESA-listed fish species.

Russian River Flood Capacity and Bank Erosion Control Activities

SCWA conducts maintenance activities under obligation to the USACE along 22 miles of the mainstem Russian River in order to maintain hydraulic capacity and to reduce bank erosion. These activities include sediment maintenance work such as gravel bar skimming operations and vegetation maintenance work that includes removing vegetation from gravel bars. Up to a 400-foot wide section of channel is maintained free from riparian vegetation within the high-flow area of the channel.

Sediment maintenance activities by SCWA in the mainstem Russian River have been determined to have a substantial negative effect on channel geomorphic and critical habitat conditions associated with high flow refuge, development of pools (rearing habitat), and overall habitat diversity. Vegetation maintenance activities by SCWA have also been determined to substantially affect channel geomorphic and critical habitat conditions, including loss of high flow refuge, loss of cover, and potential increases in water temperature.

Vegetation maintenance activities interact with the sediment maintenance activities, compounding the effects on gravel bars and resulting critical habitat conditions. Without the stabilizing influence of vegetation on gravel bars, these bars do not function effectively to trap and store sediments. This results in changes to channel geomorphology, by reducing sinuosity and reducing hydraulic complexity. In combination, the vegetation and sediment maintenance practices probably reinforce the already substantial effects on high flow refuge and rearing habitat for steelhead and chinook salmon.

MCRRFCD also conducts sediment and vegetation maintenance activities in Mendocino County under obligation to the USACE along 36 miles of the mainstem Russian River in order to maintain hydraulic capacity and to reduce bank erosion. These activities consist of gravel bar skimming and removal of vegetation from bars which are then placed along the bank for erosion control. The changes to channel geomorphology and critical habitat conditions resulting separately from sediment and vegetation maintenance practices are similar to those described above. In combination, the vegetation and sediment maintenance practices by MCRRFCD probably reinforce the already substantial negative effect on high flow refuge and rearing habitat for steelhead and chinook salmon.

The gravel bar grading operations and vegetation maintenance activities conducted for streambank stabilization on the Russian River by both MCRRFCD and SCWA combined are likely to adversely modify critical habitat for steelhead and chinook salmon. This is a substantial adverse effect that extends over an approximate linear distance of 60 miles along the mainstem Russian River.

SCWA is obligated to perform maintenance activities to stabilize streambanks and maintain levees at multiple sites on Dry Creek and the maintstem Russian River. Most of these sites have existing structures such as anchored steel jacks that were installed when Coyote Valley Dam and Warm Springs Dam were constructed. Much of the work requires removal of vegetation, including trees. In combination, the multiple sites represent several thousand feet of channel on Dry Creek and several thousand feet on the mainstem Russian River. This maintenance work is considered to have a negative effect on critical habitat conditions, with a moderate overall effect on the population of all three ESA-listed species.

Constructed Flood Control Channel Sediment Maintenance and Vegetation Maintenance Activities

The constructed flood control channels in Zone 1A are maintenanced to ensure that they have adequate flood capacity. Some vegetation maintenance is performed on almost all of the constructed flood control channels. This vegetation maintenance can consist of removing vegetation from the lower one-third of the streambanks, removing vegetation from stream bottoms, and removal of vegetation along access roads, and fencelines. This work is not performed unless it is deemed to be necessary for flood protection. Vegetation maintenance, as it is currently practiced, does not have a substantial negative effect on the habitat in flood control channels.

In addition to the vegetation maintenance activities, sediments are removed from constructed channels for the same flood protection purposes. The sediment maintenance work is performed when the clearance between the bottom of the channel and the invert of storm-water outfalls are within one foot. Most of the sediment maintenance work occurs in the Rohnert Park-Cotati area, although there are a few other channels in the Santa Rosa area and other areas within Zone 1A that have historically required some sediment maintenance work. Sediment maintenance activities increase the width of the channel bottom and thereby reduce flow depths. This substantially alters fish passage conditions and reduces coho salmon and steelhead migration in these channels. This effect may persist for several seasons, until new sediments have deposited (usually as lateral bars) and they have become stabilized by vegetative growth.

Those channels that are subject to sediment maintenance (Table 3-3) are also generally maintenanced for vegetation. Most of the channels that require sediment maintenance function only as migration corridors, and provide little rearing habitat, except Laguna de Santa Rosa and Todd Creek. The combined effect of sediment maintenance and vegetation maintenance on flood control channels is not expected to be greater than either of the individual maintenance practices alone. Current vegetation maintenance practices on Laguna de Santa Rosa and Todd Creek are not considered to have a negative effect. Sediment maintenance activities on these two channels, as well as all of the other channels where sediment maintenance is practiced, are likely to restrict migration. In combination, the two types of maintenance practices are not considered to have any greater effect on the Laguna de Santa Rosa or Todd Creek. Once migration is affected, listed species (steelhead, chinook salmon and coho salmon) do not have access to upstream areas on these two channels. Therefore, loss of vegetation in upstream areas will have no additional effect. In areas downstream of the migration barrier created by sediment maintenance, vegetation removal (as currently practiced) has already been determined not to have a negative effect in flood control channels.

Effects on Listed Species and Critical Habitat

Channel maintenance activities performed by SCWA are likely to adversely affect the listed fish species due to:

(1) Bank stabilization maintenance activities that occasionally occur in natural channels, when there is streamflow present, including Dry Creek, mainstem Russian River, and the Mark West Creek watershed. The overall risk to populations of steelhead, coho salmon, and chinook salmon is low.

(2) Passive operation of Spring Lake Reservoir that may entrap salmonids into Spring Lake during high flows. The overall risk to populations of steelhead and coho salmon is low.

Channel maintenance activities performed by SCWA are likely to adversely modify the designated critical habitat of the listed fish species. Adverse modifications to designated critical habitat are associated with sediment maintenance, vegetation maintenance, large woody debris removal, bank stabilization activities, and passive operation of the flood control reservoirs. Adverse effects to critical habitat are due to:

(1) Sediment maintenance activities in constructed flood control channels that reduce fish passage to spawning and rearing habitat and restricts downstream migration. The overall effect to the populations of steelhead, chinook and coho is moderate.

(2) Sediment maintenance activities in the flood control channels that provide summer rearing habitat in the Laguna de Santa Rosa and Todd Creek by reducing pool habitat, cover, shading, and habitat complexity. The overall effect to the populations of steelhead, chinook salmon and coho salmon is low. In addition, any of the identified 6 flood control channels that have a potential to support rearing habitat (Crane Creek, Paulin Creek, Rinconada Creek, Oakmont Creek, Santa Rosa Creek, and Brush Creek), although they have not historically required sediment maintenance, could require sediment maintenance in the future. These channels would also be subject to negative effects on rearing habitat. The overall effect to the populations of steelhead, chinook and coho salmon would be low.

(3) Sediment maintenance in the Russian River affects species by reducing pool habitat formation and loss of high flow refuge. The overall effects to populations of steelhead, coho salmon, and chinook salmon are high.

(4) Vegetation maintenance effects on natural channels (other than the Russian River or Dry Creek), by reducing vegetation and associated loss of high-flow refuge, shade canopy, and cover. Overall effect to populations of steelhead, coho salmon, and chinook salmon is low.

(5) Vegetation maintenance on Dry Creek and the mainstem Russian River by reducing vegetation and associated loss of high-flow refuge, shade canopy, and cover. Overall effect to populations of steelhead, coho salmon, and chinook salmon is high.

(6) Potential adverse effects to critical habitat in flood control channels associated with vegetation maintenance practices, should the existing practices be modified in the future. The potential for adverse effects depends upon the extent to which vegetation is removed from flood control channels, and if the maintenance practice is performed on those channels identified as potential rearing habitat.

(7) Loss of large woody debris in constructed flood control channels and flood control reservoirs (Spring Lake and Mantanzas Reservoir), due to loss of cover and scour. The overall effect to populations of steelhead and coho salmon is low.

(8) Bank stabilization activities under USACE obligations on Dry Creek and the mainstem Russian River, primarily due to loss of riparian vegetation and associated reduction in shade canopy and cover. The overall effect to populations of steelhead, coho salmon and chinook salmon is moderate.

(9) Passive operation of Spring Lake due to release of predators. Overall risk to population of steelhead and coho salmon is low.

(10) Passive operation of Matanzas Creek due to delay or decrease of downstream flow during early part of coho salmon spawning season and rearing habitat. Also, loss of transport of spawning gravel to downstream spawning habitat. Overall risk to population of steelhead and coho salmon is low.

Channel maintenance activities performed by MCRRFCD are likely to adversely modify the designated critical habitat of the listed fish species due to:

(1) Vegetation maintenance activities on the mainstem Russian River by reduction in cover, shade canopy, and loss of high flow refuge. Overall effect to populations of steelhead and chinook salmon is high.

(2) Sediment maintenance activities on the mainstem Russian River by reducing pool habitat formation and loss of high-flow refuge. Overall effect to populations of steelhead and chinook salmon is high.

It may seem to the reader that it is contradictory to state that there is a low risk of adverse effects to protected populations, along with the statement that the proposed project is likely to adversely affect the listed species. However, the first statement is a general assessment of the risk to the larger population of the protected fish species, while the second statement reflects the possibility that one or more fish might be harmed by certain activities. These conclusions will assist NMFS with preparing a BO which may include an incidental take statement (with regard to the individual fish that may be harmed by the proposed action), as well as a determination of whether the proposed action is likely to jeopardize the continued existence of the species.

1.1 SECTION 7 CONSULTATION

The Sonoma County Water Agency (SCWA), the U.S. Army Corps of Engineers (USACE), and the Mendocino County Russian River Flood Control and Water Conservation Improvement District (MCRRFCD) are undertaking a Section 7 Consultation under the Federal Endangered Species Act (ESA) with the National Marine Fisheries Service (NMFS) to evaluate effects of operations and maintenance activities. The activities of the USACE, SCWA, and MCRRFCD span the Russian River watershed from Coyote Valley Dam and Warm Springs Dam to the estuary, as well as some tributaries. The Russian River watershed is designated as critical habitat for threatened stocks of coho salmon, chinook salmon and steelhead. The SCWA, USACE, and MCRRFCD operate and maintain facilities and conduct activities related to flood control, water diversion and storage, hydroelectric power generation, and fish production and passage. The SCWA, USACE, and MCRRFCD also are participants in a number of institutional agreements related to the fulfillment of their respective responsibilities.

Federal agencies such as the USACE are required under the ESA to consult with the Secretary of Commerce to insure that their actions are not likely to jeopardize the continued existence of listed species or adversely modify or destroy critical habitat. The USACE, SCWA, and NMFS have entered into a Memorandum of Understanding (MOU) which establishes a framework for the consultation and conference required by the ESA with respect to the activities of the USACE, SCWA and MCRRFCD that may directly or indirectly affect coho salmon, chinook salmon and steelhead in the Russian River. The MOU acknowledges the involvement of other agencies including: the California Department of Fish and Game (CDFG), the U.S. Fish and Wildlife Service (USFWS), the State Water Resources Control Board (SWRCB), the North Coast Regional Water Quality Control Board (RWQCB), the State Coastal Conservancy, and the Mendocino County Inland Water and Power Commission (MCIWPC).

1.2 SCOPE OF THE BIOLOGICAL ASSESSMENT

As part of the Section 7 Consultation, the USACE and SCWA will submit to NMFS a biological assessment (BA) that provides a description of the actions subject to consultation, including the facilities, operations, maintenance and existing conservation actions. The BA will describe existing conditions including information on hydrology, water quality, habitat conditions, and fish populations. The BA will provide the basis for NMFS to prepare a biological opinion (BO) that will evaluate the project, including conservation actions.

This document presents an analysis of the potential for adverse impacts to the Russian River populations of coho salmon, steelhead, and chinook salmon as a result of certain activities. Because the ESA prohibits take of any individuals, the document will come to a conclusion of “likely to adversely affect” if any individual fish could be harmed by the proposed action, even if the overall risk of adverse impact to the overall population is low. Such a conclusion would mean that one or more listed fish might be harmed by the proposed action. Once a BA containing this determination is submitted to NMFS, formal consultation under the ESA will be initiated. During the formal consultation process, NMFS will make an assessment of whether the proposed action is likely to jeopardize the continued existence of the species. NMFS will present this conclusion in the form of a BO.

The BA will integrate a number of Interim Reports:

Report 1	Flood Control Operations
Report 2	Fish Facility Operations
Report 3	Instream Flow Requirements
Report 4	Water Supply and Diversion Facilities
Report 5	Channel Maintenance
Report 6	Restoration and Conservation Actions
Report 7	Hydroelectric Projects Operations
Report 8	Estuary Management Plan

This interim report evaluates the effects of channel maintenance on listed species and critical habitat in the Russian River Watershed. The activities evaluated include:

1) Russian River
   a) Channel maintenance related to the construction and operation of Coyote Valley Dam.
   b) Channel maintenance related to Public Law 84-99 sites (non-federal sites).
   c) Channel maintenance related to USACE identified and constructed flood and erosion control sites (federal sites).
2) Dry Creek channel maintenance related to the construction and operation of Warm Springs Dam (federal and non-federal sites).
3) Channel maintenance within the Central Sonoma Watershed Project and Mark West Creek Watershed.
4) NPDES storm water discharge permit activities.

1.3 STATUS OF COHO SALMON, STEELHEAD, AND CHINOOK SALMON IN THE RUSSIAN RIVER

The primary biological resources of concern within the project area are coho salmon, steelhead and chinook salmon. These species are each listed as threatened under the ESA. The pertinent Federal Register notices for these species are provided in Table 1-1. Coho salmon and steelhead are native Russian River species, although there have been many plantings from other river systems (CDFG 1991). It is uncertain whether chinook salmon used the Russian River historically (NMFS 1999). They have been stocked in the past, were not stocked in the last two years, but continue to reproduce in the watershed. The Central California Coast Coho Salmon Evolutionarily Significant Unit (ESU), which contains the Russian River, extends from Punta Gorda in northern California south to and including the San Lorenzo River in central California, and includes tributaries to San Francisco Bay, excluding the Sacramento-San Joaquin River system. The Russian River is the largest drainage included in the Central California Coast Steelhead ESU, which extends from the Russian River down the coast to Soquel Creek near Santa Cruz, California. The chinook salmon listing defined the population unit that contains the

Russian River as the California Coastal ESU. This ESU encompasses the region from Redwood Creek in Humboldt County to the Russian River (Sonoma County).

Critical habitat for each of these species within the Russian River is designated as the current estuarine and freshwater range of the species including "all waterways, substrate, and adjacent riparian zones.…" For each species, NMFS has specifically excluded areas above Warm Springs and Coyote Valley dams and within tribal lands.

Table 1-1 Federal Register Notices for the Salmonids of the Russian River

Species	**Listing**	**Take Prohibitions**	**Critical Habitat**
Coho Salmon	Vol. 61, No. 212, Pgs. 56138-56147 Oct. 31, 1996	Vol. 61, No. 212, Pgs. 56138-56147 Oct. 31, 1996	Vol. 64, No. 86, Pgs. 24049-24062 May 5, 1999
Steelhead	Vol. 62, No. 159, Pgs. 43937-43954 Aug. 18, 1997	Vol. 65, No. 132, Pgs. 42422-42481 July 10, 2000	Vol. 65, No. 32, Pgs. 7764-7787 February 16, 2000
Chinook Salmon	Vol. 64, No. 179, Pgs. 50394-50415 Sept. 16, 1999	Not yet issued	Vol. 65, No. 32, Pgs. 7764-7787 February 16, 2000

Life history descriptions for these species are provided in sections 1.3.1 through 1.3.3 so that effects from project operations can be evaluated. All three species are anadromous, but steelhead may also exhibit a life history type that spends its entire life cycle in freshwater. These species migrate upstream from the ocean as adults and spawn in gravel substrate. Their eggs incubate for a short period, depending on water temperature, and generally hatch in the winter and spring. Juveniles spend varying amounts of time rearing in the streams and then migrate out to the ocean, completing the cycle. Details on life history, timing and habitat requirements are provided for each species.

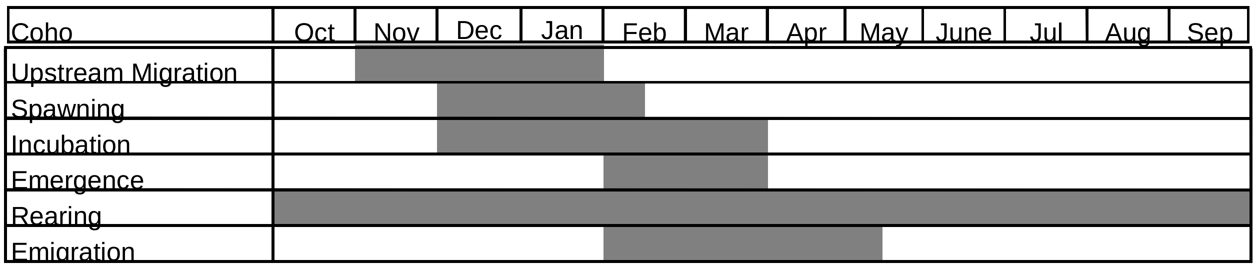
1.3.1 Coho Salmon

Coho salmon are much less abundant than steelhead in the Russian River basin. Spawning occurs in approximately 20 tributaries of the lower Russian River, including Dry Creek. In wet years, coho salmon have been seen as far upstream as Ukiah. The Don Clausen Fish Hatchery produced and released an average of about 70,000 age 1+ coho salmon each year (1980-1998). However, no coho have been produced in the last two years.

1.3.1.1 Life History

The coho salmon life history is quite rigid, with a relatively fixed three-year life cycle. The best available information suggests that life history stages occur during times outlined in Figure 1-1 (EIP Assoc. 1993, SCWA 1996, SWRCB 1997, RMI 1997, S. White, SCWA, pers. comm. 1999). Most coho enter the Russian River in November and December and spawn in December and January. Spawning and rearing occur in tributaries to the lower Russian River. The most upstream tributaries with coho salmon populations include Forsythe, Mariposa, Rocky, Fisher, and Corral creeks. The mainstem below Cloverdale serves primarily as a passage corridor between the ocean and the tributary habitat.

After hatching, young coho will spend about one year in freshwater before becoming smolts and migrating to the ocean. Freshwater habitat requirements for coho rearing include adequate cover, food supply, and water temperatures. Primary habitat for coho includes pools with extensive cover. Outmigration takes place in late winter and spring. Coho salmon live in the ocean for about a year and a half, return as three-year-olds to spawn, and then die. The factors most limiting to juvenile coho production are high summer water temperatures, poor summer and winter habitat quality, and predation.



(EIP Assoc. 1993, SCWA 1996, SWRCB 1997, RMI 1997, S. White, SCWA, pers. comm. 1999).

Figure 1-1 Phenology of Coho Salmon in the Russian River Basin

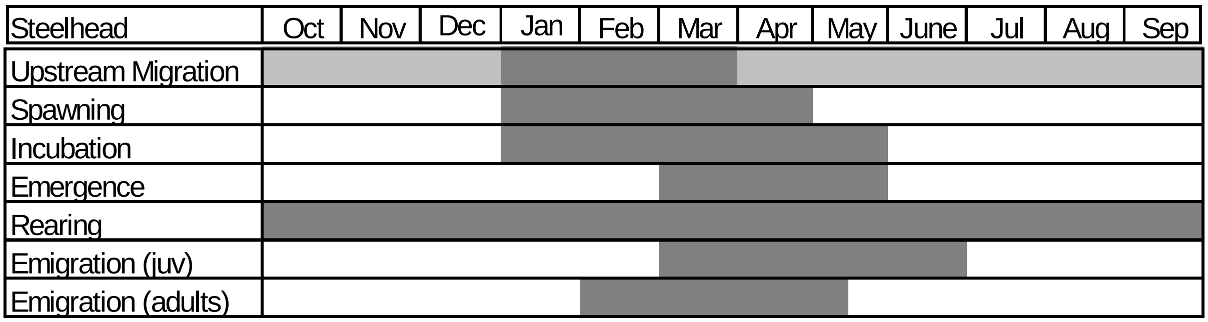
1.3.2 STEELHEAD

There have been no recent efforts to quantify steelhead populations in the Russian River, but there is general agreement that the population has declined in the last 30 years (CDFG 1984, 1991). SCWA, CDFG and NMFS are currently developing programs to monitor trends in salmonid populations within the designated critical habitat boundaries for the basin. There has been substantial planting of hatchery reared steelhead within the basin, which may have affected the genetic constitution of the remaining natural population. Almost all steelhead planted prior to 1980 were from out-of-basin stocks (Steiner 1996). Since 1982, stocking of hatchery reared steelhead has been limited to progeny of fish returning to the Don Clausen Fish Hatchery and the Coyote Valley Fish Facility.

Steelhead occupy all of the major tributaries and most of the smaller ones in the Russian River Watershed. Many of the minor tributaries may provide spawning or rearing habitat under specific hydrologic conditions. Steelhead use the lower and middle mainstem Russian River primarily for migration to and from spawning and nursery areas in the tributaries and the mainstem above Cloverdale. The majority of spawning and rearing habitat for steelhead occurs in the tributaries. However, it is possible that juvenile rearing may occur in the mainstem before smolt outmigration.

1.3.2.1 Life History

Adult steelhead generally begin returning to the Russian River in November or December, with the first heavy rains of the season, and continue to migrate upstream into March or April. Adults have been observed in the Russian River during all months (S. White, SCWA pers. comm. 1999). However, the peak migration period tends to be January through March (Figure 1-2). Flow conditions are suitable for upstream migration in most of the Russian River and larger tributaries during the majority of the spawning period in most years. Sandbars blocking the river mouth in some years may delay entry into the river. However, during the times the sand barrier is closed, the flow is probably too low and water temperature is too high to provide suitable conditions for migrating adults further up the river (CDFG 1991).



Note: Peak upstream migration occurs January through March, but adults have been observed in all months. (EIP Assoc. 1993, SCWA 1996, SWRCB 1997, RMI 1997, S. White, SCWA, pers. comm. 1999).

Figure 1-2 Phenology of Steelhead in the Russian River Basin

Most spawning takes place from January through April, depending on the time of freshwater entry (Figure 1-2). Steelhead spawn and rear in tributaries from Jenner Creek near the mouth, to upper basin streams including Forsythe, Mariposa, Rocky, Fisher and Corral creeks. Steelhead usually spawn in the tributaries, where fish ascend as high as flows allow (USACE 1982). Gravel and streamflow conditions suitable for spawning are prevalent in the Russian River mainstem and tributaries (Winzler and Kelly Consulting Engineers 1978), although gravel mining and sedimentation have diminished gravel quality and quantity in many areas of the mainstem. In the lower and middle mainstem (below Cloverdale) and the lower reaches of tributaries, water temperatures exceed 55°F by April in some years (Winzler and Kelly Consulting Engineers 1978), which may limit the survival of eggs and fry in these areas.

After hatching, steelhead spend from one to four years in freshwater. Fry and juvenile steelhead are extremely adaptable in their habitat selection. Requirements for steelhead rearing include adequate cover, food supply, and water temperatures. The mainstem above Cloverdale and upper reaches of the tributaries provide the most suitable habitat, as these areas generally have excellent cover, adequate food supply, and suitable water temperatures for fry and juvenile rearing. The lower sections of the tributaries provide less cover, as the streams are often wide and shallow and have little riparian vegetation, and water temperatures are often too warm to support steelhead. In the summer, these areas can dry up completely. Available cover has been reduced in much of the mainstem and many tributaries because of loss of riparian vegetation and changes in stream morphology.

Emigration usually occurs between February and June, depending on flow and water temperatures (Figure 1-2). Sufficient flow is required to cue smolt downstream migration. Excessively high water temperatures in late spring may inhibit smoltification in late migrants.

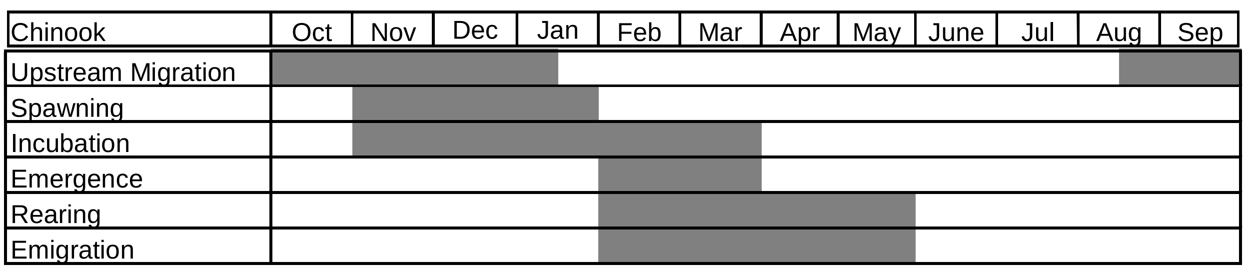
1.3.3 CHINOOK SALMON

The historic extent of naturally occurring chinook salmon in the Russian River is debated (NMFS 1999). Whether or not chinook were present historically, the total run of chinook salmon today, hatchery and natural combined, is small. Historic spawning distribution is unknown, but suitable habitat formerly existed in the upper mainstem and in low gradient tributaries. Chinook currently spawn in the mainstem and larger tributaries, including Dry Creek. Chinook tissue samples were collected this year by the SCWA, CDFG and NMFS from the mainstem, Forsythe, Feliz and Dry creeks, and there were anecdotal reports of chinook in the Big Sulphur system.

1.3.3.1 Life History

Adult chinook salmon begin returning to the Russian River as early as August, with most spawning occurring after Thanksgiving. Chinook may continue to enter the river and spawn into January (Figure 1-3) (S. White, SCWA, pers. comm., 1999).

Unlike steelhead and coho, the young chinook begin their outmigration soon after emerging from the gravel. Freshwater residence, including outmigration, usually ranges from two to four months, but occasionally chinook juveniles will spend one year in fresh water. Chinook move downstream from February through May (Figure 1-3). Ocean residence can be from one to seven years, but most chinook return to the Russian River as two to four-year-old adults. Like coho salmon, chinook die soon after spawning.



(EIP Assoc. 1993, SCWA 1996, SWRCB 1997, RMI 1997, S. White, SCWA, pers. comm. 1999).

Figure 1-3 Phenology of Chinook Salmon in the Russian River Basin

1.4 PROJECT DESCRIPTION

The Sonoma County Water Agency (SCWA) conducts channel maintenance activities in the Russian River and its tributaries for the purposes of flood and erosion control. SCWA's scope of responsibilities include activities related to U.S. Army Corps of Engineers (USACE) dams on the East Fork Russian River (Coyote Valley Dam (CVD)) and Dry Creek (Warm Springs Dam (WSD)), the Mark West Creek Watershed, and the Central Sonoma Watershed Project. The activities implemented by SCWA for flood control purposes include sediment maintenance, channel debris clearing, vegetation maintenance, and bank stabilization. The locations of the channel maintenance areas on the Russian River are shown in Figure 1-4. The Zone 1A flood control zone is also shown in Figure 1-4. The following discussion provides background information on these activities and a description of their components.

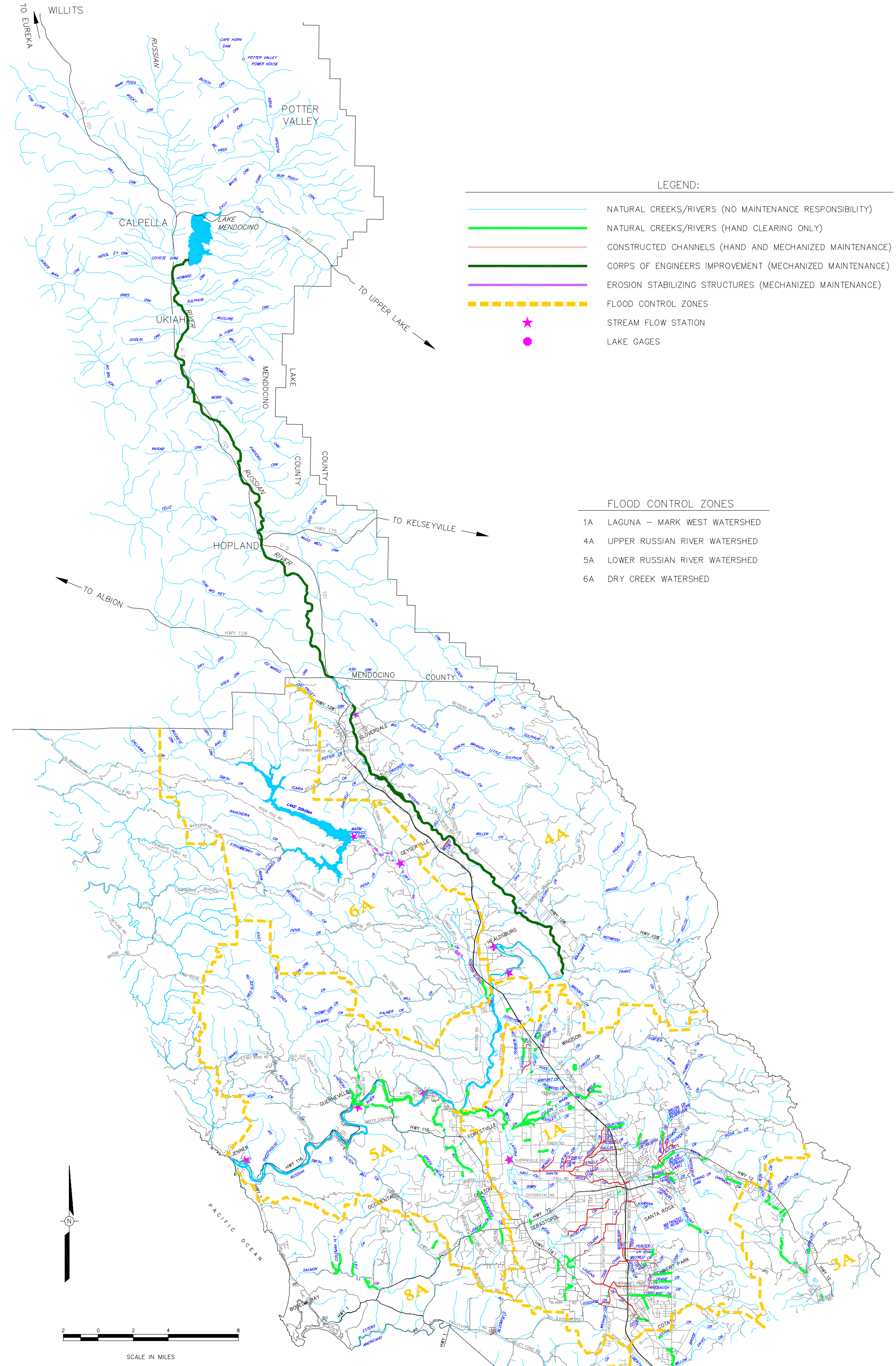


Figure 1–4

Channel Maintenance Areas In The Russian River Watershed

1.4.1 BACKGROUND

1.4.1.1 Coyote Valley Dam

SCWA and Mendocino County Russian River Flood Control and Water Conservation Improvement District (MCRRFCD) were designated as the local agencies responsible for channel maintenance below CVD following completion of the dam. The USACE provided SCWA and the MCRRFCD with the Water Control Manual for Coyote Valley Dam (USACE 1986) which includes procedures for operating and maintaining the flood control improvements on the Russian River channels.

In addition to channel improvements installed as part of the project for Coyote Valley Dam, SCWA and MCRRFCD have responsibility for maintaining certain channel improvement sites that were constructed between 1956 and 1963. The Russian River has been subjected to substantial meandering and erosion problems near these sites since they were constructed. The sites are located at various places in Sonoma and Mendocino Counties extending from river mile 98 near Calpella to river mile 21 near Mirabel Park. The "river mile" designation refers to the distance from the mouth of the river at the estuary upstream to the site referenced. Operation and maintenance of these sites became the responsibility of local agencies after construction. Manuals provided by the USACE (USACE 1965a and USACE 1965b) have provided guidelines for inspecting and maintaining the installed improvements on a yearly basis or as needed before, during, and after flood events.

1.4.1.2 Warm Springs Dam

Channel improvements along Dry Creek were built by USACE between 1981 and 1982 as part of the Warm Springs Dam and Lake Sonoma Project. The improvements included five rock-type grade-control structures and approximately 2,500 feet of rip-rap bank protection and flow-deflection fences, and were intended to provide bank and riverbed stabilization at sites where erosion previously occurred or where studies indicated that future erosion would be likely to occur due to the construction and operation of Warm Springs Dam. Operation and maintenance responsibility for the channel stabilization project lies with SCWA. The USACE provided an "Operation & Maintenance Manual" for the Warm Springs Dam and Lake Sonoma Project (USACE 1991) to SCWA that provides information, instruction, and guidance to the personnel responsible for proper operation, inspection, and maintenance of channel improvements and bank stabilization measures along Dry Creek below Warm Springs Dam to the confluence of the Russian River.

1.4.1.3 Central Sonoma Watershed Project

The Central Sonoma Watershed Project includes four flood control reservoirs that were built in the late 1960s to reduce flooding in the Santa Rosa area. These four flood control reservoirs are located on Santa Rosa Creek, Brush Creek, Paulin Creek, and Matanzas Creek. The Santa Rosa Creek Reservoir (Spring Lake) is located offstream and allows relatively large flows to pass downstream unimpeded. A diversion structure on Spring Creek also diverts water to Spring Lake. The other reservoirs and the diversion on Spring Creek are onstream and are equipped with facilities that allow minimum streamflows to be bypassed around them. These reservoirs are not equipped with flood control gates and their reservoirs operate passively.

Although facilities are not provided for anadromous fish passage above the onstream flood control reservoirs or the diversion on Spring Creek, a fish ladder and vortex weir are located on Santa Rosa Creek to assist anadromous fish passage.

1.4.1.4 National Pollutant Discharge Elimination System (NPDES) Permit

Because of SCWA's jurisdiction over flood control channels within the Santa Rosa area, SCWA has entered into an interagency agreement with the City of Santa Rosa and the County of Sonoma for coverage under a National Pollutant Discharge Elimination System (NPDES) permit for storm water discharges. SCWA, the City of Santa Rosa, and the County of Sonoma own and operate storm water conveyance systems which discharge storm water into tributaries of the Laguna de Santa Rosa, which is a tributary in the Russian River watershed. SCWA's flood control activities on Russian River tributaries in the Santa Rosa area affect and are affected by the NPDES permit and the interagency agreement with the City of Santa Rosa and the County of Sonoma.

1.4.2 Channels Maintained in the Russian River Watershed

As described above, SCWA and the Mendocino County Water District are responsible for maintaining channel improvement sites along the main stem Russian River that were implemented in association with the installment of Warm Springs or Coyote Valley Dam. SCWA is also responsible for maintaining certain levees along the upper Russian River under a program administered by the USACE. The channel improvement areas and levees are inspected periodically by SCWA and USACE, followed by recommendations from USACE as to maintenance work that may be needed. In general, SCWA has been required to keep the project levees free from vegetation, remove instream gravel bars that may be impeding flow, and inspect and maintain the channel improvement sites. If small repairs are needed to the levees, they have typically been performed by SCWA. If major repairs are needed, the property owner and USACE are notified of the need for the repair. Typical maintenance recommendations for the channel improvement sites have included removing loose anchor jacks from the river, adding bank erosion protection at sites found to be eroding, managing vegetation to reduce blockage of the river channel and increase access for maintenance and inspection of the banks, repairing or replacing loose grout or rip-rap, and removing driftwood. In recent years, SCWA has performed only limited maintenance activities in these areas (e.g., removing loose anchor jacks) due to concerns about potential effects to ESA-listed fish species.

In addition to maintenance obligations on the Russian River main stem, SCWA conducts channel maintenance activities on over 300 miles of creeks within the Sonoma County portion of the Russian River watershed. The creeks maintained include both natural waterways and constructed flood control channels (see Tables 1-2 and 1-3). Natural waterways are waterways that have not been modified for flood control purposes by SCWA or USACE. SCWA holds permissive channel-clearing easements on many natural waterways in the Russian River watershed.

Table 1-2 Natural Waterways (Portions Thereof) Maintained by SCWA (in the Russian River Watershed)

Atascadero Creek	Fife Creek	Laguna de Santa Rosa	Roseland Creek
Barlow Creek	Forestville Creek	Libreau Creek	Santa Rosa Creek
Blucher Creek	Foss Creek	Lower Russian River	Sheephouse Creek
Burton Ditch	Fountain Grove Creek	Mark West Creek	Spring Creek
Calder Creek	Fulton Creek	Matanzas Creek	Starr Creek
Coleman Creek	Green Valley Creek	Norton Slough	Steele Creek
Colgan Creek	Hartman Creek	Olivet Creek	Wikiup Creek
Copeland Creek	Hessel Creek	Paulin Creek	Wilfred Creek (N Fork)
Crane Creek	Hood Mountain Creek	Piner Creek	Willow Creek
Dry Creek	Hulburt Creek	Pocket Canyon Creek	Windsor Creek
Dutch Bill Creek	Jonive Creek	Rieman Creek	Woolsey Creek

Table 1-3 Constructed Flood Control Channels (Portions Thereof) Maintained by SCWA (in the Russian River Watershed)

Airport Creek	Gird Creek	Paulin Creek	Steele Creek
Austin Creek	Gossage Creek	Peterson Creek	Todd Creek
Brush Creek	Hinebaugh Creek	Piner Creek	Washoe Creek
Colgan Creek	Hunter Lane Channel	Redwood Creek	Wendell Creek
College Creek	Indian Creek	Roseland Creek	Wilfred Creek
Cook Creek Sediment Basin	Kawana Creek	Russell Creek	Windsor Creek
Copeland Creek	Laguna de Santa Rosa	Santa Rosa Creek	Woods Creek
Faught Creek	Lornadell Creek	Sierra Creek	
Five Creek	Norton Slough	Spivok Creek	
Forestview Creek	Oakmont Creek	Starr Creek	

Constructed flood control channels are widened and straightened waterways which have been significantly altered and improved based on flood control criteria. The purpose of the improvements is to increase hydraulic capacity. SCWA either owns in fee the rights-of-way for constructed flood control channels, or holds a drainage easement on them. These channels generally include service roads to facilitate maintenance access.

In the future, SCWA will also be performing channel maintenance activities on channels in the Russian River watershed which have undergone restoration activities. For example, SCWA has entered into an agreement with the City of Santa Rosa regarding maintenance of portions of Santa Rosa Creek once the City of Santa Rosa's Prince Memorial Greenway project is complete. Thus, SCWA will be performing channel maintenance activities, such as those described below for natural channels, constructed flood control channels, and for certain flood control channels which have been modified to provide increased habitat value for fish and wildlife species.

1.4.3 TYPES OF CHANNEL MAINTENANCE ACTIVITIES

The channel maintenance activities employed by SCWA consist of sediment removal, channel clearing, vegetation maintenance, and bank stabilization. An overview of past practices in these categories, as well as the proposed future actions, is provided in the sections below. Channel maintenance is now conducted as a cooperative effort between SCWA operation and maintenance staff and biologists on staff, to achieve both flood control and aquatic and riparian habitat objectives. For all of the activities described below, SCWA complies with the best management practices described in the San Francisco Bay Area Stormwater Management Agencies Association's *Flood Control Facility Maintenance Best Management Practices- A Manual for Minimizing Environmental Impacts from Stream and Channel Maintenance Activities*. Copies of this document are available for review at the SCWA offices in Santa Rosa.

1.4.3.1 Sediment Maintenance and Channel Debris Clearing

Sediment buildup in flood control channels can reduce the capacity of the channels and reduce the level of flood protection. Sediment buildup tends to be more frequent in areas of change in gradient and/or flow velocity, including tributaries of the Laguna de Santa Rosa. Sediment removal used to be performed on an annual basis; however, it is now conducted in areas that have been identified as problems. Sediment removal is currently performed on an as-needed basis in the constructed flood control channels. Occasionally, sediment and debris removal is conducted on natural channels in response to an event such as a large storm. In recent years, this has included Austin Creek and Big Sulphur Creek. Some of the constructed flood control channels require annual removal of sediment, while others are maintained approximately every two to five years. Recent sediment removal activities on flood control channels have included Copeland Creek, Colgan Creek, Russell Creek, Todd Creek, Indian Creek, and Hinebaugh Creek. Depending on the condition of the channels, the frequency of sediment removal on the constructed flood control channels could increase in future years, if such activities are needed to maintain flood protection.

Sediment removal is conducted as needed in the flood control reservoirs maintained by SCWA (*i.e.*, Santa Rosa Creek, Brush Creek, Paulin Creek, Matanzas Creek, and Spring Creek diversion facility). Sediment excavation is performed either when the reservoir is dry, or when there is no flow out from the reservoir. The frequency of this maintenance varies depending on the reservoir and the level of sediment that has accumulated, but could be from approximately every 3 years to every 10 years. Vegetation removal at the outfall of the reservoirs could occur annually, if needed.

Sediment removal is conducted with excavators with extended arms, and in some areas, with bulldozers. Excavating equipment with a reach ranging from 21 to 41 feet is used, depending on the channel being cleared. The equipment is driven along the access road and sediment removal is carried out perpendicular to the channel length. Because of the increasing number of trees on the channels, bulldozers are used in the channel to stockpile sediment in areas that do not contain trees. These stockpiles are then removed by an excavator. Sediment removal is performed in the summer; however, if water is still flowing in the channel, a barrier is constructed downstream. This barrier consists of washed pea gravel which is brought in trucks, dumped and placed across the channel with the excavator or other equipment. The barrier slows the flow of water, which allows suspended sediment to settle out where it can then be removed. In dry channels, a front-end loader is used to remove sediment and debris from channels which are shallow enough that the loader can load a ten-yard dump truck from the channel bottom. The front-end loader is driven along the channel bottom after being driven in on an existing ramp or over shallow sides. The loader is not driven on the channel banks. Sediment is sometimes cleared from only a portion of the channel (typically in the center part of the channel), with the remaining sediment build-up being carried downstream by high winter flows. Sediment and debris are dumped directly into ten-yard dump trucks or twenty-yard semi-trucks on the service road, and hauled off-site to a disposal area. Sediment removed from the flood control reservoirs is also trucked to an off-site disposal area.

Prior to implementation of sediment removal activities, the sites scheduled for sediment removal are evaluated by SCWA staff biologists to make any needed recommendations for protecting aquatic and riparian species and habitat. If the potential for salmonid species to occur in the area were identified, sediment removal operations would be modified to include a fish rescue by staff biologists. Fish rescue activities have not been needed in the past because of the poor-quality habitat that exists in the channels that typically accumulate sediment.

Grade control structures and fish ladders under SCWA's jurisdiction are inspected annually, and cleared of debris, as necessary, to protect the structures. Hand labor is used to clear debris from structures.

Large debris is removed from channels on an as-needed basis, as determined through the cooperative efforts of SCWA operations and maintenance personnel and fisheries biologists. Removal of large woody debris or other structures providing fish habitat is only performed if the debris is causing a significant erosion problem or flow blockage. Such actions are implemented in coordination with NMFS and CDFG staff. Large anchored jacks that have come loose from their original placements and are found in the river channel are also removed on an as-needed basis.

MCRRFCD performs streambank maintenance consisting of obstacle removal, streambank repair, and preventative maintenance. Since the majority of bank erosion is caused by the river being directed into the river bank by obstacles within the river banks, most of the maintenance work is directed toward the removal of these obstacles. This work is primarily performed by using an excavator with an extended arm and thumb as well as a small bulldozer.

In Mendocino County, the summer flow, or low water channel, is approximately 25% of the width of the winter flow, or high water channel. The summer flow channel typically meanders from one side of the high-water channel to the other. In this configuration, willows have a tendency to take root on the inside of the low-flow channel during the summer and collect gravel during the ensuing winter. This process forms a bar running parallel with the flow of the river. If left unchecked, this process continues until a willow-reinforced bar has developed to a size that is sufficient to divert the river into the high-water streambank, causing extensive bank erosion and river siltation. In order to prevent this from occurring, MCRRFCD maintains the channel by removing the willows from bars that develop as obstacles to the high-water flows. If a river bank failure occurs, often there is an adjacent island bar that can be pushed into the eroded area to re-establish the high-water river bank. Willows that are removed from bars are pushed against the bank where they may take root. This maintenance work is normally done at the end of the summer during low-flow conditions.

MCRRFCD has attempted to work on 1/3 of the river channel each year, thereby being able to control the willow growth before a substantial bar can develop within the calm waters being created by the willows. MCRRFCD has stated that if left unchecked, the bars can, and have, developed into 10-feet high, 1000-feet long, willow-infested obstacles that obstruct and divert the winter high-flowing river.

Major channel work has been performed by MCRRFCD in the past. Thousands of yards of gravel have been pushed up against the banks in an effort to provide bank stabilization and eliminate channel splits. Currently, the California Department of Fish and Game recommends actual removal of the gravel; however, MCRRFCD does not find removal of the gravel to be feasible, and a preferred course of action has not been identified.

1.4.3.2 Vegetation Maintenance

Vegetation maintenance in stream banks and channels is conducted by SCWA to maintain flood control capacity of the streams. To meet the objectives of flood control and protecting aquatic and riparian habitat, SCWA is in the process of further refining its procedures for vegetation maintenance on natural and constructed flood control channels. These practices, which differ somewhat in the natural channels and constructed flood control channels, are described below. SCWA has hydraulic maintenance easements that are permissive and allow SCWA to access various natural creeks to remove debris or vegetation to restore hydraulic capacity. SCWA's vegetation maintenance activities are described in additional detail below.

Vegetation maintenance in Mendocino County is also provided by MCRRFCD. Vegetation growing on gravel bars in the middle of the channel are removed and pushed up against the streambanks, where they have taken root and provided erosion control as well as riparian enhancement. This work is performed with as little invasion into the stream channel as possible.

Natural Channels

Regular maintenance on natural channels was historically performed with the objective of maximizing the hydraulic capacity without enlarging the channels. In the 1980s, SCWA staff would use heavy equipment and hand crews with chainsaws to clear vegetation from the bottom of natural channels. The use of heavy equipment ended in 1987, with clearing continuing to be performed by four-man crews using hand labor.

One of the goals of SCWA's riparian enhancement projects is to create a shade canopy over the stream channels which reduces plant growth on the channel bottom, and in turn will help maintain hydraulic capacity. In accordance with this goal, native trees growing along stream banks have been allowed to establish, which is a significant change from past practices. Some vegetation growing as understory along the channel banks and in the main channel that could substantially reduce hydraulic capacity is removed by hand clearing. This practice is implemented with the participation of SCWA staff, including both operations and maintenance personnel and staff biologists. SCWA staff may occasionally need to use herbicides (approved for aquatic use) and/or hand labor to remove invasive exotic species. Native vegetation is generally not removed unless it is found to be presenting a significant flood risk.

SCWA staff have observed, through various riparian enhancement projects, the effectiveness of planting native trees along the streambank in a fairly straight line parallel to the stream. These plantings have increased the riparian habitat value of the stream without negatively affecting the hydraulic capacity of the stream or substantially increasing the roughness factor of the stream. This procedure for riparian enhancement plantings will continue to be implemented as part of SCWA's fisheries and riparian restoration projects in the Russian River watershed.

Constructed Flood Control Channels

SCWA maintains approximately 150 miles of constructed flood control channels. For the purposes of maintaining constructed flood control channels, SCWA has divided the maintenance activities into six "zones": access roads, fence lines, upper channel bank, middle channel bank, lower channel bank, and the channel bottom.

The access roads for the constructed flood control channels were historically kept clear of vegetation through the use of residual herbicides, which are effective for an extended period of time. This practice was replaced in the early 1990s with the use of aquatic contact herbicides, which are effective only at the time of application (early spring), and mowing.

The portion of the channel between the access roadways and the fence lines that border the channels is mowed annually for fire control purposes. In areas that do not contain access roads, an area of width 1.5 times the average height of the fuel source is mowed adjacent to the fence lines. Mowing in this area is performed in a manner that avoids native trees.

The upper channel bank zone consists of the upper third of the channel bank. Historically, the upper channel bank was mowed to remove all grasses, bushes, and small trees. Since 1996, the upper bank areas have not been mowed, sprayed, or cleared.

The middle channel bank zone consists of the middle third of the channel bank. Maintenance practices in this part of the channel have typically been limited to debris removal, as necessary.

The lower channel bank zone consists of the lower third of the channel bank, including the toe of the channel. Historically, vegetation removal in the lower channel was conducted on an annual basis. Current and future channel maintenance practices in the lower channel zone will consist of the removal of understory vegetation as necessary, and allowing native trees that are establishing along the bank to remain, thus increasing the shade canopy of the channel. Understory vegetation removal will be accomplished by hand clearing. Removal of plants will be selective based on the species present, with an emphasis on protecting native riparian species wherever possible. Since vegetation removal practices were modified in the last few years, significant tree growth has occurred on Brush Creek, Santa Rosa Creek, and Hinebaugh Creek.

SCWA also has vegetation maintenance responsibilities on a section of Santa Rosa Creek for the Prince Memorial Greenway restoration project and for a restoration project on the lower reaches of Brush Creek. In general these responsibilities include maintaining vegetation that has been planted along the streambanks for each of these projects (on Brush Creek vegetation is not cut on the lower one-third of the streambank), so that there is no loss of the riparian canopy. SCWA is also responsible for maintaining the hydraulic capacity of these restored flood control channels.

The channel bottom of constructed flood control channels is cleared of vegetation through the use of aquatic contact herbicides and hand clearing. Future selected vegetation clearing from the channel banks may be necessary to allow access to the channel bottoms for silt removal operations.

1.4.4 Bank Stabilization

Bank stabilization activities by SCWA and the MCRRFCD on the Russian River and its tributaries are limited to maintenance of past channel improvement projects, several of which were implemented by the USACE on the Russian River, and for which SCWA and the MCRRFCD are the local sponsoring agencies responsible for maintenance. These activities are primarily located on the upper Russian River and Dry Creek. Examples of facilities previously installed and now maintained, as necessary, include anchored steel jacks in single and multiple rows, flexible fence training structures, wire mesh and gravel revetments (*i.e.*, retaining wall), and pervious erosion check dams. Anchored steel jacks, used in bank protection, are used to prevent stream banks from undercutting. The jacks are 4 inches by 4 inches by ¼-inch angle iron with 16-foot legs, cabled together and anchored to the stream bank on the ends. Pervious erosion check dams consist of gravel and wire mesh, and are used to control sheet erosion on stream banks. Many of the channel improvements described above were implemented to prevent erosion and provide bank stabilization. Many have been covered with soil, brush, and trees, and continue to provide the protection they were designed for with little or no maintenance needed. Typically, annual inspections are conducted and written reports are provided to USACE. If the need for repairs is identified, those repairs are implemented and described in the annual reports to USACE.

The MCRRFCD assists ranchers with bank stabilization on the upper Russian River. When necessary, they have been the lead agency on public-law funding when major bank failures have occurred. MCRRFCD also encourages ranchers to stabilize their banks by planting native habitat along the banks to reduce erosion.

Through the Fisheries Enhancement Project, SCWA has worked with local landowners to implement bioengineering projects to assist with bank erosion problems. This change in bank stabilization procedures has assisted both landowners in protecting the streambank and has improved riparian and fisheries habitat along the Russian River and its tributaries. Examples of these projects are provided in *Interim Draft Report 6: Restoration and Conservation Actions*.

Occasionally, bank stabilization and sediment removal is necessary on natural channels in response to bank erosion after unusually large storm events. In recent years, this type of work was performed on Austin Creek and Big Sulphur Creek.

The Big Sulphur Creek work serves as an example. In September of 1995, SCWA was the local sponsor for a project to remove sediment from the channel, which had aggraded approximately 8-10 feet due to landslides the previous winter. In October of 1997, another sediment removal project was necessary following the large storm events in January 1997. In both cases, the channel aggradation posed a significant flood risk to the surrounding area; thus, the activity was treated as an emergency repair action.

Potential activities include bank stabilization, levee repair, vegetation or sediment removal, or channel realignment. These activities are initiated only by a request from a private landowner after a washout threatens property or structures. Based on past history, such activities occur about once every five to ten years. Typical project lengths under these circumstances are approximately 500 feet, but could be up to 1,000 feet. SCWA will not implement bank stabilization or sediment removal activities in natural channels if more than 1,000 feet of channel are to be affected by any single project. If a project affects more than 1,000 feet of channel or would be within 1,000 feet of a previously armored sited, a separate section 7 consultation would be initiated for that action. The intent is to avoid large segments of continuous hard-armoring within a given channel segment from cumulatively developing during a single project or over the course of several years.

Potential direct and indirect effects of a project to salmonid habitat are considered during project planning and efforts are made to reduce adverse effects to listed species. Construction occurs during the summer to avoid spawning and egg incubation periods. Before any activity is implemented, the site is assessed with a qualified fisheries biologist, feasible alternatives are considered, and plans are developed in consultation with CDFG. The planning phase includes an assessment of habitat and biological resources in the area, and consideration of those factors that may have contributed to the washout or sediment deposition.

Bio-engineering bank stabilization measures are given priority on smaller channels (less than 50 feet wide), when it is deemed to be a feasible and effective treatment. On larger channels, use of bioengineering techniques is often not a feasible or effective means for providing bank stabilization. In these instances, rip-rap or other hard-armoring measures are the only effective bank stabilization technique. SCWA will give priority to incorporating vegetative plantings, as feasible, into bank stabilization measures that require rip-rap or other hard-armor techniques (such as flow deflectors). SCWA also incorporates fish habitat restoration elements into their bank stabilization measures where they are feasible. Examples of such measures include the use of native material revetments which combine boulders, logs and live plant material to armor a stream bank (as outlined in Flosi *et al*. 1998). Revegetation with native plant species is always implemented in association with bank stabilization measures if site conditions are suitable.

As part of bank stabilization efforts, it is also sometimes necessary to remove deposited sediments or vegetation growing on bars. Preference is always given to thinning vegetation on gravel bars, which allows gravel to move over time so that it does not have to be excavated with heavy equipment. However, bars are removed if necessary to prevent erosion that would occur if flows are directed into vulnerable streambanks by the bar deposit. If LWD is present in the excavated sediment deposits, it is removed from the stream only if it threatens to de-stabilize a section of streambank. Otherwise, the LWD is allowed to remain in the channel. On occasion, it is necessary to straighten a short portion of the channel by cutting off a meander instead of excavating the bar sediments. If this re-alignment practice is used, SCWA will consider replacing any lost habitat by incorporating native material revetments as discussed above.

1.4.5 Types of NPDES Permit Activities

Several activities are undertaken by SCWA, the City of Santa Rosa, and the County of Sonoma under an interagency agreement for a NPDES permit. The Zone 1A channels listed in Table 1-4 are the channels maintained by SCWA for flood control purposes, which are also included in the NPDES permit area.

Table 1-4 NPDES-permitted Channels in the Zone 1A area (Portions thereof)

Austin Creek	Hunter Lane Channel	Moorland Creek	Santa Rosa Creek
Brush Creek	Indian Creek	Oakmont Creek	Sierra Park Creek
Coffey Creek	Kawana Springs Creek	Paulin Creek	Spring Creek
Colgan Creek	Lornadell Creek	Piner Creek	Steele Creek
College Creek	Matanzas Creek	Roseland Creek	Todd Creek

The following is a summary of actions undertaken by SCWA, the City of Santa Rosa, and Sonoma County related to storm water discharge under the NPDES permit:

- The County Board of Supervisors has adopted a Vineyard Erosion and Sediment Control Ordinance that will help protect creeks.
- Composite grab samples for chemical analysis have been collected during storms to evaluate possible trends or specific constituents.
- Enforcement of existing and new development standards has been used to protect creeks and prevent erosion.

- Outreach efforts have been undertaken to educate the automotive industry, construction industry, landscape industry, carpet cleaners, high schools, colleges, and food service businesses in pollution prevention and best management practices.

- SCWA has implemented an education program for students and teachers about local watershed issues, pollution prevention, and stream protection.

- Erosion control seminars have been presented to local homebuilders.

- Responses to spills in storm drain facilities within the NPDES permit boundary have been improved. Response procedures for spills and erosion control violations have been standardized. Each year of the permit (1997-2000), between 91 and 230 spills have been responded to, resulting in the removal of a large variety of pollutants from the stream. These pollutants have included constituents such as antifreeze, petroleum products, diesel, sewage, corrosive parts cleaner, paint-contaminated water, and cement-contaminated water.

- The City storm drain cleaning system has been improved by implementing a dedicated maintenance crew and computerizing the cleaning tracking system.

- Stream cleanup efforts have been undertaken, including removal of shopping carts, trash, tires, car batteries, mattresses, and other large items. Also, canopy cover on some streams was raised to discourage encampments.

- The City has implemented an Integrated Pest Management (IPM) program which includes a reduction in the use of pesticides. Herbicide use has also been reduced through the use of non-chemical vegetation control methods (e.g., weed mowers, hoeing, hand pulling, and mulching).

The NPDES permit activities related to storm water discharges in the Santa Rosa area reduce pollution in the streams in SCWA's Zone 1A channel maintenance area, which provides a benefit to salmonid and other aquatic species.

1.4.6 Overview of Salmonid Habitat in the Russian River Basin Relative to Channel Maintenance Activities

An analysis of the effects of channel maintenance activities on the populations of coho salmon, steelhead, and chinook salmon requires an understanding of the importance of various geographic areas to the various life history stages of these species. Activities within a particular geographic area can then be assessed for their overall effect on populations of listed species.

Figure 1-5 is a CDFG map of all the steelhead and coho salmon streams within the Russian River watershed. Primary coho salmon spawning and rearing habitat is most likely to occur in the coastal fog-influenced, forested, tributaries. Steelhead occupy all of the major tributaries and most of the smaller ones in the Russian River Watershed. Less is known about chinook habitat, but spawning habitat is most likely to occur in Dry Creek and in the mainstem of the Russian River above Asti. Good quality coho salmon and steelhead habitat also occurs in the upper portion of the Russian River Watershed. Much of the watershed area is privately owned and agricultural industries (particularly vineyards) predominate.

SCWA channel maintenance activities related to USACE obligations for flood control structures occur in Dry Creek and the mainstem of the Russian River. Dry Creek is not likely to be primary coho spawning and rearing habitat because coho salmon generally utilize the tributaries. However, chinook and steelhead spawning and rearing habitat does occur on Dry Creek. Passage conditions for all three species occur in Dry Creek and the mainstem of the Russian River.

The most urbanized portion of the watershed is in Santa Rosa and the Cotati-Rohnert Park areas. These areas contain most of the constructed flood control channels. Natural streams and constructed channels in the Rohnert Park area are generally low gradient and run through a valley plain to the Laguna de Santa Rosa. Poor summer water quality from urbanizing areas and low summer flows limit rearing habitat. The Laguna de Santa Rosa has important wetland and flood control functions for this part of the watershed. Santa Rosa Creek also drains to the Laguna de Santa Rosa which in turn drains to Mark West Creek. Channel maintenance activities on constructed and natural channels in this part of the Mark West Creek Watershed, including the Santa Rosa Creek watershed, have the potential to affect coho and steelhead because this part of the watershed contains good rearing and spawning habitat for these species. Much attention has been given in recent years to restoration opportunities in this area. SCWA restoration actions within this watershed are outlined in *Interim Report 6: Restoration and Conservation Actions*.

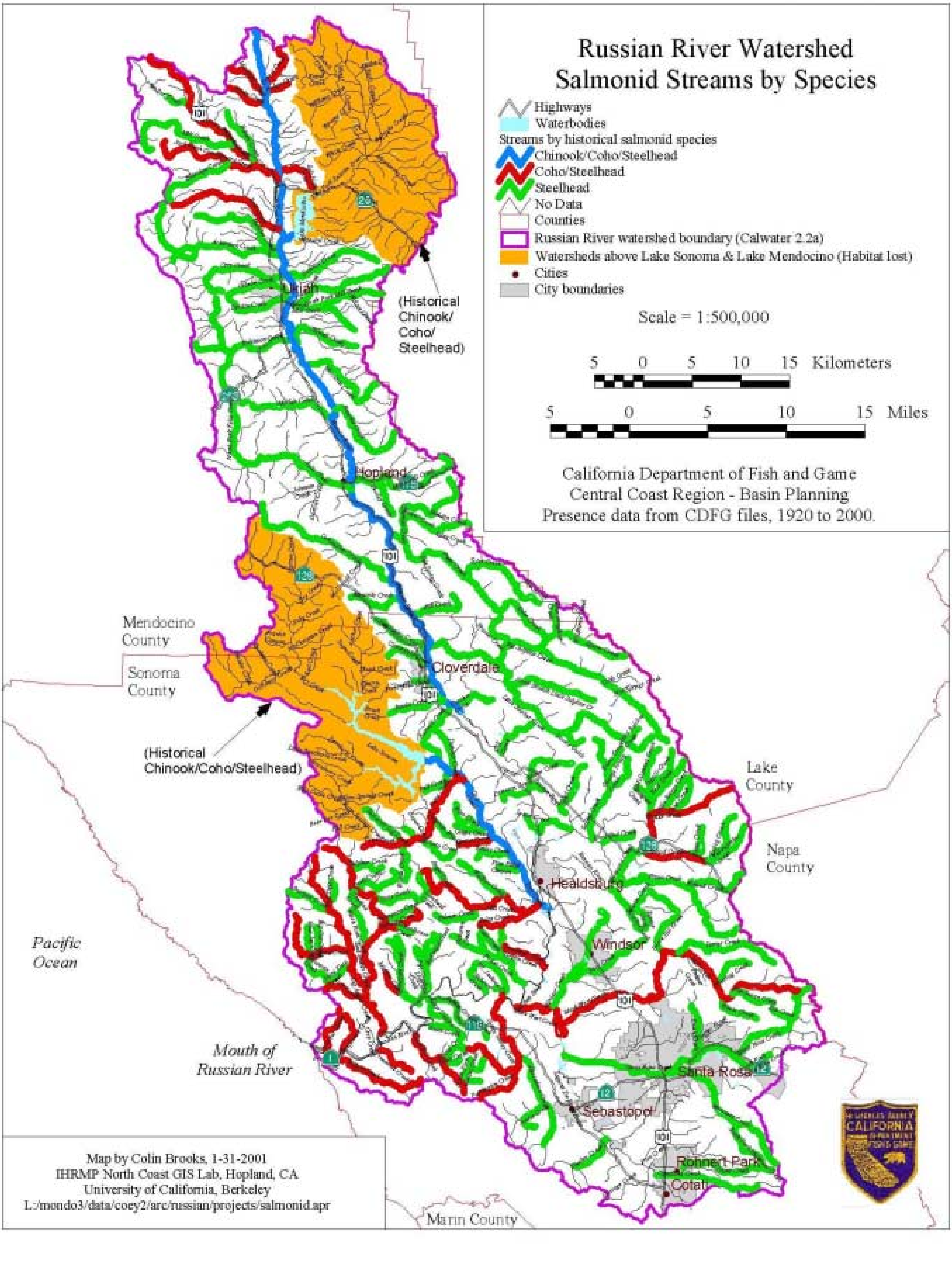


Figure 1-5 CDFG Map of Steelhead, Chinook Salmon and Coho Salmon Streams within the Russian River Watershed

Channel maintenance and NPDES permit activities may have direct and indirect effects on protected fish species and their habitat. There may be both immediate, direct effects of channel maintenance activities during implementation, and effects that may persist after a maintenance activity has been completed as a result of channel geomorphic or fish habitat alteration. For example, rip-rap installation for bank stability control may have immediate effects related to equipment working in a channel with water. After installation, the rip-rap may have effects on the amount of cover, water temperature, or other habitat conditions that persist over time.

This section identifies issues of concern and potential effects from these activities, and outlines evaluation criteria to assess these effects. Evaluation criteria are based upon published, peer-reviewed literature and generally accepted guidelines, where available. Issues of concern include:

Immediate, direct effects from construction, operation and maintenance activities

- Increased fine sediment and turbidity
- Injury to listed fish species due to equipment operation
- Direct mortality or injury to listed species due to chemical release for vegetation control
- Entrapment or injury of listed fish species at flood control reservoirs

Alterations to habitat from:

- Streambank and streambed stabilization
- Sediment maintenance
- Debris clearing
- Vegetation control
- Passive operation of flood control reservoirs

Indirect Effects from NPDES storm water discharge permit activities

2.1 IMMEDIATE EFFECTS FROM CONSTRUCTION, OPERATION AND MAINTENANCE ACTIVITIES

Immediate and direct effects from channel maintenance activities associated with debris clearing, bank stabilization, and sediment maintenance include fine sediment input to the stream, short-term increased turbidity, and direct injury or mortality of fish. Immediate and direct effects can also occur due to vegetation removal activities associated with chemical spraying, and operation and maintenance of flood control reservoirs that may entrain fish.

2.1.1 INCREASED FINE SEDIMENT AND TURBIDITY

Fine sediments can potentially decrease the survival of salmonid eggs (Bell 1990) and the production of aquatic invertebrates (Pennak 1978, Merritt and Cummings 1984), which are the primary food source of juvenile salmonids. When an excess of silt is deposited after spawning, eggs can be "smothered" when silt settles into the spaces between the gravel particles, blocking the flow of water, and therefore oxygen, through the redd. The abundance of aquatic invertebrates can be reduced by a similar mechanism. Many invertebrates reside within the spaces between the gravel substrate. As these spaces are filled with fine sediment, there is less physical space for the invertebrates, and the flow of water, oxygen, nutrients and light are also decreased. This leads to the loss of invertebrate production.

Turbidity is measured by the amount of light that penetrates the water and is measured in nephelometric turbidity units (NTUs) or Jackson turbidity units (JTUs). Turbidity is affected by a number of factors including microorganisms, organic debris, minerals, clays and silts, pigments from vegetation and others. These factors reduce the amount of light that can penetrate the water and cause light within the water column to scatter, reducing visibility.

Most streams and rivers have some level of natural turbidity that varies seasonally. During the summer months, turbidity and erosion are usually lower than during the winter and spring months when storms produce runoff that increases turbidity. Turbidity can affect fish and aquatic life both positively and negatively. Aquatic ecosystems have some resistance to short term exposures to increased turbidity or suspended sediments, as these increases are part of the natural cycle of streams and rivers.

Low or moderate exposures of short duration can be tolerated by the fish. High turbidity levels over long periods of time can cause stress (Newcombe and MacDonald 1991), impede migration (Cordone and Kelley 1961, as cited in Bjornn and Reiser 1991), reduce growth of fry (Sigler *et al*. 1984), interfere with feeding and growth (Berg and Northcote 1985) and cause avoidance reactions (Bisson and Bilby 1982, Lloyd *et al.* 1987). However, moderate levels of turbidity may give juveniles protection from predators (Gregory 1993), and chinook salmon are known to occupy turbid rivers for a significant portion of their early life. In general, however, salmonids survive better in clear water at all life stages, and high, long-term levels of turbidity can negatively affect them (Newcombe and Jensen 1996).

Turbidity can also reduce primary productivity in aquatic systems (Lloyd *et al*. 1987). Chronic turbidity decreases light penetration in streams, which can reduce primary productivity (aquatic plants). Dramatic changes in light penetration and primary production can be caused by even small (5-10 NTUs) increases in turbidity above naturally clear conditions (Lloyd *et al.* 1987). By modeling the effect of various turbidity levels on light available at depth, Lloyd calculates that a turbidity of only 5 NTUs can decrease the primary productivity of shallow, clear-water streams in Alaska by about 3-13%. An increase of 25 NTUs may decrease primary production by 13-50%. This can result in decreased production of zooplankton and macroinvertebrates (secondary production), and decreased abundance and production of fish (Lloyd 1987). Lloyd therefore suggests a moderate level of protection for salmonids would be 25 NTUs above natural conditions in streams. A higher level of protection would be 5 NTUs above natural conditions, which would bring total turbidities in salmonid streams to 8 NTUs. Absolute turbidities of 8 NTUs and higher have been shown to reduce sport fishing in Alaska.

2.1.2 Evaluation Criteria for Sediment Containment

Maintenance activities can affect salmonids or their habitat in the immediate work area or in nearby areas downstream of the activity. If activities take place when no life history stage for the species is present, then no adverse short-term effect would be expected. Most channel maintenance activities take place during the low-flow period in the summer and fall seasons, so potential direct, short-term effects would be restricted to juvenile salmonids and their rearing habitat, and some limited steelhead and chinook migration.

Evaluation criteria for sediment control address two components: instream and upslope sediment control (Table 2-1). For component 1, instream sediment control, a high score indicates instream work practices with the highest degree of sediment containment, and a low score indicates poor or no sediment containment measures. Working in a stream that is dry receives a score of 5. Rerouting streamflow from the construction area into a clean bypass, or other method that reroutes streamflow, isolates the construction area and prevents sediment input to the stream; therefore, these options are given a fairly high score of 4. A clean bypass is routing streamflow around the maintenance activity so that continuity of flow and water quality is maintained downstream. A clean bypass isolates the work area from the wetted stream channel. For instream work in a wetted channel that does not use a bypass, there is a greater potential for sedimentation downstream, unless other effective methods of controlling sedimentation are used. For example, SCWA typically uses a gravel berm downstream to filter turbid waters and reduce potential sedimentation. Such effective sediment control measures are given a moderate score of 3. Limited sediment control is a measure that is only partially effective, and that may allow significant turbidity and sedimentation. Limited sediment control measures receive a score of 2, and no instream sediment control measures in wetted channels receive the lowest score of 1.

A second aspect of sediment control evaluated (Component 2) is identified as “upslope” sediment control. Depending on the site-specific characteristics, upslope sediment control may include either streambanks that are immediately adjacent to the channel, or in some cases, may include more distant upland areas where erosion control measures are employed. Component 2 evaluates the amount of disturbance, the effectiveness of erosion control measures, and whether bank stabilization is improved or degraded. Similar to the instream component, a high score indicates minimal or no slope disturbance and a low score indicates maintenance activities that are likely to cause slope failure or bank erosion, with resulting sediment input.

Table 2-1 Sediment Containment Evaluation Criteria

Category Score*	Evaluation Criteria Category
	Component 1: Instream sediment control
5	Project area does not require rerouting streamflow
4	Clean bypass or similar method used
3	Effective instream sediment control (*e.g.* berm/fence)
2	Limited sediment control
1	No instream sediment control

Table 2-1 Sediment Containment Evaluation Criteria –Continued–

Category Score*	Evaluation Criteria Category
	Component 2: Upslope sediment control
5	No upslope disturbance, or an increase in upslope stability
4	Limited disturbance with effective erosion control measures
3	Moderate to high level of disturbance with effective erosion control measures
2	Action likely to result in increase in sediment input into stream
1	Action likely to result in slope failure, bank erosion, an uncontrolled sediment input to the channel or major changes in channel morphology

*A score of 5 is the highest, 1 is the lowest.

2.1.3 Injury to Fish

Work in a streambed that has flowing water or standing pools may result in direct injury or mortality to fish or incubating eggs. Furthermore, displaced fish may be subjected to short-term stress, predation or competition.

2.1.4 Evaluation Criteria for Injury to Fish

Immediate effects from construction or maintenance activities are scored according to the opportunity for injury to protected species (Table 2-2). BMPs are generally implemented to reduce the risk of injury to fish and may include scheduling the work when protected species are not present or when the stream channel is dry, conducting a biological survey of the project area to assess appropriate BMPs, isolating the project area from streamflow, and providing escape or rescue for fish that may be present. Site-specific factors dictate appropriate BMPs. For example, isolating a construction or maintenance area from streamflow may be a preferred alternative for some projects, but may result in an unacceptable disruption of habitat for other activities, such as one that take place in a long reach of stream but involves minimal instream work. While a fish rescue may reduce the risk of injury, it has its own risks associated with it, and there may be times when providing escape is a preferred alternative.

High scores are associated with activities that have a low risk of injury, such as those that do not take place in the channel, or that take place in a dry channel. Some activities require almost no interaction with the stream channel or water in the stream, for example maintenance activities related to road maintenance and scour holes around culverts. If activities take place when no fish species are present, then no direct injury to fish would be expected. The greater the interaction with the stream, the higher the risk of direct mortality to fish and effects associated with increased turbidity and sedimentation of aquatic habitat. Occasionally, a project may require equipment in the flowing channel. Appropriate BMPs, such as project area surveys by a qualified biologist, isolation of the project area from flow, and fish rescue or escape, reduce the potential for direct injury from equipment or due to stranding.

The lowest scores are given to activities that occur in a wetted channel where appropriate BMPs are not applied or applied in a limited way. There may be site-specific considerations that limit the ability of staff to apply appropriate BMPs. For example, emergency work after a landslide may restrict the ability of staff to implement all practices that might be desirable.

Table 2-2 Opportunity for Injury Evaluation Criteria

Category Score	Evaluation Criteria Category
5	Project area is not within flood plain or below maximum water surface elevation, and requires no isolation from flow.
4	Project area is within dry part of channel, or construction and maintenance activity scheduled when species of concern is not present.
3	Appropriate BMPs are applied; *e.g.* project area survey, escape or rescue provided, project area isolated from flow (if appropriate).
2	Limited ability to apply appropriate BMPs.
1	Appropriate BMPs are not applied.

The risk to protected fish species may be greater if there are sensitive biological or habitat conditions in a particular area. For example, if a maintenance activity is scheduled in the late summer in the upper mainstem Russian River, where important rearing habitat is known to occur, the effects may be more significant than if the work were performed in the Mirabel area where high summer water temperatures are likely to limit the number of fish that are present. The level of risk is qualified and described where there is a general knowledge of the tributary or channel reach conditions where the work is performed.

2.1.5 Vegetation Control Associated with Spraying

Spraying herbicides to control vegetation in channels can have an immediate direct effect on fish and water quality due to introduction of pollutants. Herbicides have been developed to minimize effects in riparian and wetland habitats. For some plants, such as the highly invasive, non-native weed *Arundo donax* (Giant Reed), a combination of mechanical/hand clearing and herbicide use are effective, while the use of one or the other is not. A commonly used herbicide that has been approved by the Environmental Protection Agency (EPA) for use near aquatic areas is glyphosate, (Rodeo®). Glyphosate, when used according to directions, is practically nontoxic to fish and may be slightly toxic to aquatic invertebrates (EXTOXNET 1996).

Other vegetation control methods for example hand-trimming or mechanized mowing are primarily related to long-term habitat alteration effects (although effects may also be considered to occur immediately upon implementation). The long-term habitat alteration effects associated with vegetation maintenance activities are discussed in Section 2.2.4 Vegetation Maintenance.

2.1.6 Evaluation Criteria for Vegetation Control Associated with Spraying

The vegetation control evaluation criteria (Table 2-3) assesses the amount and quality of chemicals released into the aquatic environment when herbicides are used. Higher scores are associated with practices that use only an aquatic contact herbicide, and limit herbicide use to smaller, targeted areas. Herbicide application can be limited with the use of an individual backpack unit as opposed to being broadcast over a wider area, or it can be applied over a large area with aerial spraying. Moderate to heavy herbicide use is associated with large-scale vegetation removal activities; for example, if a large infestation of *Arundo* had to be removed.

Table 2-3 Evaluation Criteria for Vegetation Control Associated with Herbicide Use

Category Score	Evaluation Criteria Category
5	No chemical release
4	Limited use of herbicide approved for aquatic use in riparian zones or over water
3	Moderate to heavy use of herbicide approved for aquatic use in riparian zones or over water
2	Use of herbicide not consistent with instructions
1	Use of herbicide not approved for aquatic use in riparian zones or over water

2.1.6.1 Central Sonoma Watershed Project Flood Control Reservoirs

Three passively operated flood control reservoirs are located onstream (Mantanzas, Brush, and Piner,) and a diversion structure on Spring Creek diverts water to Spring Lake. All four structures block upstream passage making upstream habitat unavailable to anadromous salmonids. Spring Lake Reservoir, the largest of the flood control reservoirs, is located offstream and diverts water from Santa Rosa Creek. Potential direct effects associated with maintenance activities are evaluated for downstream habitat.

Maintenance activities include removing sediments to restore flood control capacity or removing noxious pondweeds. These activities involve draining reservoirs, conducting fish rescues as necessary, removing sediments or weeds, and allowing the reservoirs to refill. Potential direct effects from maintenance activities include changes in downstream water temperature when the reservoirs are drained, changes in turbidity, injury to fish during sediment removal activities, changes in downstream flow, and a reduction in riparian vegetation associated with maintenance practices at reservoir inlets and outfalls.

Potential direct effects related to turbidity and sedimentation are evaluated using criteria developed for sediment containment (Table 2-1). The opportunity for injury to fish is evaluated using criteria presented in Table 2-2.

2.2 ALTERATIONS TO HABITAT: LONG-TERM EFFECTS FROM CONSTRUCTION, OPERATION, AND MAINTENANCE ACTIVITIES

Alterations to salmonid rearing habitat could affect protected species. As specified within the critical habitat designations for these species (coho salmon - May 5, 1999, steelhead trout and chinook salmon - February 16, 2000) critical habitat within the Russian River for all three salmonid species is defined as "all waterways, substrate, and adjacent riparian zones below longstanding, naturally impassable barriers" (NMFS 1999, 2000). NMFS specifically excluded areas above Warm Springs and Coyote Valley dams as critical habitat. Critical habitat includes areas where critical life history events occur, including migration, spawning, and rearing.

Critical habitat would be considered adversely affected if it were "altered or destroyed by the proposed activities to the extent that the survival and recovery of the affected species would be appreciably reduced" (USFWS and NMFS 1998). This alteration or loss is most significant if it is permanent in nature or occurs at a time of year when this habitat is being used, especially if the habitat were limited or used for a critical life history stage, such as spawning.

Alterations to habitat could include changes to water quality, such as changes in temperature or dissolved oxygen levels. It would also include changes to physical elements such as instream cover, canopy cover, the type of habitat available such as pools or riffles, or channel configuration.

Four general classes of channel maintenance activities are addressed: streambank and streambed stabilization, sediment maintenance, debris removal, and vegetation control and removal. Each of these activities has potential long-term effects on salmonid habitat conditions.

2.2.1 Streambank and Streambed Stabilization

Streambanks have been stabilized on Dry Creek and the mainstem Russian River using gravel revetments, steel jacks, sheet-pile, trees, and other materials. Levees are maintained to reduce bank erosion and flooding. On Dry Creek, concrete sills have been installed to provide grade control, preventing streambed incision and resulting accelerated streambank erosion. No new streambank stabilization projects are being built by SCWA, and project activities are restricted to maintenance of existing structures.

Potential effects related to streambank stabilization projects may be both positive and negative. Positive effects are associated with reduction or prevention of erosion and resulting sedimentation in the channel. Negative effects may be associated with loss of riparian shading and increased water temperatures. Bank stabilization techniques may reduce the complexity of in-stream cover naturally provided by undercut banks, and exposed root wads. Additionally, the recruitment of spawning gravels, which are often supplied by natural bank erosion processes, may be impeded by bank stabilization structures. Streambed stabilization structures installed on Dry Creek are intended to reduce channel head-cutting and resulting streambank erosion.

Qualitative evaluation of these effects is based on the extent to which maintenance of bank stabilization structures reduce overstory canopy cover (shading), in-channel cover (undercut banks, exposed root wads, backwater areas), and gravel recruitment. The greater the loss of these habitat elements (in comparison with what normally could be supported by the stream reach), the greater the effect.

2.2.2 Sediment Maintenance

Sediments are removed from constructed flood control channels and are re-distributed in natural channels (*i.e.*, bar grading) with flood easements to ensure that channel capacity is maintained and to reduce bank erosion. Sediment maintenance takes place in three types of streams: (1) constructed flood control channels, (2) mainstem Russian River, and (3) natural channels other than the Russian River. Each of these three channel types are addressed in separate sections.

Habitat effects from sediment maintenance activities for listed species may include:

- increased water temperatures and reduced cover if riparian vegetation is removed or disturbed
- reduced supply of spawning gravels
- change in channel geomorphology that may result in various habitat effects such as alteration of fish passage conditions, reduced channel sinuosity that limits pool and rearing habitat, and reduced high-flow refuge
- general loss of hydraulic and associated aquatic habitat complexity depending upon the type of habitat conditions normally present in the project reach

It should be recognized that are also benefits to aquatic habitat associated with sediment maintenance practices. Without this type of maintenance there is likely to be increased bank erosion, particularly in natural channels, as stable bars develop with mature vegetation. Large gravel bars with mature vegetation, such as can occur on the Russian River, tend to accrete sediments over time thereby increasing channel sinuosity. Increased sinuosity causes the channel to laterally adjust, increasing the meander belt width by bank erosion. Fine sediment production to the channel will likely increase as bank erosion occurs.

2.2.2.1 Flood Control Channels

Almost all sediment removal activities in Zone 1A constructed flood control channels is confined to streams draining to Laguna de Santa Rosa near Stony Point Road in the Rohnert Park-Cotati area. The combination of very flat gradients (typically less than 0.002 ft/ft) and high sediment production to the streams result in sediment deposition that adversely effects channel flood capacity. The status and recent history of sediment excavation for all Zone 1A flood control channels is listed in Table 3-3.

Long-term changes to critical habitat for salmonids may occur due to sediment maintenance, but these effects could be either positive or negative. Long-term negative effects include potential reduction in available gravels that are of suitable size for spawning and lack of bed-form features such as bar-pool development that influences fish passage and also provides hydraulic diversity and associated habitat diversity. Long-term positive effects may include a reduction in fine sediment loading to downstream reaches that could improve spawning gravel quality, pool depth, and overall habitat diversity.

Evaluation of sediment removal effects in flood control channels is based on observations of changes in channel geomorphic and habitat conditions prior to and following excavation activities in 2000 and 2001.

2.2.2.2 Russian River

Sediment maintenance is conducted by two different agencies, the MCRRFCD and SCWA. SCWA is under obligation to the ACOE to excavate and grade sediments over a 22 mile reach between river mile 41 near Cloverdale to river mile 63, near the Mendocino County Line. The sediment maintenance work consists of grading and re-aligning bars in the channel, and also devegetating gravel bars during the dry summer season. Sediments are redistributed in the channel, and SCWA may remove bed sediments from the channel in some instances, usually under contract to commercial gravel extractors (pers. comm. Bob Oller, SCWA). Bars are graded back to about a 2% slope toward the low-flow channel. Typically a buffer strip of vegetation is preserved along the perimeter of the bar adjacent to the low-flow channel. Heavy equipment including excavators, front-end loader and rippers are used. The purpose of this work is to maintain channel flood capacity and to control bank erosion. This sediment maintenance activity is closely linked to vegetation maintenance practices, which is also intended to ensure channel flood capacity and to control bank erosion. The procedure for gravel bar grading and sediment removal conjunctively removes willows and other riparian vegetation from the bars. Vegetation removal on the Russian River is separately discussed in Section 2.2.4.2. SCWA discontinued performing sediment maintenance work in the Russian River since 1993, but remains under obligation to the ACOE to provide flood capacity and to control bank erosion.

MCRRFCD is also under obligation to the ACOE to excavate and grade sediments over a 36 mile reach of the Russian River. Approximately 12 mile segments are maintained in any given year. This maintenance work consists of grading gravel bars (and conjunctively removing riparian vegetation growing on the bars) that are determined to be threatening bank stability. MCRRFCD does not remove bed sediments from the river. This maintenance work is performed in order to improve channel capacity and alignment of the high flow path, thereby reducing streambank erosion during high flows. The work is performed during the dry summer season using an excavator, scraper, and a CAT. The wetted low-flow channel is not entered by equipment. Gravel bars are skimmed to a depth that does not exceed the low-flow channel water level, and the gravels are pushed up against the streambank. The bars are graded back to a slope toward the low-flow channel, similar to natural conditions. In some instances realignment of the bar and low-flow channel is necessary for up to ½ mile, with excavation up to 4 ft in depth. The MCRRFCD also assists ranchers with bank stabilization by encouraging the planting of trees and shrubs along banks to reduce erosion.

Gravel bar grading and re-alignment in the Russian River has the potential to affect the geomorphology of the channel. By preventing stable bar development, the channel is essentially straightened and sinuosity decreased. This decreased sinuosity reduces bank erosion, but also reduces the opportunity for pool development by limiting scour on the outside of meander bends. In addition, gravel bar grading generally results in a flatter streambed, reducing the hydraulic diversity and associated aquatic habitat diversity represented in the channel. This lack of hydraulic diversity could include reduced availability of high-flow refuge habitat due to a flattened bedform topography resulting from bar skimming.

Since gravel bar grading is closely inter-related with removal of riparian vegetation growing on the bars, there is an associated loss of shade and canopy cover near the low-flow channel. The effects of vegetation maintenance in the Russian River are separately discussed and evaluation criteria provided in Section 2.2.4.2. Loss of spawning gravels is not an effect expected from the maintenance practices by MCRRFCD on the Russian River since sediments are not permanently removed from the river. However, SCWA does remove sediments in some instances, which could reduce the supply of spawning sized gravels.

Evaluation of habitat altering effects of sediment maintenance activities on the Russian River is based on a qualitative assessment that considers the extent and frequency of maintenance actions, as well as observations of existing aquatic habitat and geomorphic conditions.

2.2.2.3 Natural Channels Other Than Russian River

In addition to the sediment removal obligations to the ACOE on the Russian River, SCWA has under certain site-specific catastrophic conditions removed sediments from other natural channels in the Russian River basin. This sediment removal is usually done in conjunction with bank stabilization work, and is initiated only after a specific landowner request, usually to protect property and infrastructure. The range of activities associated with bank stabilization and sediment removal include levee repair, vegetation removal, and channel realignment where bars are directing high flows into unstable streambanks. The sediment removal and bank stabilization work could potentially be requested on almost any natural channel in the Russian River basin. In recent years this type of maintenance work was performed on Austin Creek and on Big Sulphur Creek. SCWA has developed very specific guidelines for implementing sediment maintenance and bank stabilization work in natural channels in order to protect aquatic habitat and listed species (see Section 1.4.3.1). Potential long-term habitat altering effects of sediment maintenance and bank stabilization maintenance activities in natural channels include:

- Reduced canopy cover, increasing water temperatures
- Reduced recruitment of spawning gravels
- Change in channel geomorphology, including straightened channel planform that limits development of pool habitat, and overall simplification of habitat complexity

Evaluation of habitat altering effects of sediment maintenance activities in natural channels is based on a qualitative assessment that considers the extent and frequency of maintenance actions. Consideration is also given to the type of protections and best management guidelines built into the SCWA approach for work in natural channels.

2.2.3 Debris Clearing

Debris clearing includes the removal of large woody debris (LWD), construction debris, and trash (e.g., shopping carts, tires, cars) from the stream channel to improve the flood capacity of the waterway. Equipment is operated from the stream bank rather than in the channel, so there is little risk for direct fish mortality attributable to debris clearing activities. Changes to instream habitat may occur when debris is removed. LWD may be removed from flood control channels in Zone 1A under certain conditions, and is infrequently removed from natural channels only under catastrophic conditions. The effects of the flood control reservoirs on the recruitment of LWD is separately evaluated under Section 2.2.5.

Construction debris and trash may not always be harmful to salmonid habitat, and may even provide some of the only instream shelter available in a degraded urban stream. However, removal of trash or construction debris that can degrade water quality is beneficial. Furthermore, streams that are free of trash and filled with more natural- instream cover elements are more aesthetically pleasing, and public clean-up events encourage stewardship of streams by local residents. Therefore, purposes of this BA it is assumed that trash removal provides a net benefit, and only the effects of LWD removal are considered.

LWD can play an important role in the structure and function of fish habitat, particularly in forested regions. In non-forested regions, LWD may be non-existent, or have only a very limited scope of influence on channel and aquatic habitat conditions. Removal of LWD can potentially reduce the amount of instream cover, reduce pool frequency and depth, and simplify hydraulic and habitat diversity in the channel. Given the importance of woody debris to salmonid habitat, particularly LWD, evaluation criteria specifically address LWD removal.

The importance of large woody debris (LWD) for salmonid habitat and biological productivity has been well documented. LWD provides cover and habitat diversity for salmonids and substrate for benthic invertebrates that serve as food (Sedell *et al*. 1984, Sedell *et al*. 1988, Bisson *et al*. 1987). LWD creates pools and undercut banks for cover, plays an important role in controlling stream channel morphology (Keller and Swanson 1979, Lisle 1986, Sullivan *et al*. 1987 cited in Hicks *et al.* 1991) and influences sediment movement, gravel retention, and composition of the biological community (Bisson *et a*l. 1987 and Sullivan *et al*. 1987 cited in Murphy and Meehan 1991, Bilby and Ward, 1989 cited in Flosi *et al*. 1998). LWD creates hydraulic gradients that increases microhabitat complexity (Forward 1984) and the abundance of salmonids is often linked to the abundance of woody debris, especially in the winter (Bustard and Narver 1975, Tschaplinski and Hartman 1983, Murphy *et al*. 1986, Hartman and Brown 1987).

CDFG defines LWD as a piece of wood having a minimum diameter of 12 inches and a minimum length of 6 feet (Flosi *et al*. 1998). Root wads must be 12 inches in diameter at the base of the trunk but do not have to be six feet long.

LWD may be found in the instream zone (stream channel within bankfull discharge demarcations), or in the recruitment zone. Although researchers have various means of identifying the width of the riparian zone from which LWD is recruited, in general terms it is no wider than the average height of the typical tree that borders the channel. Trees that are more distant from the channel than their average height, cannot be readily recruited into the channel as LWD. The recruitment zone represents about 70 percent of the LWD recruitment potential to the stream in natural forested channels (McDade *et al*. 1990, Forest Ecosystem Management 1993 cited in Flosi *et al*. 1998) so long-term management of the riparian zone is important. Evaluation criteria associated with vegetation control (Section 2.2.4) address the extent of vegetation removal in the recruitment zone.

Evaluation criteria are structured to give high scores when LWD is not removed or if it is modified in place, but retained in the channel rather than completely removed. Modification, as used in this evaluation, includes cutting and removing a portion of the LWD. Alternatively, modification could include re-orienting in the stream to prevent bank erosion or anchoring a piece of LWD so that it is not unstable. An intermediate score is given for limited removal practices (infrequent, only as necessary for flood control), and low scores when it is removed indiscriminately or entirely, and results in reduction of cover or other habitat functions provided by scour around LWD (Table 2-4). Because the recruitment of LWD to a stream can be infrequent or episodic, even occasional removal of LWD has the potential to reduce the availability of high quality salmonid habitat.

Table 2-4 Large Woody Debris Removal

Category Score	Evaluation Category
5	No LWD removal
4	LWD not removed, but modified
3	LWD removal limited to only when it poses a flood control hazard, removal does not result in substantial reduction of cover or scour in the area
2	LWD removal limited, but potentially results in moderate reduction of cover or scour
1	Complete removal of LWD resulting in substantial reduction of cover or scour

If LWD is removed in areas where spawning and rearing is likely to occur in either immediate or downstream areas, the effect would be greater than if LWD is removed from stream reaches that primarily function as a migration corridor. However, even in a migration corridor, LWD can provide cover and velocity breaks for migrating adults to rest and therefore should be retained as much as possible. In urban areas, the installation of instream structures may provide some of the benefits of LWD for migrating or rearing salmonids but still retain sufficient flood control capacity in the stream, and therefore very infrequent removal of LWD may not result in a large reduction of cover or scour elements. As part of the scoring for activities associated with LWD removal, consideration is given to the primary habitat function of the channel where LWD is removed.

On the constructed flood control channels, the dominant streambank vegetation is willow, blackberry, and grasses. About one-third of the channels have some portions of their channel length with bordering trees, including coast live oaks and various species of coniferous trees, some of which are non-native. Most of these trees were planted during construction of the flood control channels in the 1950's to 1960's. Many of these trees are set-back from the top of bank and from the service road a distance that is about equal to their height, so that they would be unlikely to ever be recruited to the channel. Some trees are found growing near the top of bank and are more likely to eventually be recruited to the stream after they have matured. In the case of the coast live oaks, this may take at least 50 to 100 years from now.

2.2.4 Vegetation Maintenance

Vegetation may be removed from streambanks and stream-channel bottoms to maximize channel flow capacity and to reduce the risk of fires. Vegetation control methods include removal by hand trimming or mechanized mowing, spraying, and indirectly by excavation of sediments and gravel bars. Another indirect method of vegetation control is to plant desirable native riparian vegetation that will exclude the establishment of non-native or undesired vegetation (discussed in *Interim Report 6: Restoration and Conservation Actions*). Clearing of native vegetation may allow non-native, noxious plants to establish themselves in the disturbed area.

The duration of potential effects of vegetation removal may be short if vegetation grows back quickly, or long term, if vegetation is restored over a long time (for example, it takes years for trees to reestablish). However, effects of vegetation removal can be far more complex.

Riparian vegetation has several important functions for the quality of fish habitat (Meehan 1991). Water quality, including temperature and suspended sediment concentrations, may be influenced. Riparian vegetation, especially trees, provide canopy cover and shade, and removal may increase solar input and result in higher water temperatures in the summer. On narrower streams loss of riparian vegetation may have a greater effect on temperature than on wider streams where the canopy covers only a small portion of the channel. Since salmonids occupy a wide variety of habitat types during various life history stages, it is important to have quality habitat in small and large streams. On small streams, grasses and shrubs may be sufficient to provide beneficial effects, while on larger streams, shrubs and trees may be more effective.

2.2.4.1 Vegetation Control and Removal in Flood Control Channels

Riparian vegetation is essential for building and maintaining stream structure and for buffering the stream from incoming sediments and pollutants. On natural channels when bank vegetation is reduced, flood events are more likely to accelerate changes in channel morphology such as widening or incision. However, the Zone 1A constructed flood control channels were designed to be stable with minimal bank protection associated with riparian vegetation. As part of the design criteria, if flood velocities were calculated to exceed 6 ft/sec, then hard-armoring to protect sections of the bank from erosion were installed (SCWA, 1983). Thus, removal of riparian vegetation on streambanks (except grass banks which are maintained) was always anticipated to be an ongoing maintenance activity in order to preserve the channel design flood capacity.

Over the long-term, trees contribute to habitat diversity, often by creating high-quality pools or high-flow refuge habitat when they fall into the channel. This process of tree recruitment may help to control the slope and stability of the channel, particularly in forested regions (Beschta and Platts 1986). Streambank stability is also maintained and water quality improved by flexible vegetation such as willows and grasses. During floods, water transports large amounts of sediment in the stream. Vegetation mats on the streambank reduce water velocity, causing sediment to settle out and become part of the bank, increasing nutrients that are so important to productive riparian vegetation. Root systems of grasses and other plants can trap sediment to help rebuild damaged banks. Riparian vegetation provides cover, an important determinant of fish biomass. Well-sodded banks tend to gradually erode, creating undercuts important as refuge habitat. Riparian vegetation provides a basis for food production.

Vegetation provides habitat for terrestrial insects, which are an important food for salmonids. Plant matter provides organic material to the stream, essential for production of aquatic insects. This organic input is especially important to narrow, heavily shaded, headwater streams that support an aquatic insect community known as “shredders”, which in turn supports salmonids. In sunnier, wider streams, an insect community known as “grazers” is supported by algal growth. Where cover and stream temperatures are not limiting, additional sunlight after limited vegetation removal may benefit primary productivity.

Vegetation removal can be beneficial if it involves the removal of non-native noxious species. Non-native vegetation, such as the invasive *Arundo donax*, can negatively alter critical habitat of salmonids, including alterations to the food web, the amount and quality of riparian and instream cover, streambank stability, and alterations to flow regimes. *Interim Report 6: Restoration and Conservation Actions* discusses the effects of invasive plant species in greater detail. Replacement of non-native species with native species generally will help restore a naturally functioning, native, riparian ecosystem.

It is not the policy of SCWA to establish non-native vegetation. It should be noted that narrow, heavily shaded streams may have lower primary productivity than streams that allow more sunlight to the stream, and some decrease in vegetation may benefit salmonids. However, past vegetation control practices have resulted in indiscriminant loss of the riparian vegetation in these channels, and vegetation control practices that increase that corridor are likely to increase the habitat value for salmonids. Activities related to the restoration of riparian corridors are discussed in *Interim Report 6: Restoration and Conservation Actions*.

Evaluation criteria for vegetation control is based on the extent of removal of native riparian vegetation (Table 2-5). Higher scores are associated with activities that preserve or increase a riparian corridor composed of native species. Lower scores are given for maintenance practices that result in removal of riparian vegetation. The greater the extent of removal, the lower the score. Removal of invasive, non-native vegetation could have a beneficial effect because this may allow native riparian vegetation to establish.

For maintenance activities that include only selective removal of vegetation along access roads and between the access roads and fencelines, or for removal of non-native species, the highest score, 5, is given. The category score of 5 also includes "spot" or site-specific treatments that may require vegetation removal over very small distances, typically near structures such as culverts or at bridge crossings.

For maintenance activities that require more than selective removal of vegetation in order to keep access roads open, and thereby result in removal of vegetation across up to 25% of the cross-sectional area of the channel, the score is 4. When more than 25% and up to 50% of the cross-sectional area of vegetation is removed, then the score is 3. Removal of more than 50% up to 75% of the vegetation represented in the cross-sectional area of the channel receives a score of 2, and more than 75% removal results in the lowest score, 1.

Table 2-5 Vegetation Control Evaluation Criteria for Flood Control Channels

Category Score	Evaluation Criteria Category
5	No removal except selectively along access roads, fencelines, "spot" treatments, or to remove non-native species
4	< 25% removal
3	>25% to < 50% reduction in vegetation
2	>50% to <75% reduction in vegetation
1	>75% reduction in vegetation

Consideration is also given to the life history stage of listed species that are likely to be utilizing channels subject to vegetation maintenance and to the quality of habitat available. For example, if listed species are primarily using a flood control channel for migration rather than for rearing or spawning, the effect of vegetation loss is not considered to be as significant. If more than one life-history stage is potentially affected, the loss of vegetation becomes more significant. These considerations are addressed in conjunction with the scoring criteria listed in Table 2-5 above.

2.2.4.2 Vegetation Removal in Natural Channels

The Zone 1A flood control channels are designed to be stable without the influence of riparian vegetation. Unlike the constructed flood control channels, riparian vegetation has an important effect on bank strength and stability in natural channels. Bank erosion and lateral channel migration contribute sediments to the stream if protective vegetation and root systems are removed from streambanks. Loss of vegetation decreases bedform roughness, thereby increasing velocities which may reduce the potential for sediment deposition on the channel margins or on the bank. Riparian vegetation provides cover, an important determinant of fish biomass. Additionally well-sodded banks gradually erode, creating undercuts important as refuge habitat. Root systems of grasses and other plants can trap sediment to help rebuild damaged banks.

Other potential effects of vegetation removal in natural channels are similar to those described above for flood control channels (Section 2.2.4.1). The potential for recruitment of trees and other large woody debris is probably much greater in natural channels compared with constructed flood control channels. This is due to the stable design and lack of lateral channel migration associated with the flood control channels. Meandering and lateral channel migration is often part of the natural channel processes that will cause bank erosion and tree recruitment. Therefore, removal of riparian vegetation in natural channels likely represents a greater loss of potential recruitment of large woody debris and resulting habitat diversity.

Natural channels tend to provide rearing and spawning habitat, in addition to migration, that most flood control channels do not provide. This is particularly true for Dry Creek and the mainstem Russian River, for which SCWA has vegetation maintenance obligations to the ACOE. In addition, MCRRFCD has maintenance obligations similar to SCWA on the Russian River in Mendocino County. Therefore, vegetation maintenance activities in natural channels have a greater potential for altering habitat conditions that support multiple life history stages. On this basis, greater weighting is given to habitat alteration effects resulting from vegetation removal in natural channels compared with constructed flood control channels.

Evaluation criteria for vegetation control is similar to that for flood control channels, and is based on the extent of removal of native riparian vegetation (Table 2-6). The scoring is slightly different in that there is no removal of vegetation associated with access roads or fencelines on natural channels (category score 5), and the percent of vegetation removal allotted within each of the scoring categories is lower than for flood control channels.

Table 2-6 Vegetation Control Evaluation Criteria for Natural Channels

Category Score	Evaluation Criteria Category
5	No vegetation removal except "spot" treatment, or removal of only non-native species
4	<10% removal
3	>10% to <25% reduction in vegetation
2	>25% to <50% reduction in vegetation
1	>50% reduction in vegetation

In conjunction with these scoring criteria, consideration is also given to the typical lengths of channel that are subject to vegetation maintenance. Maintenance practices that remove vegetation over long channel reaches are more likely to result in significant change to habitat conditions than shorter channel reaches. So, for example, complete removal of vegetation (100%) in the cross-sectional area) over a 25 ft length of channel downstream of a culvert outfall (*i.e.*, "spot" treatment) does not have the same degree of habitat altering effects as 50% removal over a linear distance of 5,000 ft.

These criteria assess the amount of vegetation removed within a site. While limited vegetation removal in isolated sites may not negatively affect salmonid habitat, if the work is done over several sections of a stream and/or in prime spawning and rearing habitat, the net effect may be larger. For example, if willows are removed from several gravel bars to reduce streambank erosion in an important coho salmon stream, the net effect may be to significantly alter channel morphology, the amount of instream cover, and the availability of winter refugia from high flows. To avoid significant effects to salmonid habitat, vegetation removal in natural channels is kept to a minimum and used only where there is an unacceptable threat from a 100-year flood event or where a decrease in bank stabilization threatens a structure or property. Most vegetation removal projects in natural channels are about 300-600 ft in length. Alternative solutions are pursued where feasible, such as the utilization of bio-engineering practices to stabilize banks, tree planting to add bank stability and reduce understory growth, offset levees to increase floodplain, or floodplain level culverts to increase floodplain draining at culvert crossings.

2.2.5 Effects from Passive Operation of Flood Control Reservoirs

The five flood control reservoirs and diversion facilities operate passively. Long-term effects can include changes to salmonid habitat, specifically an increase in downstream water temperature and a reduction of sediment and debris transport from upstream areas. By capturing streamflow in detention storage until they fill and spill, onstream reservoirs can alter the magnitude and timing of downstream flow. Delaying the onset of early season runoff downstream of each reservoir can reduce for a period of time habitat available for rearing or spawning until reservoir inflow and outflow has equilibrated. The magnitude of peak flows may also be reduced by detention storage (this is a primary function of flood control reservoirs). At Spring Lake, outmigrating salmonids may be trapped in the reservoir during high flows. Spring Lake creates warmwater habitat for fish species that prey on salmonids and if these fish are released to Santa Rosa Creek there could potentially be an increased risk of predation.

The onstream reservoirs act as sediment detention basins, reducing the supply and transport of bed and suspended load, and woody debris to downstream areas. This change in sediment and flow routing could reduce the amount of instream cover due to loss of woody debris, and could reduce the supply of spawning gravel to downstream reaches.

The potential effects to downstream areas are evaluated based on characteristics of the watershed above each dam, the reservoir storage area, the capacity to deliver woody debris or sediments to downstream areas, and the amount of sediment estimated to be removed over time from these basins.

Reservoir water temperature can be increased due to the increased surface area exposed to solar warming. Temperature data above and below the reservoirs are not available, so temperature criteria from published peer-review literature cannot be applied. Instead, a qualitative assessment is made based on information about habitat characteristics of the stream and flow conditions above and into the reservoirs during the rainy and dry seasons.

2.2.5.1 Evaluation Criteria for Fish Passage at Spring Lake

Adult upstream passage is available on Santa Rosa Creek around Spring Lake through a fish ladder and vortex tube that routes streamflow around the reservoir. Adult upstream passage can potentially be impaired if the fish ladder does not function to provide flow depths and velocities suitable for migration. Downstream migrants or rearing juvenile salmonids are also potentially affected by operation of Spring Lake because they face the possibility of entrapment during high spring flows. Juvenile fish caught in any diversion are subject to migration delay or failure, and may be at an increased risk from warmwater predators in the lake and to fishing pressure. Large bass have been caught in Spring Lake. Steelhead trapped in the lake that survive are likely to revert from the anadromous to resident form of trout.

2.2.5.1.1 *Entrapment into Spring Lake*

Evaluation criteria for fish passage past diversion facilities assess the risk of entrapment based upon fish screen design and opportunity for escape or rescue. Passage is also evaluated for the opportunity for entrapment, impingement, or injury based upon the percentage of the streamflow diverted and the amount of time water is diverted during a species life history stage.

If a diversion is screened, it can be evaluated based on how well the screen meets NMFS screening criteria, and therefore how well the screen prevents entrapment or injury to migrating salmonids. If a diversion facility is not provided with screens, fish rescues or an effective escape route may help reduce negative effects to trapped fish. High scores are associated with screened diversions that meet NMFS criteria (NMFS 1997a), and low scores are associated with ineffective or unscreened diversions (Table 2-7).

Table 2-7 Juvenile Salmonids Passage Evaluation Criteria for Screen Design

Category Score	Evaluation Category
5	Fish screens meet NMFS criteria and pass fish without injury or delay.
4	Facility provided with fish screens, but the facility has a low risk of entrainment, impingement, or migration delay.
3	Facility provided with fish screens, but the facility has a moderate risk of entrainment, impingement, or migration delay, effective rescue or escape is provided.
2	Facility provided with fish screens, but the facility has a high risk of entrainment, impingement, or migration delay, ineffective rescue or escape is provided.
1	Facility not provided with fish screens, no rescue or escape is provided.

Fish passage at a diversion facility is also evaluated for the risk of entrapment, impingement, or injury to protected species based on 1) the proportion of surface water diverted and 2) the degree of overlap between the migration period and the timing of the diversion. If more water is diverted, the potential to affect fish increases. In general, we estimate that if more than 50% of surface water flow is diverted, there is a significant risk of entrapment for salmonids. Because the amount of water diverted to these flood control reservoirs has not been quantified, this evaluation criteria is not applied. Instead, an indirect assessment is made based on the estimated percentage of time water is diverted. The greater the percentage of a species migration period that the diversion facility is operated, the greater the risk to that species (Table 2-8).

Table 2-8 Passage Evaluation Criteria for Juvenile Salmonids – Opportunity for Entrapment, Impingement or Injury – Time Water is Diverted

Category Score	Evaluation Category
5	Facility does not affect surface water flow during any time of migration period.
4	Facility diverts surface water flow during less than 10 % of migration period.
3	Facility operates between 10 and 15 % of migration period.
2	Facility operates between 15 and 25% of migration period.
1	Facility operates during more than 25% of the migration period.

2.2.5.1.2 *Passage at Spring Lake Fish Ladder*

To provide successful fish passage, Denil fishways must be carefully engineered for width and depth relationships to provide the low velocity flows required in their design. Furthermore, there must be enough water flowing through the ladder at a range of flows that enables fish to find the entrance of the passage structure (attraction flow) and pass upstream with minimal delays. Established criteria for a properly operating Denil-style fish ladder are summarized below (Bell 1986, Powers and Orsborn 1985, and Thompson 1972).

- Fishway slope has a ratio of at least one to six.
- Individual run is less than 30 feet.

- Resting areas with velocities of 0.1 feet per second (fps) or normal swimming speed.
- Maximum of 12 inches drop between pools.
- Average maximum velocities over weirs of 4 fps.
- Entrance velocities of 4 to 8 fps.
- Water depth as a weir measurement over pool weir 6 inches minimum and 12 inches maximum.
- A 0.2 cubic foot of space in pool per pound of fish.
- Ten percent of total flow provided as attraction flow.

The fish ladder should be built to pass fish as described in standard engineering terms as presented above, and the ladder should have sufficient attraction flows (10 percent of total flow so fish can find the entrance to the passage structure). The evaluation criteria used in this assessment is based on the three components of the engineering design that are available for the Spring Lake ladder: fishway slope, individual run length, and drop between pools. No hydraulic performance data are available for the Spring Lake fish ladder. Table 2-9 provides the scoring categories for design of the ladder from an engineering perspective. A score of 5 is the best, 1 or 0 is the worst. The scoring is based on how well the engineering design criteria presented above are met. Effective fish ladder designs generally pass fish with minimal delay.

Table 2-9 Passage Evaluation Criteria for Adult Salmonids at Spring Lake - Fish Ladder Design

Category Score	Evaluation Categories
5	Fish passage passes adult salmonids without delay
4	Fish passage passes adult salmonids with acceptable delay
3	Fish passage passes all target species after extended delay
2	Fish passage does not pass all target species of adult salmonids
1	Passage provided but does not appear to pass any adult salmonids, or passage not provided

2.2.5.2 Predation

By concentrating predators and prey, or by introducing predators into salmonid habitat they have not previously had access to, structures that pass fish have the potential to increase predation on protected species. Spring Lake creates warmwater habitat for fish species that prey on salmonids. If predators are released, populations could be established in Santa Rosa Creek, increasing predation on salmonids. Of particular concern are nonnative largemouth bass and smallmouth bass, green sunfish and native Sacramento pikeminnow. There are currently self-sustaining populations of these warmwater species in the Russian River.

Structures that concentrate prey increase the potential for predation on protected species. If there are holding areas that favor predators near structures that concentrate salmonids, and if predators are actually present near those structures, protected species may be adversely affected. Structures that provide predators access to areas that they have not historically reached would increase the level of predation, but structures that provide predators access to areas with established populations of predators may or may not increase the level of predation. Furthermore, water temperatures favorable to predators would be needed.

To evaluate the risk of increased predation on protected species, three components were developed for predation evaluation criteria: structural criteria, access criteria, and habitat criteria. Structural criteria (Table 2-10) assess whether the structure concentrates predators and prey. Access criteria (Table 2-11) assess passage opportunities for predators and whether predators are given access to areas they have not historically been. Predator habitat criteria (Table 2-12) are based on water temperatures favorable to warmwater predators, especially centrarchids and Sacramento pikeminnow. The optimum temperature for Sacramento pikeminnow is 26.3°C (Knight 1985). Warmwater temperatures favor these predatory fish at the same time that they negatively affect protected salmonids and their ability to avoid predation.

Table 2-10 Predation Evaluation Criteria: Component 1 Structural Criteria

Category Score	Evaluation Criteria
5	No features that concentrate salmonids or provide cover for predators, concentrations of predators not found.
4	No features that concentrate salmonids, predator cover near, predators in low abundance locally.
3	Features that concentrate salmonids, no predator cover nearby, predators in medium to low abundance locally.
2	Features that concentrate salmonids, predator cover nearby, predators in medium to low abundance locally.
1	Features that highly concentrate salmonids, predators abundant locally.

Table 2-11 Predation Evaluation Criteria: Component 2 Access Criteria

Category Score	Evaluation Criteria
5	Structure does not allow passage of predators, predators not present near structure.
4	Structure does not allow passage of predators, predators present near structure.
3	Structure provides limited passage of predators, or limited passage to areas they are already well established, predators not present near structure.
2	Structure provides limited passage of predators to areas they have historically not been found or have been found in limited numbers, predators present in limited numbers near structure.
1	Structure provides passage of predators to areas they have historically not been found or found in limited numbers, predators present or migrate to structure.

Table 2-12 Predation Evaluation Criteria: Component 3 Warmwater Species Temperature Criteria

Category Score	Evaluation Criteria
5	Water temperatures < $13^{O}C$
4	Water temperatures 13 - $18^{O}C$
3	Water temperatures 18 - $20^{O}C$
2	Water temperatures 20 - $22^{O}C$
1	Water temperatures 22 - $24^{O}C$
0	Water temperatures >= $24^{O}C$

2.3 NPDES PERMIT ACTIVITIES

SCWA pollution prevention activities are achieved through management activities associated with flood control facilities and maintenance, spill response and prevention, and public outreach activities. Monitoring and assessment plans have been developed and implemented to characterize storm water runoff quality. A qualitative assessment of the success of these NPDES permit activities is made based on the goals of these activities and monitoring results.

Section 2.0 identified potential effects that channel maintenance activities may have on protected species and their critical habitat. Evaluation criteria were developed to assess the effects of channel maintenance activities. This section applies the evaluation criteria to assess effects of these activities.

Four general channel maintenance activities are evaluated:

1. Sediment maintenance
2. Debris clearing
3. Vegetation maintenance
4. Bank stabilization

These activities are evaluated as they are applied in the Mark West Creek Watershed, Dry Creek, and the mainstem Russian River.

3.1 SEDIMENT MAINTENANCE

Sediments are removed and re-distributed (*i.e.*, bar grading) in constructed flood control channels and in natural channels with flood easements to ensure that channel capacity is maintained and to reduce bank erosion. Sediment maintenance takes place in three types of streams: (1) constructed flood control channels, (2) mainstem Russian River, and (3) natural channels other than the Russian River. Each of these three channel types are evaluated in separate sections. SCWA is responsible for performing needed sediment maintenance activities in constructed flood control channels. In the mainstem Russian River, sediment maintenance is performed by SCWA in Sonoma County and by the MCRRFCD in Mendocino County, under obligation to the ACOE. SCWA also performs sediment maintenance activities in natural channels other than the Russian River.

3.1.1 SEDIMENT MAINTENANCE IN FLOOD CONTROL CHANNELS

Under current policy, sediment removal is performed by SCWA as a standard maintenance practice on an as-needed basis in constructed flood control channels. This work is done primarily in channels located in the Rohnert Park-Cotati area.

Sediment removal is deemed necessary when field inspections indicate that the invert elevation of outfall channels is generally less than 12-inches above the streambed (pers. comm. Bob Oller, SCWA). Sediment removal is performed during the summer or fall months (until October 31) when most flood control channels are dry. However, in some years sediment removal activities may occur in channels with isolated, standing pools or with small amounts of flowing water that are in part derived from urban return flows. Urban return flows have been increasing in recent years (pers. comm., Bob Oller, SCWA). Since sediment removal activities take place during the summer and fall, the only life history stage that potentially would be directly affected is rearing juvenile salmonids or chinook spawners.

The constructed flood control channels are part of the designated critical habitat for threatened salmonids, but have rearing habitat that is very limited in extent and is of marginal quality where it does exist. Flood control channels in the Rohnert Park-Cotati area are considered to have very limited and poor quality rearing habitat due to:

- Dry to very low summer flows
- Poor water quality from urban runoff
- Straightened channel planform
- Low-gradient
- Susceptibility to sediment deposition

Juvenile rearing habitat is mostly unavailable in streams draining the Rohnert Park-Cotati area since many of these channels are often naturally dry, or have only very small amounts of flow during the summer. Dry or very low summer flows were most likely a condition that historically existed in these channels. The pool/riffle type habitat needed for rearing conditions is likely poorly developed due to the straightened channel planform. Channel straightening, which is an integral part of the flood control design, eliminates channel sinuosity (*i.e.*, meandering). Sinuosity is an important element of the natural channel geomorphology that promotes pool development on the outside bend of a meander and bar development on the inside of the meander. Since the flood control channels have a permanently straightened planform, the development of pool-bar units with a meandering planform and associated rearing habitat is inhibited.

Many of the flood control channels are subject to some sediment deposition, but deposition is particularly significant (*i.e.*, adversely affects flood capacity and requires excavation) in those channels that have a relatively low-gradient such as those in the Rohnert Park-Cotati area. The average flood control channel gradient is about 0.2%, and is often less for those channels that tend to require excavation in the Rohnert Park-Cotati area. Sediment deposition may reduce the depth and capacity of pools (if they are present), and thereby reduce the availability of rearing habitat. In combination, the lack of summer flows and limited amount and depth of pool habitat is likely to cause relatively high summer temperatures and large diurnal temperature fluctuations that will also limit the availability of juvenile rearing habitat.

For all of the reasons presented above, rearing habitat is unlikely to be present in those Rohnert Park area flood control channels that require sediment removal in order to maintain flood capacity. It is acknowledged that potentially a few individuals may be found rearing during the summer months, but the primary function of these channels is as a migration corridor. Steelhead are the most abundant of the protected species in these channels. Chinook salmon and coho salmon may also utilize portions of these channels, but are unlikely to be either widely distributed or to be a significant presence.

3.1.1.1 Direct Fish Injury

Injury to fish can be caused by an increase in turbidity and sediment input, stress from displacement, or direct injury or mortality from equipment. When operating in streams with flowing water, sediment containment during maintenance activities consists of washed pea gravel placed across the channel. This barrier slows the water flow, allowing suspended sediment to settle out where it can be cleared. The gravel used in constructing the berm is pre-washed, and therefore does not contribute fine sediment. More aggressive sediment control techniques, such as a clean bypass, are not utilized. However, the current sediment containment practices are likely to result in effective sediment control, with a limited amount of fine sediment being introduced within the immediate area. Therefore, the score for sediment removal practices for component 1 of the sediment containment evaluation criteria is a 3 (Table 3-1).

The use of heavy equipment on a streambank could potentially result in "upslope" disturbance (for sediment removal activities in flood control channels, upslope is synonymous with the streambank). SCWA does not use equipment on the streambank, but rather works from the service road adjacent to the channel or within the channel bottom. Occasionally, a new access road to the stream bottom may be necessary. The use of existing access roads limits the amount of streambank disturbance, protecting vegetation and soil structure. Therefore, the risk of an adverse effect on rearing salmonids is low. Component 2 of the sediment containment evaluation criteria receives a score of 4 (Table 3-1).

Table 3-1 Sediment Containment Evaluation Scores for Sediment Removal

Category Score	Evaluation Category	Current Operations Score*
	Component 1: Instream sediment control	
5	Project area does not require rerouting streamflow	
4	Clean bypass or similar method used	
3	Effective instream sediment control (*e.g.* berm/fence)	Co, St, Ch
2	Limited sediment control	
1	No instream sediment control	
Category Score	**Evaluation Category**	**Current Operations Score***
	Component 2: Upslope sediment control	
5	No upslope disturbance, or an increase in upslope stability	
4	Limited disturbance with effective erosion control measures	Co, St, Ch
3	Moderate to high level of disturbance with effective erosion control measures	
2	Action likely to result in increase in sediment input into stream	
1	Action likely to result in slope failure, bank erosion, an uncontrolled sediment input to the channel or major changes in channel morphology	

*St = Steelhead, Co = Coho salmon

Sediment removal and channel clearing activities have the potential to injure or kill fish when equipment is operated in the channel. Fish that are temporarily displaced may be subjected to stress, increased competition or predation. SCWA biologists assess habitat conditions prior to sediment removal to determine if protected fish species are in the maintenance area. SCWA has found that salmonids are not usually present in these areas during the time of year that the work is performed (A. Harris, SCWA, pers. comm., 2000). If protected salmonids are determined to be present, a gravel berm is established to exclude fish from the area, and a fish rescue is performed, if necessary. Because efforts are taken to avoid effects on protected species by exclusion from the area affected or relocation to other habitat, the risk of injury is low. Therefore, sediment removal and channel clearing activities receive a score of 3 (Table 3-2).

Table 3-2 Opportunity for Injury Evaluation Scores for Sediment Removal

Category Score	Evaluation Category	Current Operations Score*
5	Project area is not within flood plain or below maximum water surface elevation (WSEL), and requires no isolation from flow.	
4	Project area is within dry part of channel, or construction and maintenance activity scheduled when species of concern is not present.	
3	Appropriate BMPs are applied; *e.g.* project area survey, escape or rescue provided, project area isolated from flow (if appropriate).	Co, St, Ch
2	Limited ability to apply appropriate BMPs.	
1	Appropriate BMPs are not applied.	

*Co = Coho, St = Steelhead

The level of risk for injury to fish depends, in part, on how much of the channel is "cleaned" and how often the work is performed. Table 3-3 lists the constructed flood control channels and provides estimates on the extent and frequency of sediment removal activities. Many of these channels have never required sediment maintenance (*i.e.*, self-cleaning). The magnitude of these activities is discussed in more detail in Section 3.1.1.2.

In summary, sediment removal activities may adversely affect a few individual juvenile steelhead, coho salmon, or chinook salmon, but are not likely to result in a population level effect for any of the three species. Disturbance to the streambank is minimized, and effective sediment control practices are used during instream work in wetted channels. Channels are assessed by SCWA biologists before sediment removal activities are performed, and in the rare instances that it is determined that protected species are likely to be present, a gravel berm is established to exclude fish and, if necessary, rescue is performed. To date, gravel berms and fish rescues have not been necessary. Because sediment-laden constructed flood control channels do not generally provide rearing habitat for steelhead or coho salmon, they are likely to have few, if any fish, so the risk for injury to fish is low. While some individual fish may be exposed to injury, there is low risk to the population as a whole.

Table 3-3 Frequency and Extent of Sediment Removal in Constructed Flood Control Channels

Creek	Total Constructed Channel Length (ft)	Percent of Channel Worked	Average Bottom Width (ft)	Frequency of Work	Recently Cleaned*	Comments
Santa Rosa Area Streams						
Austin	5,000		20	>20 yrs		Self cleaning
Brush	12,100		25	>20 yrs		Self cleaning
College	4,400		15	>20 yrs		Self cleaning
Forestview	3,850			>20 yrs		Self cleaning
Indian	1,650	100%	10	>10 yrs	1999	From Piner Rd north 2,000 ft
Lornadell	1,200	100%	15	5-10 yrs	1987/88	Not cleaned in last 5 years
Matanzas	2,500	100%	35	>10 yrs	1988/89	Last cleaning
Oakmont	6,600		20	> 10 yrs		Hydraulic only/ no sediment removal
Paulin	15,400		20	>20 yrs		Self cleaning
Peterson	8,800		15	>20 yrs		Self cleaning
Piner	12,000	50%	20	>10 yrs	1989	Remove sand bar at Sleepy Hollow Ct
Roseland	23,000		25	5-10 yrs		Not cleaned in last 5 years
Russell	3,800	100%	15	5-10 yrs	1989/97	From Mendocino Ave to Indian Cr
Santa Rosa	48,400		30/40	>20 yrs		Self cleaning
Sierra	1,600		15	>20 yrs		Hydraulic only/ no sediment removal
Steele	12,000	20%	15	10-20 yrs		Planned for 2001
Wendell	6,100	50%	15	5-10 yrs		Not cleaned in last 5 years
Windsor	5,000	50%	20	5-10 yrs		Not cleaned in last 5 years
Cotati-Rohnert Park Area Streams						
Colgan	19,250	50%	30	5-10 yrs	2000	From Stony Point Rd Llano Rd
Coleman	3,300		20	1-5 yrs	1997	Cleaned upper reach 2 times in Golis Park in last five years

Table 3-3 Frequency and Extent of Sediment Removal in Constructed Flood Control Channels –Continued–

Creek	Total Constructed Channel Length (ft)	Percent of Channel Worked	Average Bottom Width (ft)	Frequency of Work	Recently Cleaned*	Comments
Cotati-Rohnert Park Area Streams –continued-						
Copeland	19,250	100%	30	1-3 yrs	2000	Commerce Blvd to Jasmine Ct 12,100 ft
Copeland South Fork	4,000	100%	15	10-20 yrs	1986/87	Last cleaning
Cotati	1,000	100%	15	5-10 yrs		Not cleaned in last 5 years
Crane	800	100%	15	5-10 yrs	1991/92	Planned for 2001
Five	6,600	100%	25	5-10 yrs	2000	From Snyder to Country Club
Gossage	7,700	90%	15	5-10 yrs	1989/98	Gravenstein Hwy (Hwy 12) to Laguna de Santa Rosa
Hinebaugh	13,200	25%	25	1-5 yrs	1989,95, 99	3 separate reaches of approximately 1,000 ft
Hunter Lane Channel	6,600	100%	20	5-10 yrs	2000	Santa Rosa Ave to Hunter Lane
Kawana Springs	2,200	100%	20	10-20 yrs	1988/89	Petaluma Hill to Colgan Creek
Laguna de Santa Rosa	24,200	10%	40	5-10 yrs	1992/93	East Cotati Ave to Commerce Blvd
Spivok	1,600		10	5-10 yrs		Not cleaned in last 5 years
Todd	15,400	40%	20	5-10 yrs		Not cleaned in last 5 years
Washoe	1,600	100%	15	5-10 yrs		Not cleaned in last 5 years
Wilfred	22,000	100%	15	5-10 yrs	1989/95	From Laguna de Santa Rosa to Snyder Lane
Healdsburg Area Streams						
Norton Slough	6,600	100%	20	1-5 yrs	1987/88	Planned for 2001
Windsor Area Streams						
Starr	2,500	100%	15	10-20 yrs	1985/86	Last cleaning
Geyserville Area Streams						
Woods	3,500	30%	15	1-5 yrs	1995, 98, 99	Cleaned approx 500 ft near rail road tracks

*Some creeks that have not required recent cleaning may require cleaning in the future.

3.1.1.2 Long-term Changes to Critical Habitat Associated with Sediment Removal

Table 3-3 lists the constructed flood control channels and the estimated frequency of maintenance related to sediment removal (P. Valenti, SCWA, pers. comm. 2000). Estimates of the channel length (defined as a percentage of total channel length) where work is usually performed are indicated. This percentage does not represent a continuous length of channel in which sediment is removed, since the actual maintenance work is typically performed at discrete sites. Only that portion of the channel reach that is hydraulically impaired is cleaned. The frequency and length of work varies over time. In the past, flood control channels were cleaned at least once every five years. Currently, channel cleaning is restricted to an as-needed basis to maintain flood capacity. For example, 100% of Copeland Creek was cleaned once in 1997, but only 17% (2,000 feet) requires cleaning this year. The frequency of work may change in the future if land-use practices or development occurs that alters sediment supply conditions in the sub-basins draining the flood control channels.

One of the largest recent sediment removal activities was performed in a two and a half mile stretch of Copeland Creek three years ago. About 2,000 feet of channel was maintained in 2000. Sediment input from a large runoff area upstream has resulted in significant sediment loads into this creek (R. Anderson, SCWA, pers. comm. 2000). SCWA is working on restoring approximately 6,000 feet of streambank upstream on Copeland Creek to reduce streambank erosion (see *Interim Report 6: Restoration and Conservation Actions* for details of this and other erosion control projects).

Sediment was removed from a wide section of Hinebaugh Creek west of the freeway in 1999. Some sediment is deposited there when backwater from Laguna de Santa Rosa enters the creek. Coleman Creek has a short segment of constructed channel through a local golf course that requires sediment removal activities. Increased sedimentation in this creek may be due to upstream development. It is expected that the Cook Creek Conduit Sediment Basin upstream of Rohnert Park, completed two years ago, will help to reduce some of the sediment input to Coleman Creek.

Flood control channels that are subject to sediment removal activities function primarily as migration corridors for upstream and downstream migrants during the winter and spring. Sediment removal activities that may have long-term habitat effects on migration include reduction of habitat complexity such as loss of a low-flow “thalweg” needed to provide fish passage, and loss of instream cover (rocks, vegetation). Such habitat features are often removed within the reach targeted for excavation.

Summer rearing habitat is not typically found in constructed channels subject to sediment removal (see section 3.1.1). There are two channels identified that potentially support rearing habitat and have needed sediment removal activities in the past. The two channels are: (1) Laguna de Santa Rosa, (2) Todd Creek. The basis for identifying these channels as potentially supporting rearing habitat is that they either maintain flow through the summer season or steelhead have been known to occur. Both channels are likely to require sediment maintenance at some time in the future. However, low summer flows and high summer water temperatures limit rearing habitat in Copeland Creek.

Spawning habitat is also not provided by those flood control channels needing sediment maintenance, for reasons similar to those discussed regarding the lack of rearing habitat. Low-gradient channels with a straightened planform that are subject to sediment deposition do not generally provide spawning habitat conditions. Observations of flood control channels indicate that suitable spawning sites such as gravel deposits at pool-tailouts are very infrequent and limited in extent. Lack of hydraulic complexity probably accounts for limited sites where sorting of gravels into suitable spawning riffles might occur. This is due to the straight channel planform and entrenched (vertical containment) geomorphic condition of the flood control channels. There are no known reports or observations of spawning in those constructed flood control channels which require sediment excavation. In fact, only Oakmont, Paulin, and Santa Rosa creeks are believed to provide spawning habitat.

In general, sediment removal activities under current practices are performed in channel reaches that contain relatively poor habitat, with significant sediment deposition. These channels function primarily as migration corridors. Small lateral bars are observable in many locations along the channel bottom, and these deposits are usually stable, being vegetated with either grasses or tules. The sediment deposits are primarily fine sediments, of silt and clay size classes. These small lateral bars and other deposits narrow the bottom width of the channel, and tend to create a sinuous low-flow path contained within the straight flood control channel.

Following sediment removal activities, observations indicate that the channel bed is devoid of the small lateral bars and associated in-channel vegetation. The loss of a sinuous, narrow, low-flow channel allows the streamflow to spread over the bottom width, reducing depth. This reduced depth of flow results in a fish passage barrier when runoff is relatively low. Reduced depth of flow can be expected to occur whenever there are lateral bars that are removed, eliminating a low-flow thalweg and widening the channel bottom. As a result, migration may be limited to periods when flows are higher depth is adequate for passage.

The lateral bar features are eventually re-established when there are runoff events capable of mobilizing and depositing bed sediments, and vegetation has had an opportunity to develop on the bars. Vegetation on the streambed bars may take more than one season to become re-established, so migration could be effected for more than one year.

The post-sediment removal effects on passage conditions have been recently observed on Copeland and Five Creeks. Sediments were excavated from sections of both channels during fall of 2000. Flow depths on both streams in the excavated portions were estimated to be on average 2 to 3-inches during a field inspection in March. In the un-excavated portions of these channels, depths were a minimum of 6 inches. Figure 3-1 is a photograph (December 2000) of recently excavated section of Copeland Creek with a wide, shallow, and flat bottom. Figure 3-2 is a photograph of an un-excavated section of Copeland Creek from the same date, showing a narrowed channel bottom and vegetated lateral bars. Steelhead generally require approximately 6-inches of depth for migration (Flosi *et al.* 1998).

Given the 2-to 3-inch depths observed on Copeland and Five creeks, fish passage is likely to be impaired following sediment maintenance. Based on the types of habitat alteration that occurs, sediment removal can adversely affect migration in constructed flood control channels during low flows.

Figure 3-1 Copeland Creek downstream from Snyder Lane, December 2001. Channel reach was excavated in October 2000.

Figure 3-2 Copeland Creek downstream of Country Club Drive, December 2000. This reach of Copeland Creek has not been recently excavated. Note the vegetated lateral bars and the narrowed channel bottom.

Sediment removal in Todd Creek and Laguna de Santa Rosa could potentially reduce rearing habitat by eliminating pools and associated cover within the excavated reach. Sediment excavation flattens the bed topography, reducing hydraulic and habitat complexity. This is likely to be a significant effect for steelhead and coho salmon, the two listed species most likely to be present in these channels. The effect would occur within the excavated reach only, and would not extend to downstream areas.

Sediment excavation does not affect other aspects of channel geomorphology or aquatic habitat downstream of the excavated reaches. Observations of the flood control channels indicate that there are relatively few sites that function as sediment deposition areas within the well-entrenched and straightened flood control channels. Small lateral bars narrowing the low-flow channel are already a common feature where there are suitable deposition sites. There is also very little evidence of channel incision due to sediment excavation based on the inverts of culverts and bridge crossing structures. Excavation has apparently not significantly reduced sediment supply to reaches downstream of maintenanced areas. Additional sediment that would be transported downstream if this maintenance activity ceased would most likely lead to channel aggradation, and possibly increased erosion along the channel banks. This would cause a loss of not only channel flood capacity, but would allow additional sediments to reach Laguna de Santa Rosa and ultimately the Russian River. The Russian River drainage is identified by the Regional Water Quality Control Board (303-D listing) as impaired for sediment.

3.1.2 Sediment Maintenance in Natural Channels other than the Russian River

SCWA does not perform routine sediment removal activities in natural channels. Sediment removal and bank stabilization work is occasionally required in natural channels. These instances are usually brought to the attention of SCWA, when landowners request SCWA to remediate problems associated with reduced channel flood capacity. In the past, sediment excavation in natural channels has almost always been related to landslides. It is estimated based on past activities, that sediment removal in natural channels occurs about once in every 10 years (pers. comm., Bob Oller, SCWA). The most recent sediment removal project in a natural channel occurred on Big Sulphur Creek in 1997. However, sediment removal in natural channels could be needed on almost any stream in the Russian River basin. Any of the protected fish species may or may not be present in the stream, and habitat conditions may vary widely.

Some standard BMPs would apply to work in natural channels. If possible, sediment excavation and bank stabilization is performed when the stream is at low-flow, during the summer or fall months. Depending on the location, there may or may not be flow in the channel at the time of the sediment removal work. If the channel is not dry, then flows are diverted, typically using earthen coffer dams (pea gravel or, if necessary, a clean bypass). A fish biologist would inspect the reach planned for de-watering, and rescue would be provided if necessary. Work is performed using backhoes, excavators, and dump trucks, depending upon the site configuration and access. BMPs for operating equipment in or near an active stream channel would be followed.

3.1.2.1 Direct Fish Injury

Evaluation for sediment containment and opportunity for injury is presented in Tables 3-4 and 3-5. Since any of the listed species may be present on a given stream at the time of the sediment excavation work, the scoring is applied to all three listed species. The scoring results are similar to that for the flood control channels, except that a score of 3 is given to the upslope sediment control component. Unlike the flood control channels, easy access to the site from existing service roads at the top of bank may not be available on a natural channel. However, SCWA employs upslope sediment control measures such as silt fences when performing sediment excavation work, so a score of 3 indicating a moderate to high level of disturbance with effective erosion control measures is given.

Table 3-4 Sediment Containment Evaluation Scores for Sediment Removal

Category Score	Evaluation Category	Current Operations Score*
	Component 1: Instream sediment control	
5	Project area does not require rerouting streamflow	
4	Clean bypass or similar method used	
3	Effective instream sediment control (*e.g.* berm/fence)	Co, St, Ch
2	Limited sediment control	
1	No instream sediment control	

Category Score	Evaluation Category	Current Operations Score*
	Component 2: Upslope sediment control	
5	No upslope disturbance, or an increase in upslope stability	
4	Limited disturbance with effective erosion control measures	
3	Moderate to high level of disturbance with effective erosion control measures	Co, St, Ch
2	Action likely to result in increase in sediment input into stream	
1	Action likely to result in slope failure, bank erosion, an uncontrolled sediment input to the channel or major changes in channel morphology	

*St = Steelhead, Co = Coho salmon, Ch = Chinook salmon

Sediment removal and channel clearing activities have the potential to injure or kill fish. Fish that are temporarily displaced may be subjected to stress, increased competition or predation. SCWA biologists assess habitat conditions prior to sediment removal to ensure that protected fish species are not likely to be in the maintenance area. If protected salmonids are determined to be present, a gravel berm is established to exclude fish from the area, and a fish rescue is performed, if necessary. Therefore, sediment removal activities receive a score of 3 (Table 3-5).

Table 3-5 Opportunity for Injury Evaluation Scores for Sediment Removal

Category Score	Evaluation Category	Current Operations Score*
5	Project area is not within flood plain or below maximum water surface elevation (WSEL), and requires no isolation from flow.	
4	Project area is within dry part of channel, or construction and maintenance activity scheduled when species of concern is not present.	
3	Appropriate BMPs are applied; *e.g*. project area survey, escape or rescue provided, project area isolated from flow (if appropriate).	Co, St, Ch
2	Limited ability to apply appropriate BMPs.	
1	Appropriate BMPs are not applied.	

*St = Steelhead, Co = Coho salmon, Ch = Chinook salmon

3.1.2.2 Long-term Changes to Critical Habitat Associated with Sediment Removal and Bank Stabilization in Natural Channels

Sediment removal activities in natural channels occurs on a very limited and infrequent basis. All past sediment removal activities were associated with large landslides or storm events that had deposited in the channel and reduced flood capacity, potentially adversely affecting infrastructure such as roads, bridges, homes, utilities, *etc*. It is estimated that such sediment removal actions occur about once in every 10 years. The extent of sediment removal may vary depending upon the site. On Big Sulphur Creek in 1997, approximately 1000 ft of channel was excavated and bank stabilization work was performed.

SCWA has developed BMPs and other guidelines for planning and implementing sediment removal and bank stabilization work performed in natural channels in order to protect listed species and to minimize the potential for significant habitat alterations. These guidelines are discussed in Section 1.4.4 and are summarized below:

(1) Sediment removal and bank stabilization projects are not to exceed 1,000 ft in length for any single project.

(2) Projects that are within 1,000 ft of a previously armored site are not implemented.

(3) Construction occurs during the summer to avoid spawning and incubation periods.

(4) A qualified fisheries biologist consults on the project design prior to implementation to consider all feasible alternatives. Habitat and biological resources in the area are evaluated

(5) Projects are developed in consultation with CDFG.

(6) Bio-engineering bank stabilization methods are given priority where they will provide effective erosion control measures.

(7) Where bio-engineering bank stabilization methods are not deemed to be practical, then priority is given to incorporating vegetative plantings into the hard-armoring techniques.

(8) Fish habitat restoration elements (such as native material revetments) are incorporated into bank stabilization practices where they are feasible and are to be used to replace any lost habitat.

(9) If LWD is present in excavated sediments, then it is removed from the channel only if it threatens to de-stabilize a section of streambank.

Potential habitat altering effects include loss of shade canopy and cover, and loss of hydraulic and associated habitat diversity due to sediment removal. However, given the infrequent need for maintenance activities in natural channels (about every 10 years), the prescriptions for limiting the size of any project to 1,000 ft, and the guidelines for incorporating bio-engineering, revegetation, and fish habitat elements into bank stabilization work, the potential for habitat-altering effects that are significant to the population of steelhead, coho salmon, and chinook salmon is small.

3.1.3 Sediment Removal in the Russian River under ACOE Obligations

In the mainstem Russian River, sediment maintenance is conducted by two different agencies, the MCRRFCD and SCWA, each in their respective counties. SCWA is under obligation to the ACOE to excavate and grade sediments over a 22-mile reach between river mile 41 near Cloverdale to river mile 63, near the Mendocino County Line. The sediment maintenance work consists of grading and re-aligning bars in the channel, and also vegetation removal on gravel bars during the dry summer season. Sediments are redistributed in the channel, and may also be excavated and removed from the active river channel. The purpose of this work is to maintain channel flood capacity and to control bank erosion. This sediment maintenance activity is closely linked to vegetation maintenance practices, which are also intended to maintain channel flood capacity and to reduce bank erosion. SCWA discontinued performing sediment maintenance work in the Russian River since 1993, but remains under obligation to the ACOE to provide flood capacity and to control bank erosion.

MCRRFCD is also under obligation to the ACOE to maintain flood capacity and reduce bank erosion by excavating and grading sediments over a 36 mile reach of the Russian River. MCRRFCD sediment maintenance program is ongoing in order to meet these obligations. The sediment maintenance work consists of grading and re-aligning bars in the channel, and also vegetation removal from gravel bars during the dry summer season. Sediments are redistributed in the channel, but are not removed from the active river channel.

3.1.3.1 Direct Fish Injury

Evaluation for sediment containment and opportunity for injury is presented in Tables 3-6 and 3-7. Listed species that may be present on the Russian River at the time of the sediment excavation work are rearing juvenile steelhead and adult chinook salmon. The scoring results are 3 for effective instream sediment control techniques. Most of the time, work takes place on dry gravel bars, and does not require re-routing streamflow in the low-flow channel. However, occasionally the low flow channel is redirected when the channel splits around a gravel bar, so that instream sediment control is necessary.

Unlike the flood control channels, easy access to the site from existing service roads at the top of bank may not be available along the Russian River. However, SCWA employs up-slope sediment control measures such as silt fences when performing sediment excavation work, so a score of 3 indicating a moderate to high level of disturbance with effective erosion control measures is given. MCRRFCD does not work in upslope areas or in the wetted channel, so there is little potential for sediments to enter the low-flow channel, and therefore sediment control is not necessary.

Table 3-6 Sediment Containment Evaluation Scores for Sediment Removal and Channel Clearing Practices

Category Score	Evaluation Category	Current Operations Score*
	Component 1: Instream sediment control	
5	Project area does not require rerouting streamflow	
4	Clean bypass or similar method used	
3	Effective instream sediment control (*e.g.* berm/fence)	Co, St
2	Limited sediment control	
1	No instream sediment control	

*St = Steelhead, Co = Coho salmon, Ch = Chinook salmon

Sediment removal and channel clearing activities have the potential to injure or kill fish. Fish that are temporarily displaced may be subjected to stress, increased competition or predation. SCWA biologists assess habitat conditions prior to sediment removal to ensure that protected fish species are not likely to be in the maintenance area. If protected salmonids are determined to be present, a gravel berm is established to exclude fish from the area, and a fish rescue is performed, if necessary. Therefore, sediment removal and channel clearing activities receive a score of 3 (Table 3-7).

Table 3-7 Opportunity for Injury Evaluation Scores for Sediment Removal

Category Score	Evaluation Category	Current Operations Score*
5	Project area is not within flood plain or below maximum water surface elevation (WSEL), and requires no isolation from flow.	
4	Project area is within dry part of channel, or construction and maintenance activity scheduled when species of concern is not present.	
3	Appropriate BMPs are applied; *e.g.* project area survey, escape or rescue provided, project area isolated from flow (if appropriate).	Co, St
2	Limited ability to apply appropriate BMPs.	
1	Appropriate BMPs are not applied.	

*St = Steelhead, Co = Coho salmon

3.1.3.2 Long-Term Habitat Changes

Gravel bar grading and re-alignment in the Russian River is likely to affect the geomorphology of the channel. By preventing stable bar development, the channel is essentially straightened and sinuosity decreased. This decreased sinuosity reduces bank erosion, but also reduces the opportunity for pool development by limiting scour on the outside of meander bends. In addition, gravel bar grading generally results in a flatter streambed, reducing the hydraulic diversity and associated aquatic habitat diversity represented in the channel. This lack of hydraulic diversity probably includes reduced availability of high-flow refuge habitat due to limited bedform topography as bars are regularly skimmed. In addition, SCWA may remove bed sediments from the Russian River. This activity could reduce the availability of spawning gravels, however, lack of spawning habitat is not likely to be a factor limiting populations of steelhead or chinook salmon on the mainstem. Given the large area that is routinely covered by SCWA and MCRRFCD, a combined total of nearly 60 miles, the extent of habitat alteration on the Russian River is substantial.

Since gravel bar grading is closely inter-related with removal of riparian vegetation growing on the bars, there is an associated loss of shade and canopy cover. The effects of vegetation removal in the Russian River are separately discussed and evaluation criteria provided in Section 3.2.1.1. Loss of spawning gravels is not an effect expected from the maintenance practices on the Russian River since sediments are not permanently removed from the river.

3.2 VEGETATION MAINTENANCE

Vegetation maintenance practices differ between natural and constructed flood control channels in the Mark West Creek Watershed. Salmonids use both types of channels for migration, although rearing and spawning is known to occur in only a few flood control channels. Removal of riparian vegetation has the potential to reduce cover for rearing salmonids, increase water temperatures, reduce the input of vegetation or aquatic insects that support the food chain for salmonids, and decrease bank stability (in natural channels) which increases the potential for erosion and sedimentation.

The assessment of vegetation maintenance effects is organized into two principle channel groupings, natural channels and flood control channels. Under natural channels, the assessment is further subdivided into long-term indirect effects to habitat conditions that are implemented under; (a) obligations to the ACOE on Dry Creek and the Russian River, and (b) all other natural tributary streams. The assessment of direct immediate effects to fish populations associated with herbicide spraying in natural channels is separately discussed and evaluated.

The assessment and discussion of effects in constructed flood control channels is organized based on (a) direct, immediate effects of herbicide spraying, and (b) long-term indirect habitat alteration effects. This last section evaluates current vegetation maintenance effects and also considers effects that would occur based on potential future changes in maintenance practices that may be necessary and are presently being investigated, in order to fulfill SCWA flood control obligations.

3.2.1 NATURAL CHANNELS

Table 1-2 lists the natural waterways maintained by SCWA in the Russian River Watershed. Past practices that may have resulted in degradation to native riparian vegetation and to instream vegetation on natural channels have been modified. While in the past vegetation was removed indiscriminately, current practices are changing to retain canopy cover as much as possible. Since 1987, heavy equipment has not been used in the bottom of natural streams; rather, hand labor is used. Two- to four-person crews clear brush by hand with chain saws and loppers. In heavy brush, a chipper is used to break up the slash so that it can be disposed of, rather than leaving it to decay in the stream. Larger material is cut into shorter lengths and removed from the site. The woody material is cut up and pulled out by a truck with a winch. Trees and limbs are removed from the stream channel only if needed for flood protection. SCWA maintenance practices include leaving a buffer strip of vegetation along the low-flow channel margin. Every effort is made to preserve the natural habitat for fish and riparian wildlife. No direct injury to protected species is expected.

The evaluation criteria (Table 3-8) assess the amount of vegetation removed within a site. While limited vegetation removal in isolated sites may not negatively affect salmonid habitat, if the work is done over several sections of a stream and/or in prime spawning and rearing habitat, the net effect may be larger. For example, if willows are removed from several gravel bars to reduce streambank erosion in an important coho salmon stream, the net effect may be to significantly alter channel morphology, the amount of instream cover, and the availability of refugia from high flows. To avoid significant effects to salmonid habitat, vegetation removal in natural channels is kept to a minimum and used only where there is an unacceptable threat from a 100-year flood event or where a decrease in bank stabilization threatens a structure. Most projects require between 300-600 ft of vegetation maintenance, except for Dry Creek and the Russian River (pers. comm. Bob Oller, SCWA). Alternative solutions can be pursued where feasible, such as the utilization of bio-engineering practices to stabilize banks, tree planting to add bank stability and reduce understory growth, offset levees to increase floodplain, or floodplain level culverts to increase floodplain draining at culvert crossings.

Vegetation removal by hand, done on a selective basis, limits disturbance to the streambed and streambanks. When vegetation is removed from the stream channel bottom, there is a reduction in the amount of cover available in the stream and a loss of winter high flow refugia. Therefore, this practice is restricted to when there is an unacceptable threat from a 100-year flood event or where a decrease in bank stabilization threatens a structure. Native trees growing along stream banks have been allowed to establish and this has increased the width of some portions of the riparian corridors.

3.2.1.1 Vegetation Maintenance Assessment and Scores Associated with Obligations to the ACOE on Dry Creek and Russian River

Vegetation removal has never been performed in Dry Creek, and was last performed on the mainstem Russian River about ten years ago. It is the responsibility of SCWA under contractual agreements with the USACE to perform maintenance activities related to removal of in-channel vegetation on Dry Creek and the mainstem Russian River. On Dry Creek, maintenance of vegetation (as well as sediment and debris removal) is expected over the entire 13-mile length of the stream in order to maintain pre-project (Warm Springs Dam) channel capacity and low-flow channel alignment (ACOE, 1991). In order to fulfill this maintenance obligation today, SCWA has estimated that vegetation would need to be removed over a 300 ft.-wide section of channel (Bob Oller, pers. comm.). On the mainstem Russian River, vegetation maintenance obligations extend from approximately river mile 41 near Cloverdale to river mile 63, near the Mendocino County Line. Channel clearing is to include removal of serious obstructions of a permanent nature, including trees, brush, and snags (also gravel bars and debris). No recent estimate of vegetation removal requirements have been made by SCWA for the Russian River; however, previous maintenance included removal of vegetation from approximately a 250 to 400 ft.-wide section of channel (Bob Oller, pers. comm.).

On Dry Creek, channel widths at bankfull generally range from approximately 150 to 300 ft, with up to 500 ft widths at some locations. Dry Creek is known to support rearing, spawning, and migration for steelhead, chinook, and coho salmon species. On the mainstem Russian River in the Alexander Valley, channel widths at bankfull generally range from approximately 400 ft to 800 ft, with up to 1,000 ft widths at some locations. Upstream of Alexander Valley, channel widths are narrower, approximately 200 ft to 500 ft at bankfull. Steelhead and chinook salmon are known to use the Russian River mainstem for spawning, rearing, and migration.

Given the current need to remove vegetation from an estimated 300 ft-wide section of Dry Creek, this would result in loss of 60% to 100% of the riparian vegetation within the bankfull channel. Given the estimated need to remove vegetation from an estimated 250 to 400 ft. width of the Russian River, this would result in loss of 40% to 100% of the riparian vegetation within the bankfull channel. The resulting score for Dry Creek is a 1 (Table 3-8) for steelhead, coho, and chinook. For the Russian River the score is a 1 for steelhead and chinook salmon (Table 3-9). Since Dry Creek and the Russian River support multiple life history stages for the listed species, and because the extent of vegetation removal is large (both in cross-sectional area and length of channel to be addressed under the ACOE obligations), effects on listed species are likely to be substantial and adverse.

Table 3-8 Vegetation Control Scores for Natural Channels: Dry Creek

Category Score	Evaluation Criteria Category	Score
5	No vegetation removal except "spot" treatment, or removal of only non-native species	
4	<10% removal	
3	>10% to <25% reduction in vegetation	
2	>25% to <50% reduction in vegetation	
1	>50% reduction in vegetation	St, Co, Ch

*St = Steelhead, Co = Coho salmon, Ch = Chinook salmon

Table 3-9 Vegetation Control Scores for Maintenance Activities in the Russian River

Category Score	Evaluation Criteria Category	Score
5	No vegetation removal except "spot" treatment, or removal of only non-native species	
4	<10% removal	
3	>10% to <25% reduction in vegetation	
2	>25% to <50% reduction in vegetation	
1	>50% reduction in vegetation	St, Ch

*St = Steelhead, Co = Coho salmon, Ch = Chinook salmon

The MCRRFCD also conducts vegetation maintenance practices in the Russian River under obligations to the ACOE. MCRRFCD is responsible for vegetation maintenance along a 36 mile section of the Russian River in Mendocino County. Approximately one 12 mile segment is maintained in any given year. This maintenance work consists of removing willows and grading sediments (bars) in order to improve channel capacity and alignment of the high flow path, thereby reducing streambank erosion during high flows. The work is performed during the dry summer season using an excavator and a CAT. The extent of vegetation control is to remove those willows that have established on the bars that are adjacent to the low-flow channel. The willows are moved to the margins of the channel against the streambank, where they may take root and provide improved erosion protection. Observations of these willow-reinforced bars indicate that they can typically be very large, extending up to one-half or more of the channel width, and extending for a 1,000 linear feet. Although the amount of willow removal over time is not exactly known, given the size of the bars that need to be excavated it is estimated that more than 50% of the vegetation in the channel cross-sectional area is typically removed and/or re-distributed against the streambank. Therefore the score for MCRRFCD maintenance practices is a 1, as shown in Table 3-9.

Given the large magnitude of the SCWA and MCRRFCD vegetation maintenance activities, it is likely that there are substantial adverse alterations to habitat conditions that support steelhead trout, coho salmon and chinook salmon on the Russian River, and all three listed species on Dry Creek. The nature of these alterations probably include increased stream temperatures and decreased cover due to the loss of the extent of the vegetative canopy. The loss of riparian vegetation on bars likely reduces opportunities for high flow refuge and generally decreases hydraulic and associated aquatic habitat diversity. In addition, bar accretion is minimized when velocity retarding vegetation is removed, thereby reducing sites available for sediment deposition and storage. Inhibiting bar development most likely results in a reduced channel sinuosity. This change in channel geomorphology tends to reduce the formation of pools and also contributes to the overall lack of hydraulic and aquatic habitat diversity.

3.2.1.2 Vegetation Maintenance Scores Associated with Natural Channels Other Than Obligations to the ACOE on Dry Creek and Russian River

Current practices emphasize the creation of a shade canopy over stream channels to reduce plant growth on the channel bottom. Native trees are allowed to establish, and understory in the channel and along the banks is judiciously removed. Generally, thinning of the understory and pruning of lower limbs (in order to raise the canopy) is performed in order to improve flood capacity.

For the natural channels (other than Dry Creek and Russian River) where vegetation removal may occur (Table 1-2), SCWA does not have routine or regularly implemented maintenance obligations. SCWA will remove vegetation on these natural channels only where there are site-specific problems with flood capacity. Therefore the length of vegetation removal is limited to small projects, generally 300-600 ft. in length. It is difficult to know the percentage of vegetation that may need to be removed in a cross-sectional area from any of these given channels because they vary in maintenance needs. However, since SCWA practices in natural channels call for underbrush removal and retention of a shade canopy over stream channels, it is reasonably estimated that no more than 25% of the in-channel vegetation is removed, resulting in a score of 3 (Table 3-10).

While individual projects may be small, the sum of several projects may have larger effects, especially if they occur in important salmonid spawning and rearing habitat such as some of the natural channels in Mark West Creek and its tributaries or the natural channels in the western, coastal-fog influenced portions of the watershed. Therefore removal of instream vegetation or streambank vegetation is kept to a minimum in these streams (*i.e.* only where significant flood control hazards or threats to structures exist). Vegetation removal in streams with limited rearing habitat (for example some natural channels in the Rohnert Park area) is not as likely to diminish salmonid habitat, and therefore could safely be more extensive. Current vegetation removal activities therefore, have a relatively low risk of short-term or long-term indirect effects to salmonid habitat (particularly coho salmon and steelhead) in natural streams.

Table 3-10 Vegetation Control Scores for Natural Channels Other Than ACOE Obligations

Category Score	Evaluation Criteria Category	Score
5	No vegetation removal except "spot" treatment, or removal of only non-native species	
4	< 10% removal	
3	>10% to < 25% reduction in vegetation	St, Co, Ch
2	>25% to <50% reduction in vegetation	
1	>50% reduction in vegetation	

*St = Steelhead, Co = Coho salmon, Ch = Chinook salmon

Herbicides may be selectively used in natural streams to reduce dense stands of cattails and blackberries. Spraying in natural channels is never performed on a routine basis, and is only conducted when the channel flood capacity has been reduced. This practice has become more common on streams where urban or irrigation return flows support vegetative growth throughout the summer. When spraying is necessary in natural waterways, it is performed only in focused areas, generally over project lengths of 100 to 500 ft (Bob Oller, pers. comm.). A score of 4 is therefore given for herbicide applications in natural channels (Table 3-11), due to the very limited, infrequent and site-specific extent of use with approved herbicides.

Table 3-11 Vegetation Control Scores Associated with Herbicide Use

	Herbicide use	
5	No chemical release	
4	Limited use of herbicide approved for aquatic use in riparian zones or over water	St, Co, Ch
3	Moderate to heavy use of herbicide approved for aquatic use in riparian zones or over water	
2	Use of herbicide not consistent with instructions	
1	Use of herbicide not approved for aquatic use in riparian zones or over water	

*St = Steelhead, Co = Coho salmon, Ch = Chinook salmon

While planting native vegetation is not a standard practice during channel maintenance activities, occasionally tree planting projects by volunteer groups are coordinated by SCWA. SCWA and CDFG have implemented riparian enhancement projects to increase canopy cover, and these are discussed in *Interim Report 6: Restoration and Conservation Actions.* In some cases, these projects have increased riparian cover, maintained hydraulic capacity, and reduced the need for streambank or streambed maintenance activities. For example, restoration activities in Brush Creek showed that planting native trees in a straight line parallel to the stream increased riparian habitat value of the stream without decreasing the hydraulic capacity of the stream. When native trees are established, either through restoration activities or through channel maintenance practices that allow native riparian vegetation to establish itself, it is expected that the need for vegetation removal activities will decrease and the habitat value of these streams will be significantly increased. As SCWA biologists continue to work with channel maintenance personnel to restore native vegetation, the habitat value of both natural and constructed flood control stream reaches is expected to improve over baseline conditions.

3.2.2 Constructed Flood Control Channels

3.2.2.1 Short-term Direct Effects of Vegetation Removal

Short-term direct effects of vegetation control are associated with the potential for direct injury to fish from the introduction of herbicides into the channel. In the past, access roads were sprayed with long lasting herbicides that would be toxic to fish and aquatic insects if they were to leach into the stream. Since the early 1990s, only an EPA-approved, glyphosate based, aquatic contact herbicide (Rodeo) has been used. Rodeo is much more expensive than some herbicides, but it substantially reduces the risk to protected species and aquatic life that supports their food chain. Rodeo is used in the bottom of narrow channels, as well as hand clearing, particularly to remove cattails.

Maintenance activities have the potential to introduce herbicide to the channel. Roads are mowed and sprayed with Rodeo once a year, beginning in summer and continuing to the fall. Rodeo is sprayed in a narrow width, and care is taken to not spray the herbicide too close to the edge of the creek. A ten to twelve foot wide stretch on the non-creek side of the road is sprayed. Residual vegetation is then mowed. As glyphosate degrades relatively quickly, it is unlikely that the herbicide will leach into the channel. The roads adjacent to the low-flow channels in Rohnert Park are mowed, but no herbicide is applied. Therefore a score of 4 is assigned to this limited herbicide use (Table 3-12).

Table 3-12 Vegetation Control Scores Associated with Herbicide Use

Category Score	Evaluation Criteria Category	Current Operations Score
5	No chemical release	
4	Limited use of herbicide approved for aquatic use	Co, St, Ch
3	Moderate to heavy use of herbicide approved for aquatic use	
2	Use of herbicide not consistent with instructions	
1	Use of herbicide not approved for aquatic use	

*St = Steelhead, Co = Coho

3.2.2.2 Long-Term Indirect Habitat Effects Associated with Vegetation Maintenance Practices

Frequency of vegetation control work and percent of channel length affected is estimated for constructed flood control channels in which vegetation removal activities occur (Table 3-13) (R. Anderson, SCWA, pers. comm., 2000). Where rearing or spawning activity is known or suspected to occur, it is indicated. The presence of continuous summer flow (streamflow that is not supported by urban return flows) is additionally noted in Table 3-13.

There are eight channels that may potentially support summer rearing habitat, and most of these channels have some flow during the summer and fall seasons (Table 3-13). However, not all channels that retain some flow through the summer provide potential rearing habitat, usually because of poor water quality associated with urban runoff. None of the flood control channels except Santa Rosa Creek, Oakmont Creek, and Paulin have conditions suitable for spawning. This is due to the very low gradients (between 0.0005 ft/ft and 0.004 ft/ft), and based on field observations indicating few, if any, riffles or pool-tailouts exist where spawning habitat is most likely to occur. However, fish migrate through flood control channels to reach upstream habitats.

Many of the past maintenance practices for flood control channels that could potentially have resulted in degradation to native riparian vegetation and instream vegetation have been modified. In the past, vegetation was extensively cleared to maintain hydraulic capacity and reduce fire dangers. Current vegetation maintenance practices are defined for six zones between the channel bed, banks, and extending to the access road. The amount of vegetation cleared within each of the six zones has been reduced from previous historical practices, resulting in increased canopy cover in many channels.

Since 1996, vegetation has not been removed from the zone consisting of the upper third of the channel bank. Activities in the middle third of the channel bank are limited to debris removal. The lower third of the channel bank, including the toe of the channel was, in the past, cleared of vegetation annually. Current practices call for removal of understory vegetation on the lower third of the streambank (approximately 30% of the vegetation within the bankfull channel cross-sectional area). This vegetation is removed by hand only on an as-needed basis, and to protect native riparian species wherever possible (some understory vegetation was cut on Santa Rosa Creek in 1999 with the Santa Rosa Police Department, to reduce the number of homeless encampments.). Native trees are not removed, although willows may be cut as part of a brush removal effort, and this may decrease canopy cover.

Based on the estimated 30% of the vegetation along the channel cross-section that is removed from flood control channels under current maintenance practices, the overall score for vegetation control practices is a 3 (Table 3-14). This scoring applies to all of the flood control channels,

Table 3-13 Characteristics of Vegetation Control Work in Flood Control Channels[a]

Creek	Frequency of Work[1]	Estimated % of Stream (Quartiles)[2]	Bankfull Width [3]	Summer Flow[4]	Species Known to Occur [5]
Migration, Rearing and Spawning					
Oakmont	M	1	N	Yes	
Paulin	A	1	M	Yes	
Santa Rosa	A	1	W	Yes	Co, St
Migration and Rearing					
Brush	A	1	W		St
Crane			N		
Laguna de Santa Rosa	A	2	W	Yes	St
Rinconada	M	1	N	Yes	
Todd	A	2	M	Yes	
Migration Only					
Austin [7]	A	1, 2	M		St
Colgan	A		M		
College	A	2	N		
Copeland	A	2	M		
Ducker	N	0	N		
Five	M	2	M		
Forestview	A	4	N		
Hinebaugh			W		
Hunter Lane Channel	A	1	M		
Indian	A	1	N		
Kawana	A	1	M		
Lornadell	M	1	N		
Peterson	A	3	N		
Roseland	A	2	M		
Russell	A	3	N		
Sierra	A	1	N		
Spivok	A	1	N		
Starr	A	2	M		
Steele	A	2	N		
Washoe	A	1	M		
Wendell	A	3	N		
Wikiup	I	1	N		
Wilfred				Yes	
Woolsey	N	0	N		

[a] Source: SCWA (Paul Valenti and Bob Oller, Operations & Maintenance Department)
[1]Frequency: N = never; A = annually; M = moderately (1-5 years); I = infrequent (> every 5 years),
[2] Estimated % of stream: 1 = <25%, 2 = 25-50%, 3 = 50-75%, 4 = 75-100%
[3] Bankfull Width: N = narrow (<10 ft), M = moderate (10-20 ft), W = wide (> 20 ft)
[4] Summer base flow that is not supported by relatively recent urban runoff. Portions of these channels dry up in summer, but other portions retain base flow.
[5] Where rearing activity occurs, species are listed if known. Salmonids may use other channels currently or in the future. Co = coho salmon; St = steelhead
[6] Migration corridor assumed to be a function of all flood control channels. M=migration; R=rearing; S=spawning
[7]Austin Creek in Rincon Valley, not in West Sonoma County.

Table 3-14 Vegetation Control Scoring for Flood Control Channels

Category Score	Evaluation Criteria Category	Score
5	No removal except selectively along access roads, fencelines, "spot" treatments, or to remove non-native species	
4	< 25% removal	
3	>25% to < 50% reduction in vegetation	St ,Co, Ch
2	>50% to <75% reduction in vegetation	
1	>75% reduction in vegetation	

*St = Steelhead, Co = Coho salmon

since the current maintenance practice is uniformly applied to all streams. It is recognized that there is a potential for greater effects to habitat conditions that are associated with those eight channels that are most likely to support rearing or spawning habitat.

As shade canopy becomes established in flood control channels that support trees on the streambanks (approximately one-third of the flood control channels) it is expected that there will be less of a need to remove understory vegetation, and therefore reductions in canopy cover will become less frequent. These practices are likely to increase the long-term habitat value of channel reaches over existing conditions by increasing canopy cover, and decreasing water temperatures in the summer. Also, by targeting non-native vegetation for clearing and allowing native species to become established, the chances for a naturally functioning ecosystem to become established increase, and this would be of particular benefit to coho salmon, chinook salmon, and steelhead. These effects are already being seen in Brush Creek, Santa Rosa Creek, and Hinebaugh Creek where significant tree growth has occurred.

As part of SCWA's restoration and conservation actions (see *Interim Report 6*) native trees and shrubs have been planted on Agency-owned flood control channels. A seeding program which began in 1975 continues along these channels. The current survival rate is approximately 65%, due to new planting techniques and seedling preservation.

Present-day vegetation maintenance practices in constructed flood control channels are currently being reviewed by SCWA in order to determine the influence on channel flood capacity. Because SCWA has an obligation to maintain flood capacity, it is possible that the current maintenance practices may need to be modified in the future. As vegetative growth on the streambanks become more dense and mature, channel capacity could be significantly reduced, and flooding could occur. At this time the nature and extent of modification to vegetation maintenance practices, if necessary at all, is unknown. However, a "worst-case" scenario can feasibly be considered using the evaluation criteria (Table 3-14).

It could become is necessary for SCWA to remove vegetation in the channel such that some vegetation near the top of the bankfull channel, and set-back from the top of the bank, would likely be allowed to establish. This would represent about a 75% or greater reduction in vegetation within the channel cross-section. The resulting score would be a 1, indicating a potentially significant effect. For the flood control channels supporting migration habitat only, this would be a significant adverse effect. However, the risk to the overall population of steelhead and coho salmon would be relatively small since few individuals are likely using these flood control channels. Effects would be of greater significance to the population as a whole for those flood control channels that support rearing and/or spawning habitat. There are eight flood control channels identified that potentially support spawning and/or rearing habitat (Table 3-13): and they are listed here:

- Crane Creek
- Paulin Creek
- Todd Creek
- Laguna de Santa Rosa
- Rinconada
- Brush Creek
- Oakmont
- Santa Rosa Creek

Potential vegetation removal on these channels under more aggressive maintenance practices may potentially result in increased water temperatures that could be detrimental to salmonids. Removal of understory vegetation may result in a decrease in cover for salmonids and invertebrates on which they feed.

Alternatively, other vegetation maintenance practice scenarios may be developed, if needed to meet flood control obligations. The structure of the evaluation criteria allows an estimate of the long-term indirect effects on habitat depending on the extent of vegetation removal practices. Any maintenance practice that requires between 50% and up to 75% removal of vegetation would score a 2. For the flood control channels that do not support rearing or spawning habitat, this is not expected to be a significant effect on habitat conditions. However, for those 8 channels designated as providing potential rearing and/or spawning habitat, the effect is of greater importance, and would therefore be considered a substantial and adverse habitat alteration.

3.3 LARGE WOODY DEBRIS REMOVAL

Debris removal, particularly LWD removal, is only conducted if it poses a threat for erosion or flood control. Non-native wood would also be removed from the channel. Before LWD is removed, it is assessed by SCWA biologists, and if it is determined that it is stable (*i.e.* that it is not likely to be dislodged, washed downstream and threaten the integrity of a structure), it is not removed. For example, a piece of LWD was left in place on Brush Creek recently because it was downstream of the Highway 12 bridge and was not in a position to float downstream and cause a debris jam at any bridges. A loose piece of LWD may be anchored if it is found in an area where it is not likely to pose a threat. If LWD appears in a constructed channel in downtown Santa Rosa, particularly if it is 20 feet or longer, it is likely to create a blockage under a bridge and is removed. If LWD is determined to pose a hazard, it is removed in coordination with CDFG and NMFS.

LWD is removed with a winch from the top of the bank, is cut up with chain saws, and transported away. If possible, the wood is donated to a youth camp for firewood. Brush is chipped and put on landscaped areas.

3.3.1 LWD Removal in Flood Control Channels

LWD plays a relatively small role in the structure and function of salmonid habitat within the Zone 1A flood control channels for several reasons:

(1) Flood control channels are not within forested regions that are a source of LWD.

(2) Flood control channels are designed to be stable so that bank erosion and associated LWD recruitment is minimal.

(3) Flood control channels are designed to contain large peak annual floods (10, 25, or 100 year runoff events), so that high flows prevent LWD from lodging in stable positions in the channel.

Typical LWD recruitment process whereby bank erosion helps LWD recruitment to the stream does not occur very often. SCWA estimates that approximately half a dozen pieces are removed in a year on average, and in years with few storms it is less. The most likely LWD recruitment mechanisms are probably wind damage, natural senescence of existing trees over long periods of time, or recruitment from upstream forested areas (such as Hood Mountain Regional Park to Santa Rosa Creek). The plant communities that generally exist near the flood control channels are not forested communities, and the trees that do occur are generally the slow growing oak or nonnative landscape trees, rather than fast growing conifers. It should be noted that many of the smaller trees, such as willows and alders, rarely provide wood that is of sufficient diameter to qualify as LWD. However, it is recognized that even wood of smaller diameter does provide some structure and habitat diversity, although not as long-lasting, stable, or as important for habitat development as larger diameter wood.

Furthermore, the constructed flood control channels were designed to efficiently pass high flows in relatively "flashy" watersheds that are also efficient at passing even large trees. While some LWD may be deposited in the Laguna de Santa Rosa, most of it is washed to the Russian River. There is some LWD from the upper watershed, such as the Hood Mountain area, that is caught on trash racks or deposited in Spring Lake, and this wood is removed and cut up. The effects of the flood control reservoirs on the recruitment of LWD is separately evaluated under Section 3.4.

Thus, LWD is not likely to play a significant role in providing structure or habitat in the flood control channels. This is the case today and will persist into the future, given the limited tree resources and recruitment processes. LWD is rare under existing conditions and is not anticipated into the future to play an important role in providing rearing habitat in the flood control channels. Therefore, the SCWA practice of limiting LWD removal to only when it poses a flood control hazard is not likely to result in substantial reduction of cover or scour, and the maintenance activity is scored a 3 (Table 3-15). Removal of LWD or other large structures that provide fish habitat is only performed if the debris is causing a significant erosion problem, flow blockage, or threatens the integrity of a structure such as a bridge.

Table 3-15 Large Woody Debris Removal Scores

Category Score	Evaluation Category	Current Operations Score
5	No LWD removal or modification	
4	LWD not removed, but modified	
3	LWD removal limited to only when it poses a flood control hazard, removal does not result in substantial reduction of cover or scour in the area	Co, St, Ch
2	LWD removal limited, but potentially results in moderate reduction of cover or scour	
1	Complete removal of LWD resulting in substantial reduction of cover or scour	

*St = Steelhead, Co = Coho salmon, Ch = Chinook salmon

Because recruitment of LWD is currently limited in the flood control channels, restoration actions that either promote the planting or growth of native trees or that install instream structures that provide some of the functions of LWD are likely to improve habitat for rearing, spawning or as is the case for constructed flood control channels, for migration. Restoration actions are assessed in *Interim Report 6 Restoration and Conservation Actions*. Given the timeframes to full development of a mature riparian corridor, tree planting efforts are not likely to contribute to LWD recruitment for many decades.

3.4 CENTRAL SONOMA WATERSHED PROJECT FLOOD CONTROL RESERVOIRS

Four flood control reservoirs act passively to reduce flooding in the Santa Rosa area during the rainy season. Three of these reservoirs are onstream and allow minimum streamflows to be bypassed. These three reservoirs are impassable, acting as barriers to upstream migration for anadromous coho salmon and steelhead. A diversion structure on Spring Creek also acts as a barrier to upstream migration. Potential downstream effects of operation and maintenance on anadromous salmonids and their habitat are evaluated. Additionally, safe fish passage for downstream migrants in Santa Rosa Creek past the Spring Lake diversion is evaluated.

Brush Creek and Piner reservoirs and the Spring Creek diversion are located on ephemeral streams. They are designed to impound water during the rainy season to reduce the potential for flooding in downstream urbanizing areas. Brush Creek (137 ac-ft capacity), Piner Creek (175 ac-ft capacity), and Spring Creek diversion (negligible capacity) are relatively small reservoirs that dry up by the summer (Bob Oller, SCWA, pers. comm. 2001). The reservoir on Brush Creek functions as a Little League park in the summertime. Matanzas and Spring Lake reservoirs have larger capacities (1525 ac-ft and 3550 ac-ft, respectively) and do not dry back during the summer. However, neither reservoir spills downstream during the summer season.

Spring Lake is located offstream and diverts water from Santa Rosa Creek only during high flows that occur about once every one or two years (pers. comm., Amy Harris, SCWA). Spring Lake holds water all summer. The park department adds potable water (after October when peak water demands are reduced) to maintain a recreational lake. A small tributary spring at the Spring Lake Diversion facility also feeds water to Spring Lake.

3.4.1 Evaluation of Immediate, Direct Effects of Maintenance Activities

Maintenance activities include desiltation and removal of noxious pondweeds. Desiltation, debris removal and vegetation removal are also performed at the inlets and outfalls to the reservoirs.

Because these reservoirs act as sediment retention basins, their capacity to hold water decreases over time. Sediments are excavated to restore the flood control capacity. In the past, sediment removal has occurred in Spring Lake and Matanzas reservoirs. Piner Reservoir on Paulin Creek has not been excavated in recent years, but sediment removal is likely to be needed in the future, especially if more homes are built in the watershed (Bob Oller, SCWA, pers. comm. 2001). Desiltation is required on the small Spring Creek diversion facility (that leads into Spring Lake). Small-scale (radius of 50 feet) silt, debris and vegetation removal is performed as part of the structure maintenance work on the outfall of Brush Creek about every three to five years. However, Brush Creek has not required sediment removal in the past, and is mowed regularly. Sediment removal may be necessary in the future.

Matanzas Creek Reservoir was drained and desilted in 1988 when 100,000 cubic yards of material was removed. Sediment removal work is scheduled for the summer of 2001. The activity begins in late spring or summer, after inflows have stopped, and when the reservoir has dried back as much as possible. Fish rescues are conducted, and fish are transferred to Spring Lake, but anadromous salmonids are not affected. Trenches are dug at the bottom of the reservoir to drain water from the area that will be excavated. The water is drained toward the face of the dam, and in the unlikely case where there is too much water, it is allowed to infiltrate through the ground and to evaporate. Sediments are removed and disposed offsite. The reservoir refills over the course of the next rainy season. Piner and Brush Creek reservoirs have small capacities, so sediment removal activities take place later in the summer when the water has naturally evaporated.

The Spring Creek diversion is a small diversion facility that reduces peak flows into Spring Lake. The area behind the control structure of the diversion traps sediments. After the 1995 and 1997 floods, a couple hundred cubic yards of sediment was removed from the concrete sill and box that diverts water at peak flows. Generally about 200 cubic yards, but as much as 500 cubic yards, of material may be removed, mostly gravel and sand, and disposed offsite. This maintenance occurs approximately once every five to ten years.

Spring Lake was drained and bulldozed in 1985 to remove hydrilla (an aquatic noxious weed). Some sediment was also removed at the time. Sediment has not been removed since then. A sediment basin between the toe of the spillway and the lake captures sediment before it enters the lake, so that frequent desiltation is not necessary. Approximately 1,000 cubic yards of sediment (mostly sand and silt rather than coarse sediments) are removed from the sediment basin about once every five years, especially after a large flood event. A weir keeps most of the coarse sediments out of the basin and routed to Santa Rosa Creek.

Spring Lake differs from the other reservoirs in that it holds significantly more water through the summer. The lake covers a large area, but has an average depth of only about 15 feet. There are two outlets to Santa Rosa Creek, a 6-foot wide by 8-foot deep outlet structure that carries the primary flow during flood events, and a principal spillway that carries any excess water. Before removal of hydrilla and any needed desiltation, the lake is dewatered by pumping to Santa Rosa Creek. Screening during the dewatering process prevents the release of predators from the lake. Fish rescues are conducted and salmonids are released to the stream. Dewatering begins as early in the spring as possible, typically in April, in order to avoid mixing warm summer reservoir water in Santa Rosa Creek. Dewatering may take four to six weeks, with maintenance occurring after the lake is drained. The reservoir is partially refilled with potable water by the City of Santa Rosa Parks Department to maintain a recreational lake. One or two large discharge events from Santa Rosa Creek can refill the reservoir.

Another maintenance activity at Spring Lake is the removal of sediment at the Santa Rosa Creek intake structure. This structure contains barriers and silt deflection structures to reduce the amount of material that goes from Santa Rosa Creek to Spring Lake. Sediments are excavated from detention basins in the summer when the inlet is dry.

3.4.1.1 Injury to Fish and Sedimentation

Sediment removal from the flood control reservoirs does not increase turbidity or cause downstream sedimentation, because the reservoirs are dry and there is no flow from the work area. There may be a short-term increase in turbidity when water flows back into the reservoir, but the reservoirs serve as silt detention basins and the turbidity settles before water spills downstream. The score for sediment containment is a 5 (Table 3-16).

Table 3-16 Sediment Containment Evaluation Scores for Sediment Removal in Flood Control Reservoirs

Category Score	Evaluation Category	Score
5	Project area does not require rerouting streamflow	Matanzas, Spring Lake, Piner, Brush, Spring Creek
4	Clean bypass or similar method used	
3	Effective instream sediment control (*e.g.* berm/fence)	
2	Limited sediment control	
1	No instream sediment control	

There is no opportunity for injury to anadromous fish during maintenance activities. Because the onstream reservoirs and Spring Creek diversion block fish passage, anadromous salmonids protected under the ESA are not affected. Fish in Spring Lake are moved out of the swimming hole. However, this is not considered a rescue because the operation occurs months later and the lake is not drawn down for efficient fish rescue. Anadromous salmonids that have been trapped in Spring Lake have essentially been removed from the anadromous run and this effect is evaluated separately in Section 3.4.2.1 *Fish Passage at Spring Lake*.

3.4.1.2 Effects on Downstream Water Quality

Water quality in Santa Rosa Creek may potentially be altered when Spring Lake is drained prior to maintenance work. Draining Spring Lake increases downstream flows and has the potential to affect water quality, including dissolved oxygen, turbidity and water temperature in Santa Rosa Creek. Since the other reservoirs are not dewatered, there is no effect on downstream water quality on those streams.

Because Spring Lake is a large, shallow lake dissolved oxygen stratification is not likely to occur. Without the formation of a bottom layer of water low in dissolved oxygen, water pumped to Santa Rosa Creek is not likely to reduce dissolved oxygen concentrations in the creek. Because the water is pumped rather than released from a low-flow outlet, excess fine sediments are not likely to be released to the creek. A springtime algae bloom may result in some increase in turbidity in the stream, but because this water is released during the spring when stream flow is higher than in the summer, the potential effects are minimized.

Water temperature data collected in 1999 in Santa Rosa Creek above the diversion to Spring Lake show that summer water temperatures were generally below upper tolerance limits for salmonids. Several miles downstream, water temperatures were higher (Table 3-17). Water temperatures in the spring are likely to be cooler.

Table 3-17 Santa Rosa Creek Temperature Upstream and Downstream of Spring Lake from June 23 to October 13, 1999

	Station 4 (upstream)*			Station 5 (downstream)		
	Mean	**High**	**Low**	**Mean**	**High**	**Low**
June	17.5	20.2	14.1	18.5	22.4	15.9
July	16.7	21.3	14.1	17.8	22.4	15.2
August	16.8	20.2	14.4	17.8	20.9	15.6
September	15.6	17.4	13.3	16.5	18.6	14.1

* Station 4 is directly upstream of Spring Lake, Station 5 is a couple of miles downstream.

Water temperature data have not been collected for Spring Lake. Because the lake is relatively large and shallow, the water may be warmer than in Santa Rosa Creek. De-watering during maintenance activities may increase temperatures in Santa Rosa Creek. Receiving water temperatures in Santa Rosa Creek are likely to be lower in spring than the summer temperatures shown in Table 3-17 and streamflows are higher. Because water is released as early as possible in the spring, adverse temperature effects are unlikely to occur. Migrating salmonids in Santa Rosa Creek may experience slightly warmer water temperatures during dewatering, depending upon the temperatures in Spring Lake. However, it would be very unlikely that temperatures in Santa Rosa Creek would exceed those recorded for the summer months (Table 3-17) which are below the upper tolerance limits. It can take 4 to 6 weeks to drain the reservoir. If, for example, dewatering begins in early April, the process is completed by mid-May. Draining the reservoir early in the season is less likely to raise water temperatures above upper thresholds, and is not likely lead to unsuitable water temperatures.

3.4.1.3 Maintenance of Outfalls and Vegetation Removal

Maintenance of the outfalls of the reservoirs involves desilting and vegetation removal. The area affected is small and dry. For example, the area below Brush Creek encompasses about a 50-foot radius. Removal of brushy vegetation from such a small area is not likely to affect salmonid habitat, particularly since these areas are dry during the summer and no fish rearing would be taking place at that time. Removal of nonnative weeds (like hydrilla) may benefit salmonid habitat downstream, as does removal of fine-grained sediments.

3.4.1.4 Summary of Immediate, Direct Effects of Maintenance Activities

Sediment removal or weed removal from flood control reservoirs does not increase turbidity or cause downstream sedimentation because there is no flow from the work area. Listed fish species are not injured during maintenance activities because there are no anadromous runs of salmonids past the structures on Brush, Paulin, Matanzas or Spring Creek. Salmonids trapped in Spring Lake are lost to the anadromous population, and this effect is evaluated separately. Desiltation and vegetation removal at the outfalls of the reservoirs is done when there is no flow, so there are no immediate effects on fish or their habitat. The areas affected are small, so there are no appreciable effects on salmonid habitat.

When the large, shallow Spring Lake is drained for maintenance work, it has the potential to increase water temperatures in Spring Creek. It may take four to six weeks to drain the reservoir, and this activity may occur about once every twelve years. Spring Lake is drained as early as possible in the spring while water temperatures are cooler and creek flows are higher to avoid increasing summer water temperatures above threshold limits for salmonids.

In general, maintenance activities are not likely to directly affect salmonids. While there is likely to be an increase in Santa Rosa Creek water temperature when Spring Lake is drained, this effect is unlikely to exceed thresholds that would affect survival because water is released as early as possible in the spring.

3.4.2 Evaluation of Effects on Fish and Long-term Habitat Alteration from Passive Operations

The operation of Spring Lake may affect safe fish passage for downstream migrants, adult upstream migration, or introduce predatory fish species that prey on salmonids in Santa Rosa Creek. For all reservoirs, potential effects to downstream water temperature, changes in stream flow, and the transport of sediments and woody debris are evaluated.

3.4.2.1 Fish Passage At Spring Lake

3.4.2.1.1 *Entrapment of Downstream Migrants*

The Santa Rosa Creek Reservoir (Spring Lake) is located offstream, allowing even relatively large flows to pass downstream unimpeded. During flood events, water in the creek backs up behind a culvert under Montgomery Drive until it overtops a V-aligned weir on the west side of the culvert. Salmonids can pass through the high flow channel in Santa Rosa Creek directly into Spring Lake during flood flows. Good quality spawning and rearing habitat is available in the watershed, and steelhead spawning has been documented upstream of Spring Lake. Therefore, there is a potential to entrap migrating or rearing juvenile salmonids in Spring Lake.

Because this flood bypass can not be screened, there is a potential for migrating juvenile salmonids to be trapped during high flows. This kind of event occurs about once every one to two years, and a relatively large volume of water is diverted (A. Harris, SCWA, pers. comm., 2000). Once entrapped, salmonids can not get out of Spring Lake. Juvenile fish that are trapped may be subjected to increased risk from predatory fish and heavy fishing pressure on the lake. Entrapped coho salmon are unable to complete their anadromous life history, and steelhead revert to a resident life history strategy.

The first evaluation component addresses screen design criteria and escape opportunity (Table 3-18). High flows make it unfeasible to effectively screen Spring Lake. Because the flood bypass can not be screened and no escape is provided, the score is 1.

Table 3-18 Passage Scores for Juvenile and Fry Salmonids – Screen Design and Operation for Spring Lake

Category Score	Evaluation Categories	Current Operations Score*
5	Fish screens meet NMFS criteria and pass fish without injury or delay.	
4	Facility provided with fish screens, but the facility has a low risk of entrapment, impingement, or migration delay.	
3	Facility provided with fish screens, but the facility has a moderate risk of entrapment, impingement or migration delay, effective rescue or escape is provided.	
2	Facility provided with fish screens, but the facility has a high risk of entrapment, impingement or migration delay, ineffective rescue or escape is provided.	
1	Facility not provided with fish screens, no escape or rescue is provided.	Co, St

*Co = Coho Salmon, St = Steelhead

The second component evaluates the opportunity for entrapment, impingement or injury based on how much water is diverted and how often the water is diverted. There are no estimates of the percentage of flow that is diverted during high flows, but it is assumed that it is a significant volume. A bankfull discharge event occurs on average every 1.5, years and this is how often flows are estimated to be diverted into Spring Lake.

Juvenile salmonid downstream migration is most likely to occur when streamflow increases, so for this analysis, downstream migration is assumed to occur during storm events. USGS gage data at USGS gage 11465800 (located upstream of the diversion) from water years 1959 to 1970 (an 11-year record) is used to estimate the frequency of high flow events and to see how often the highest flow events (larger than 300 cfs) occur during salmonid downstream migration periods (Figure 3-3). Gage data were not available for more recent decades, so it is not known if this record is representative of present conditions, but it is assumed that general trends persist.

Spring Lake may divert water from Santa Rosa Creek when creek flow at the inlet is approximately 200 cfs to 500 cfs (R. Zeiber, SCWA, pers. comm. April 9, 2001). Another estimate is that the weir overtops at about 900 cfs of flow, less than the estimated 2-year peak flow (Richard Morehouse Associates, *et al*. 1992). Flows at the USGS gage are less than flows at the diversion inlet (the gage is located upstream of the inlet), so the data can be used only as a general approximation for the relative magnitude of flows at the inlet structure. As a point of reference, flows higher than 300 cfs were considered larger storm events because these events occurred several times per year in 7 of the 11 years. During the gaging period of record, these highest flows (which would be the most likely to spill into Spring Lake) occurred in January or February. The largest storm events during this time produced flows higher than 300 cfs, up to 800 or 900 cfs and two events with flows even higher. Flows after February sometimes exceeded 200 cfs, but exceeded 300 cfs only once (386 cfs on April 6, 1963). These lower flows are not as likely to spill into Spring Lake.

Juvenile steelhead emigration extends from March to the end of June (Figure 1-2), and since flows are generally lower after February, most of the highest flow events are likely to occur before downstream migration begins. However, steelhead can be trapped, and residualized steelhead have been caught in Spring Lake. Therefore, the score for steelhead is 4 (Table 3-19). Coho salmon generally emigrate from February to mid-May, so they face a higher risk of entrapment. Assuming that approximately 6 storm events occur per year with flows higher than 100 cfs (to cue migration), and assuming that the risk of entrapment occurs once every 1.5 years, it is estimated that coho salmon face risk of entrapment during 11% of these storm events. Therefore, the score for coho salmon is 3 (Table 3-19).

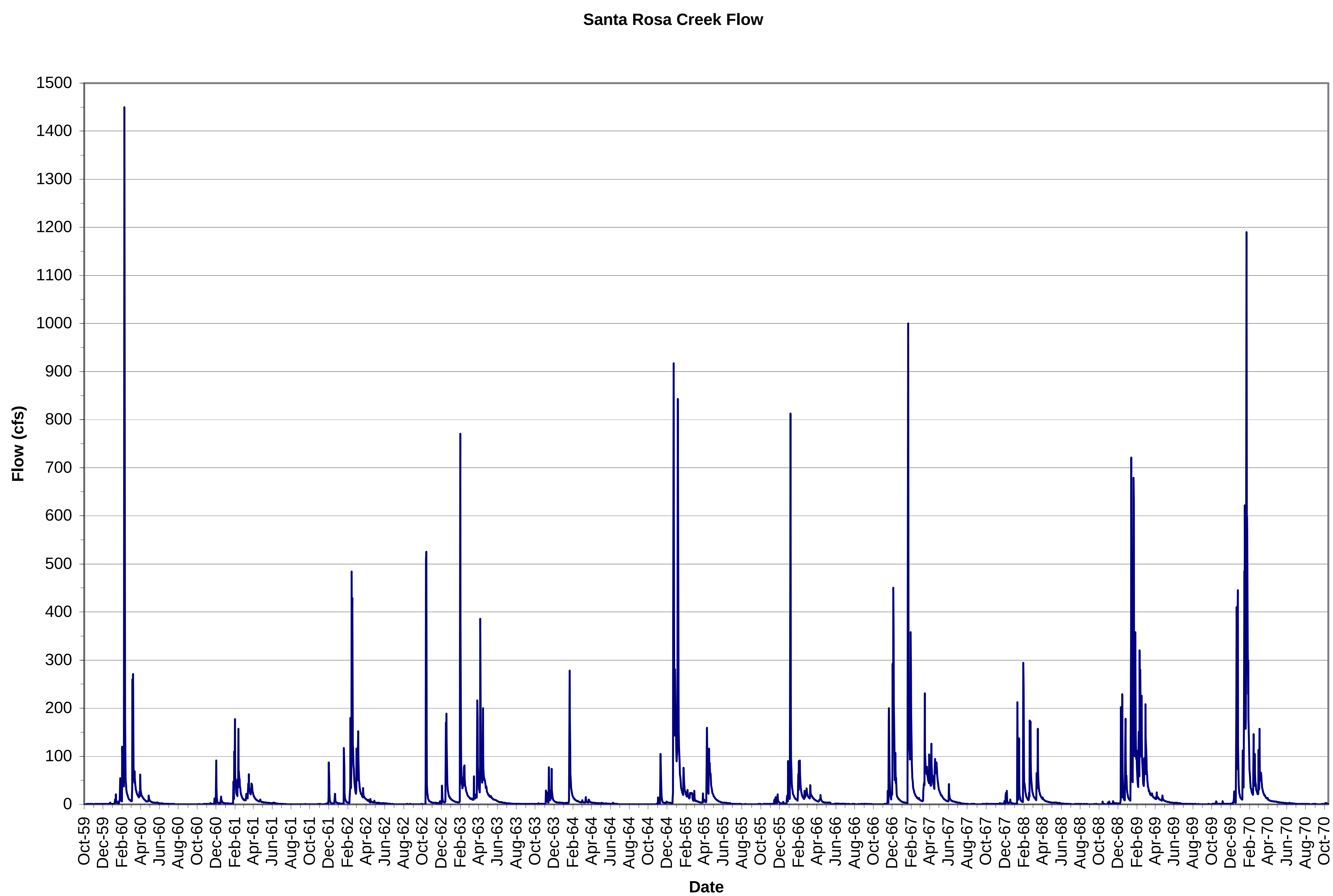


Figure 3-3 **Santa Rosa Creek Flow October 1959 to October 1970 (USGS Gage 11465800)**

Table 3-19 Passage Scores for Juvenile Salmonids – Opportunity for Entrapment, Impingement or Injury at Spring Lake –Time Water is Diverted

Category Score	Evaluation Categories	Current Operations Score*
5	Facility does not affect surface water flow during any time of migration period.	
4	Facility operates during less than 10% of migration period.	St
3	Facility operates between 10-15% of migration period.	Co
2	Facility operates between 15-25% of migration period.	
1	Facility operates during more than 25% of the migration period.	

*Co = Coho Salmon, St = Steelhead

Adult steelhead (that are not hatchery fish) have been found in Spring Lake, suggesting that juveniles have residualized in the lake. Migrating salmonids that are passing through during one of these flood events have a high risk of being entrained, but one of these events only affects a portion of the migration period, about once every one or two years. A fair amount of spawning and rearing habitat exists above the Spring Lake diversion, especially in the headwaters of Santa Rosa Creek in Hood Mountain Regional Park, and a fraction of the salmonids that utilize that habitat are at risk.

3.4.2.1.2 *Adult Upstream Passage*

The fish ladder and vortex tube at Spring Lake reservoir were constructed in 1962. The fish ladder is approximately 60 ft long and routes flow into a 130 ft long, 8 ft diameter reinforced concrete pipe known as the vortex tube. The fish ladder functions to provide passage for adult steelhead around Spring Lake reservoir to the headwaters of Santa Rosa Creek. Evaluation of the fish ladder capacity to provide adult passage is based on the engineering design aspects that were obtained from as-built construction drawings. Based on these drawings, the fish ladder meets all three elements of the engineering design criteria as follows:

- Fishway slope has a ratio of at least one to six.
- Individual run is less than 30 feet.
- Maximum of 12 inches drop between pools.

The fish ladder slope is 1:8.6 (rise:run), or 11.5%. The maximum individual run between baffle sections is 9.2 ft, and the maximum drop between pools is 12 inches. Performance criteria related to velocities and depth at the fish ladder are not available. However, observations by SCWA indicate that the fish ladder does not appear to be an impediment to fish passage (Sean White, pers. comm., SCWA). Therefore, the score for adult upstream fish passage is a 5 (Table 3-20).

Table 3-20 Passage Evaluation Criteria for Adult Salmonids at Spring Lake - Fish Ladder Design

Category Score	Evaluation Categories
5	Fish passage passes adult salmonids without delay
4	Fish passage passes adult salmonids with acceptable delay
3	Fish passage passes all target species after extended delay
2	Fish passage does not pass all target species of adult salmonids
1	Passage provided but does not appear to pass any adult salmonids, or passage not provided

3.4.2.2 Release of Predators from Spring Lake

Spring Lake is a large, shallow lake that provides habitat for warmwater fish species that prey on salmonids. If predators are released from the lake, predation on steelhead and coho salmon could potentially be increased. Water may flow from the reservoir after a flood event diverts water to Spring Lake.

Spring Lake is equipped with a drop inlet that allows up to 400 cfs of water to flow out of the reservoir when the water surface rises above 281 feet in elevation. Water flows through the inlet and into a culvert to rejoin Santa Rosa Creek downstream of Spring Lake Court off Montgomery Drive. An emergency spillway at Spring Lake located near Channel Drive protects Spring Lake from overtopping by releasing water when the elevation of water in the reservoir exceeds 307 feet (Richard Morehouse Associates *et al*. 1992). Water that passes over the spillway travels down a short grassy channel to rejoin Santa Rosa Creek upstream of Spring Lake Court.

The potential risk for predation is evaluated with three components. Component 1 evaluates the risk based on structural components that concentrate salmonids near predators. Salmonids in Santa Rosa Creek are not concentrated by the diversion facility, but predators are found in Santa Rosa Creek. Therefore the score is 4 (Table 3-21).

Table 3-21 Predation Evaluation Criteria: Component 1 Structural Criteria

Category Score	Evaluation Criteria	Current Operations Score*
5	No features that concentrate salmonids or provide cover for predators, concentrations of predators not found.	
4	No features that concentrate salmonids, predator cover near, predators in low abundance locally.	Co, St
3	Features that concentrate salmonids, no predator cover nearby, predators in medium to low abundance locally.	
2	Features that concentrate salmonids, predator cover nearby, predators in medium to low abundance locally.	
1	Features that highly concentrate salmonids, predators abundant locally.	

*Co = Coho Salmon, St = Steelhead

The second component addresses access for predators to Santa Rosa Creek. Water temperatures in the middle and lower reaches of Santa Rosa Creek are high enough to support warmwater species. A 1997 fish survey documented the presence of smallmouth bass in the creek. Predator populations that could serve as source populations also exist downstream of this watershed. Periodic outflows from Spring Lake will not introduce predators to an area where they are not already established, but can serve as a source population that helps maintain the population. Therefore the score is 3 (Table 3-22).

Table 3-22 Predation Evaluation Criteria: Component 2 Access Criteria

Category Score	Evaluation Criteria	Current Operations Score*
5	Structure does not allow passage of predators, predators not present near structure.	
4	Structure does not allow passage of predators, predators present near structure.	
3	Structure provides limited passage of predators, or limited passage to areas they are already well established, predators not present near structure.	Co, St
2	Structure provides limited passage of predators to areas they have historically not been found or have been found in limited numbers, predators present in limited numbers near structure.	
1	Structure provides passage of predators to areas they have historically not been found or found in limited numbers, predators present or migrate to structure.	

*Co = Coho Salmon, St = Steelhead

The third component assesses the risk of predation based on water temperatures. Warm summer water temperatures are favorable to predators at the same time that they stress salmonids. Water temperatures from June 6 to August 12 of 1998 in the middle reach of Santa Rosa Creek (where Spring Lake outfall is located) ranged from 15.6 to 22.8 ºC which is in the range of category scores 2 to 4. Water temperatures in the downstream reach ranged from 15.6 to 31.7 ºC (CDFG 2001b). Because summer water temperatures can be high, the score is 2 (Table 3-23).

Table 3-23 Predation Evaluation Criteria: Component 3 Warmwater Species Temperature Criteria

Category Score	Evaluation Criteria	Current Operations Score*
5	Water temperatures < 13^{O}C	
4	Water temperatures 13 - 18^{O}C	
3	Water temperatures 18 - 20^{O}C	
2	Water temperatures 20 - 22^{O}C	Co, St
1	Water temperatures 22 - 24^{O}C	
0	Water temperatures >= 24^{O}C	

*Co = Coho Salmon, St = Steelhead

In summary, Spring Lake provides warmwater habitat and a source population of predators. Predators are established in Santa Rosa Creek and warm summer water temperatures favor predators while they can stress salmonids. When predators from Spring Lake are released during high flow events, they do not introduce a new risk, but they may help to maintain the local population of predators. The risk of predation is not increased, but is maintained.

3.4.2.3 Effects on Downstream Flow

Two potential effects on downstream flows may occur due to passive operation of the flood control reservoirs. First, when the flood control capacity of the onstream reservoirs are restored after dewatering and sediment excavation, downstream flows are delayed during the time the reservoirs refill. This may reduce streamflow during the beginning of the spawning season and delay flows that would have normally supported rearing habitat. Secondly, operation of the reservoirs may reduce the magnitude of peak flood events.

The onstream reservoirs do not contain much water at the end of the summer because inflows are low or non-existent. What summer flow does exist is probably primarily urban runoff. Sediment removal activities restore the flood control capacity of these reservoirs, and there is a short-term decrease in downstream flow during the rainy season as they refill. The magnitude of the effect on habitat depends on the size of the reservoir, the relative contribution of flow from the watershed upstream of the reservoir (which is partially dependent on the size of the upstream watershed), and the amount of subsurface flow past the reservoir. Characteristics of the flood control reservoirs is given in Table 3-24.

Table 3-24 Central Sonoma Watershed Project Flood Control Reservoirs – Reservoir Capacity and Watershed Acres

Dam	Capacity (ac-ft)[1]	Watershed	Upstream (acres)	Downstream (acres)	Total Watershed (acres)
Santa Rosa	3,550	Santa Rosa and Spring Creek (to SR Dam)	14,849	negligible	14,849
Spring Creek Diversion		Spring Creek (after diversion to SR Dam)			1,654.7
Matanzas	1,525	Matanzas Creek	7,237.6	2,590.9	9,828.5
Brush	137	Brush Creek	989.5	5,654.5	6,644
Piner	175	Paulin Creek	1,280.6	5,650	6,930.6

[1]Capacities are in acre-feet to the invert flow line of the emergency spillway crest.

The reservoirs on Paulin and Brush creeks are relatively small and would be expected to fill quickly. Furthermore, the dams are located fairly high up in the watershed and therefore capture only a small percentage of the watershed flow. Therefore the reduction in downstream flows is likely to be of a very short duration and is not likely to have a significant effect on spawning habitat in the downstream portion of the watershed. The watershed area above the Spring Creek diversion is also small. Because Brush, Paulin, and Spring creeks are essentially ephemeral, they are not likely to affect flow during the summer.

The dam on Matanzas Creek does not spill water in the summer, so operation of the reservoir is not likely to negatively affect summer flows. Approximately 74% of the watershed area lies above the dam. Spring Creek is the only tributary to Mantanzas that contributes flow to this downstream area, but it joins Matanzas close to its confluence with Santa Rosa Creek. It is not known how much flow is contributed to Mantanzas Creek by the watershed area below the reservoir. Because flow data are not available for Matanzas, it is not possible to quantify the amount of flow captured relative to streamflow above and below the reservoir. However, the capacity of the reservoir is large enough and the location of the dam is low enough in the watershed that reservoir filling could delay contributing flow downstream for a period of time. Observations by SCWA indicate that Mantanzas Reservoir does not usually spill until about December in a typical year (Bob Oller, pers. comm. 2001). This could result in reduced streamflows below the reservoir for a period of time that could affect spawning and rearing habitat.

Historically, Matanzas Creek supported a self-sustaining steelhead population. The creek above the dam still supports resident trout (S. White, SCWA, pers. comm. 2001). Access to spawning and rearing habitat in Matanzas Creek was blocked by a poorly designed box culvert at the confluence of Santa Rosa Creek. Fish passage will be restored with construction to begin in 2001 (See *Interim Report 6: Restoration and Conservation Actions*). Approximately five miles of spawning and rearing habitat in Matanzas Creek will become available. In the reach that was inventoried below the dam, the best spawning habitat exists in the lower portion of Matanzas Creek, and the quality of spawning and rearing habitat diminishes upstream due to eroding stream banks, lack of riparian habitat and increased temperatures (CDFG 2001a).

Stream inventory data show that Matanzas Creek between the flood control reservoir and the confluence of Santa Rosa Creek has steelhead rearing and spawning habitat, so it is clear that operation of the reservoir does not eliminate habitat. However, it is possible that operation of the reservoir reduces the quality of that habitat by reducing streamflows until the reservoir fills. The amount of time that it takes to fill the reservoir would depend on whether it is a dry, average or above average rainfall year. The reservoir generally fills with about 10 inches of rain, and by mid-December it usually fills and spills. Therefore, effects are likely to be limited to the early portion of the coho salmon spawning season which occurs December through mid-February.

Because Spring Lake is located offstream, low and moderate flows in Santa Rosa Creek pass this reservoir unimpeded. Downstream flows are only affected during high streamflows. Potential effects are limited to a reduction of flood peaks during these high flows.

3.4.2.4 Attenuation of Peak Flows

The purpose of the onstream flood control reservoirs is to reduce flood peaks during the rainy season. This may reduce the availability of channel maintenance flows to downstream areas. As a beneficial effect, reduction of flood peaks can reduce downstream bank and bed erosion, and reduce the potential for scouring redds.

Spring Lake captures very high flow events that occur once every one or two years, but otherwise Santa Rosa Creek flows unimpeded. Bankfull stage is generally considered to be the discharge at which channel maintenance is most effective, and this is the discharge that forms the average morphological characteristics of the channel. On average, the bankfull discharge has a recurrence interval of 1.5 years (Dunne and Leopold 1978). The natural bankfull discharge has never been determined for Santa Rosa Creek. In addition, as a constructed flood control channel, the geomorphic parameters that make the relationship between bankfull discharge and channel maintenance meaningful have been radically altered on Santa Rosa Creek. Today, the constructed portion of the flood control channel is designed to hold the 100 year flood event. This is undoubtedly much greater than the capacity of the natural channel, which was probably closer to the 1.5 year bankfull discharge event.

The potential for Santa Rosa Creek to overflow its banks in downtown Santa Rosa is reduced, and floodplains are not available in the constructed channels that make up most of the downstream portion of Santa Rosa Creek. By containing the 100 year flood event, shear stress and velocities are probably very high in the Santa Rosa Creek flood control channel. The attenuation of flood peaks by Spring Lake most likely provides a benefit to listed species and habitat conditions by reducing velocities and shear stress. The extent to which this occurs is unknown, since the outlet of Spring Lake is not gaged.

Although there is not likely to be an adverse effect on the constructed flood control channel, there may be an effect on the short natural waterway portion of Santa Rosa Creek that occurs downstream of Spring Lake. Inspection of this section of “natural” waterway indicates that it too has most likely been altered in the past, by straightening and perhaps channelization. Observations of this section of Santa Rosa Creek did not indicate aggradation, which would be one of the most likely responses to reduced peak flows. In all likelihood, attenuation of peak flows provides a net benefit to this section of channel by reducing potential for bank and bed erosion.

Paulin, Brush and Spring creeks have a relatively small watershed areas above the reservoirs, so the attenuation of flood peaks is likely to be relatively small due to the small, capacity of each reservoir. Therefore, significant effects to salmonid habitat are not expected.

Matanzas Creek has a relatively long stream reach above the reservoir and large watershed area compared to the downstream reach. Therefore, operation of the reservoir may affect channel maintenance flows influencing spawning and rearing habitat in the downstream reach. However, since the reservoir also functions to capture sediments, the need for high flows for channel maintenance is not likely to be as great. In addition, once early winter storms have filled Mantanzas reservoir, spills occur, so that the upstream and downstream flows have nearly equilibrated. This would result in peak flood events passing through the reservoir to the natural downstream reach. The net effect is that the reservoir is unlikely to have significant adverse effects on channel maintenance flows, due to peak flood attenuation.

3.4.2.5 Temperature

The relatively large surface area of the reservoirs (compared with stream channels) increases exposure to solar radiation and may therefore increase water temperatures. If warmer water is released from the reservoir than downstream receiving waters, then downstream water temperatures may increase. High water temperatures could then limit rearing habitat for salmonids. The extent of temperature effects depends on water temperature of the inflow from the creek, the size of the reservoir and the amount of flow through the reservoir.

Matanzas Creek has the longest stretch of channel above its reservoir in comparison to the other onstream reservoirs. The stream is well shaded and flows through a relatively undeveloped watershed. Therefore, water temperature inflowing to the lake is likely to be relatively cool. During the summer, there is no outflow from the reservoir. Flow from the reservoir could potentially increase water temperatures in downstream areas in the springtime, but because the reservoir is small, increases to downstream water temperatures are not likely to be large. Summer temperature data collected from Matanzas Creek from June 9 to September 29, 1999 at two stations below the reservoir and above the confluence with Spring Creek is summarized in Table 3-25. These data show that in the summer mean water temperatures are between 14.7 to 16.4 ºC. If it is assumed that water temperatures are cooler in the winter and spring, when water is released from the reservoir, a small increase is not likely to increase mean water temperatures to levels that exceed published criteria for salmonids.

Table 3-25 Matanzas Creek Temperature Data from June 9 to September 29, 1999

	Station 1 (upstream)*			**Station 2 (downstream)**		
	Mean	**High**	**Low**	**Mean**	**High**	**Low**
June	15.8	18.2	13.3	15.5	18.2	12.5
July	16.4	19.4	14.4	16.1	18.6	14.1
August	16.0	17.8	14.4	16.0	17.8	14.1
September	14.7	15.9	13.3	14.7	15.9	13.3

*Temperature monitoring stations are below the dam but above the confluence with Spring Creek.

Piner Reservoir is located on Paulin Creek which runs through a more developed watershed with less riparian cover than is found in Matanzas, so inflow to the reservoir may have higher water temperatures. Summer flow to the reservoir is primarily urban runoff, and there is no flow downstream of the reservoir. Flows in the East and West Fork of Brush Creek are low above the reservoir, and the reservoir is dry in the summer. Therefore, these reservoirs are not likely to contribute to increased water temperatures in downstream areas in the summer. Spring Creek, which feeds into Spring Lake, goes dry in the summer.

Spring Lake is the largest of the reservoirs and impounds a greater amount of water, which is then subject to heating. However, it is located offstream and Santa Rosa Creek flows unimpeded during all but high flow events. There is no outflow in the summer. Therefore, Spring Lake is not likely to affect water temperatures during the warm summer months.

3.4.2.6 Sediment and Debris Transport

The onstream reservoirs act as sediment detention basins, thereby affecting the transport of sediments and woody debris to downstream areas. If spawning gravels or woody debris are trapped in the reservoir, they are not recruited to downstream habitat.

The watershed areas above Spring Creek, Piner, and Brush Creek flood control structures are relatively small (see Table 3-24). Some spawning gravel may be trapped in these reservoirs. Brush Creek has never been excavated, so there normally is not much sediment transport or recruitment from the upper part of the watershed. Approximately 200 (and up to 500) cubic yards of sediment, mostly gravel and sand, are removed from the Spring Creek diversion every five to ten years, and this material is not recruited to Spring Creek. However, the small size of the watershed above these structures suggests that the retention of small amounts of gravel is not likely to affect downstream spawning habitat. Because these headwaters do not lie in heavily forested areas, there is not likely to be much loss of LWD.

Matanzas Creek has a larger contributing upstream watershed area than the other onstream reservoirs. Approximately 100,000 cubic yards of sediment, which contained mostly fine sediments (P. Valenti, SCWA pers. comm. 2001) were removed in 1988, and the work is scheduled again for 2002. The upper portion of Matanzas Creek runs through a relatively undeveloped watershed and probably contains coarse sediments including gravels and cobbles. Therefore, loss of recruitment of spawning gravel may be greater on this creek than the other onstream reservoirs. Habitat typing in the lower watershed showed that little riffle habitat exists for spawning, what does exist is unsuitable due to high gravel embeddedness, and that substrate in riffles is dominated by large and small cobble (CDFG 2001). Spawning and rearing habitat quality diminishes in an upstream direction due to eroding stream banks, lack of riparian habitat, and increased temperatures. Portions of Matanzas Creek have been channelized and leveed, so stream velocity has increased, resulting in streambank erosion. Sediments entrained or removed from Matanzas Creek reservoir are not recruited to downstream areas, and this may contribute to a loss of spawning gravel. However, the loss of spawning gravel could be related to other issues related to the geomorphology of the channel; for example, high streamflows may contribute to the lack of suitable spawning gravel by transporting them further downstream.

The watershed above the dam on Matanzas Creek is more heavily forested in comparison with the other onstream reservoirs. However, LWD has not been removed from Matanzas Creek. It is possible that LWD is recruited in the upper portion of the watershed, but it has never been removed from the reservoir (Bob Oller, pers. comm. 2001). It is likely that flows are generally low enough that it is rarely transported downstream to the reservoir inlet. Therefore, even if LWD were to be removed in the future, the amount is likely to be so small that it will not significantly affect habitat conditions downstream, including the amount of cover and scour available. Furthermore, much of Matanzas Creek downstream of the dam has a riparian corridor which will provide its own recruitment source to the natural channel.

Santa Rosa Creek extends up into the Hood Mountain region and transports sediments and woody debris downstream. High flow events deposit sediments and debris in the diversion channel and into Spring Lake, although some portion of the sediment load and woody debris is probably transported downstream to Santa Rosa Creek through the low-flow channel. Periodically, this material is removed and disposed off-site. This has the potential to reduce the amount of spawning gravel and LWD that would otherwise be recruited to the downstream portions of the watershed.

The sediments removed from the diversion channel are generally sand and silt rather than gravel. The loss of some limited amount of coarse sediments on the order of once every one to two years is not likely to affect the spawning success of salmonids because gravel recruitment is probably not a limiting factor. Currently, the best spawning habitat exists within the middle portion of Santa Rosa Creek (CDFG 2001b). The Spring Lake diversion lies within this reach. Sediment transported downstream from the upper reach of Santa Rosa Creek (a B2 channel) in the winter impacts fair quality spawning gravel downstream, so removal of some portion of these fine sediments may have a beneficial effect, at least until restoration of upstream erosion sites is achieved.

Biological surveys in spring 1997 documented many age 0+ fish, indicating successful spawning in the middle and upper reaches of Santa Rosa Creek, but few 1+ fish, indicating there may be poor rearing or poor holding-over conditions (CDFG 2001b). CDFG recommends that where feasible, woody cover in the pool and flatwater habitat units along the middle and downstream reaches be increased. Occasionally, a piece of LWD may be caught in Spring Lake and removed. Although this is a rare event, removal of a piece of LWD means it can not be recruited downstream in the Santa Rosa Creek watershed. However, the downstream portion of Santa Rosa Creek has been altered to pass large flows and natural recruitment of LWD is reduced. LWD is more likely to be flushed out of the channelized portion of the creek. Furthermore, LWD that is recruited is likely to be removed as a hazard to bridges and structures. (Restoration actions in Santa Rosa Creek will restore some of the habitat that has been lost due to the channelization of this portion of the creek and to anchor LWD in portions of the creek where it is feasible to do so.) Most of the woody debris that has been removed from Spring Lake has been smaller than 12 inches in diameter, but on rare occasion, a larger piece has been removed. When LWD is removed, it is likely to be used in a natural revetment project elsewhere in the watershed. Therefore, if a piece of LWD is entrapped in Spring Lake and removed it will likely benefit another portion of the watershed. It is not likely that removal of wood from Spring Lake will appreciably reduce the amount of scour or cover in Santa Rosa Creek.

The effects of LWD removal in the flood control reservoirs are summarized in Table 3-26. Because the amount of LWD that has been entrained is generally small or none, it represents a very small fraction of the LWD available in the system, and the score for all reservoirs is 3.

Table 3-26 Large Woody Debris Removal Scores for Flood Control Reservoirs

Category Score	Evaluation Category	Current Operations Score
5	No LWD removal	
4	LWD not removed, but modified	
3	LWD removal limited to only when it poses a flood control hazard, removal does not result in substantial reduction of cover or scour in the area	Brush, Piner, Matanzas, Spring, Santa Rosa
2	LWD removal limited, but potentially results in moderate reduction of cover or scour	
1	Complete removal of LWD resulting in substantial reduction of cover or scour	

3.4.2.7 Summary of Effects on Fish and Long-term Habitat Alteration from Passive Operations

Attenuation of peak floods is not likely to negatively affect downstream channel geomorphology through alteration of channel maintenance flows. Only a small drainage area is captured by the Brush Creek, Piner Reservoir and Spring Creek diversion facilities so peak floods are probably not significantly altered and resulting downstream effects are not likely to be significant. Matanzas Creek Reservoir generally fills and spills after mid-December, so channel maintenance flows events are likely to pass to the natural downstream reach later in the year. Because most of

Santa Rosa Creek downstream of Spring Lake has been altered for flood control, attenuation of peak flows does not negatively affect the geomorphology of the creek.

There is no outflow from these reservoirs during the summer so summer water temperatures are not increased in the downstream reaches of the creeks.

During the time the onstream reservoirs (Matanzas, Brush and Piner) refill in the rainy season, downstream flows are reduced. Brush and Piner reservoirs are small and are located fairly high in the watershed, so the effect to downstream habitat is not likely to be significant. Matanzas Creek reservoir has a larger capacity and affects a larger drainage area. It generally begins to spill in mid-December, so flows during the early portion of the coho salmon spawning season (December through mid-February) may be affected. However, this affects only about 20% of the coho salmon spawning season. Therefore the risk to the population is low.

Sediment and LWD retention on Brush Creek, Piner Reservoir and the diversion on Spring Creek are low because these facilities are small, so effects to downstream habitat are likely to be minimal. The sediments removed from the Spring Lake diversion on Santa Rosa Creek usually contain finer rather than coarser sediments, and the diversion of some small amounts of gravel is not likely to affect the availability of spawning habitat in this reach of Santa Rosa Creek. LWD is only rarely trapped in Spring Lake, and if it is removed it is likely to be used in revetment work elsewhere. LWD has not been removed from Matanzas Creek Reservoir in the past so it appears that it is generally not recruited there.

The capacity of Matanzas Creek Reservoir is larger so retention of spawning gravel in Matanzas Creek Reservoir may affect downstream spawning habitat. However, spawning habitat is limited by other issues related to the geomorphology of the channel (CDFG 2000a). For example portions of Matanzas Creek have been channelized and levied, thus high water velocity has resulted in streambank erosion, and high gravel embeddedness makes most of the available spawning habitat unsuitable. While some spawning gravel may be retained in the reservoir, the risk to the populations of listed fish species is low.

When predators from Spring Lake are released during high flow events, they do not introduce a new risk, but they may help to maintain the local population of predators. The risk of predation is not increased, but is maintained.

The most significant effect of the flood control reservoirs is entrapment of anadromous salmonids into Spring Lake. Storm events that result in flows high enough that water is diverted generally occur in January and February, but after March the risk is reduced. While juvenile steelhead are sometimes trapped, their migration period occurs after February, so the risk is not high. Juvenile coho salmon face a higher risk of entrapment because their migration period extends from February through mid-May. Because good quality spawning and rearing habitat occurs upstream of the diversion, it is expected that some individual steelhead and coho salmon may be trapped. However, there is not a long overlap between juvenile salmonid migration periods and the time water spills to Spring Lake, and water flows to Spring Lake on average only once every 1.5 years, so the risk to the populations of coho salmon and steelhead is low.

3.5 BANK STABILIZATION ACTIVITIES

3.5.1 TYPES OF PROJECTS AND ASSOCIATED MAINTENANCE METHODS

Channel improvements were built to control streambank erosion after Warm Springs Dam and Coyote Valley Dam regulated flows in Dry Creek and the upper mainstem Russian River. In the Mark West Creek Watershed, some of the natural waterways were straightened, shaped, and stabilized between 1958 and 1983.

Several types of bank stabilization projects were implemented on Dry Creek and the Russian River:

1. Anchored steel jacks
2. Flexible fence training structures
3. Wire mesh and gravel revetments
4. Pervious erosion check dams
5. Rock Bank
6. Board Fencing
7. Erosion Control Sills
8. Concrete Weir

Current bank stabilization activities involve maintenance of these channel structures. New structures are not being built. Some structures have been covered with soil, have well-established vegetation, and, therefore, do not require maintenance beyond inspections. If, during annual inspections, the USACE finds erosion that could undermine levees, SCWA makes repairs. Two types of maintenance activities are performed, 1) bank repair (earth banks) and 2) structure maintenance/repair. Standardized maintenance methods and best management practices have been developed in conjunction with the Bay Area Storm Water Management Agencies Association (BASMAA) to minimize negative environmental effects. Those practices that are applied during bank repair and structure maintenance are outlined. (Method numbers not discussed in this section apply to sediment and debris removal and to vegetation control.) Vegetation trimming or removal associated with bank stabilization activities is assessed based on how much vegetation is likely to be removed. (Table 2-6). Each method is evaluated for direct effects on critical habitat or injury to fish during the maintenance activities (Table 3-27 and 3-28).

Method #5: A dump truck, or excavator with an extended arm, is used to repair rock rip-rap or place rock in areas of slope undercutting, scour holes or bank slope erosion. Rock is dumped directly on the bank from a dump truck. If the face of the slope has eroded, the excavator digs a two to three foot deep trench at the toe of the bank for the width of the eroded area. Two to three feet of rock is placed by the excavating equipment into the toe and rock rip-rap is placed up the bank from the toe. Smaller rock may be dumped to fill voids in the larger rip-rap. Because most of the work is done on the streambank, potential direct injury to fish is expected to be limited during the activity. Since no bypass or fish rescue is provided, there is a risk of injury to fish in the immediate area. Short-term sediment input may occur during work at the toe of the stream channel. Because equipment is operated from the edge of the bank rather than on the stream bank, sediment input is confined to work done directly near the stream channel, especially the toe. If sediment input to the stream is likely to occur during construction, a berm of washed pea gravel is placed across the stream downstream of the activity area. Removal of vegetation could result in a short-term decrease in canopy cover in the immediate area. However, the work is often done on eroding banks, so there may be minimal effects. Rock rip-rap would inhibit new growth, and a decrease in riparian vegetation could have negative effects on salmonid habitat. When the bank is stabilized, long-term erosion is likely to be reduced, and this decrease in sediment input to the stream is likely to increase the habitat value of the immediate area and areas downstream over time.

Table 3-27 Sediment Containment Evaluation Scores for Bank Stabilization and Structure Maintenance and Repair Practices

Category Score	Evaluation Category	Method # Score
	Component 1: Instream sediment control	
5	Project area does not require rerouting streamflow	9,10,12,16
4	Clean bypass or similar method used	15
3	Effective instream sediment control (*e.g.* berm/fence)	5,6,7,8,11
2	Limited sediment control	
1	No instream sediment control	
	Component 2: Upslope sediment control	
5	No upslope disturbance, or an increase in upslope stability	5,6,7,10,11,16
4	Limited disturbance with effective erosion control measures	9,12,15
3	Moderate to high level of disturbance with effective erosion control measures	8
2	Action likely to result in increase in sediment input into stream	
1	Action likely to result in slope failure, bank erosion, an uncontrolled sediment input to the channel or major changes in channel morphology	

Table 3-28 Opportunity for Injury Evaluation Scores for Bank Stabilization and Structure Maintenance and Repair Practices

Category Score	Evaluation Category	Method # Score
5	Project area is not within flood plain or below maximum water surface elevation (WSEL), and requires no isolation from flow.	7,10,16
4	Project area is within dry part of channel, or construction and maintenance activity scheduled when species of concern is not present.	12
3	Appropriate BMPs are applied; *e.g.* project area survey, escape or rescue provided, project area isolated from flow (if appropriate).	
2	Limited ability to apply appropriate BMPs.	5,6,8,11,15
1	Appropriate BMPs are not applied.	

Method #6 is used to repair large and long erosion areas. In addition to activities in method #5, the excavating equipment may fill the area farthest from the channel slope with native soil or road base shale and then compact the area. Rock rip-rap is placed up the band from the toe. Smaller rock may be dumped to fill the voids. As in method #5, there is a risk of injury to fish in the area and increased sediment input into the stream. A gravel berm is constructed downstream of the construction area to reduce the amount of suspended sediments in the water. Long-term erosion would be reduced. There would be a reduction in the riparian vegetation along the length of the project. The rock rip-rap would inhibit new riparian vegetation from growing.

Method #7: Erosion areas around culverts are repaired by excavating the trench containing the culvert with excavating equipment, dumping sand or native soil on the bank, and then using the excavating equipment to place the material into the trench. Portable compactors compact the fill. Six inches of road base is dumped into the excavated area and compacted using a roller/compactor. Because the work is done outside of the wetted stream channel, no direct injury to fish is expected. There could be some short-term sediment input to the stream. If significant sediment input to the stream is expected, a gravel berm would be placed downstream of the construction area. Long-term erosion would be reduced. Some limited vegetation removal is likely to occur.

Method #8: Shaping may be done in constructed channels, but not on natural channels. A dozer with a blade is used to align flow direction of the creek or channel and to protect banks or restore erosion damage. The dozer is operated across or up and down the bank, using the blade, and the tracks compact the soil. If the equipment is operated near the stream, sediment input and direct injury to fish may occur. The soil on the banks can be disturbed, the potential for erosion may be increased, and riparian vegetation is likely to be disturbed if this method is used without other BMPs. However, this method is normally used as preparation for and in conjunction with another bank stabilization activity, like placing rip-rap, and is only occasionally used for other reasons, for example, to repair a landslide. In these cases, the practice is needed to add stability to the bank and reduce streambank erosion. Over the long-term, riparian vegetation may be reestablished if bank stabilization has improved with the activity. Because this kind of work is generally done on unstable, eroding banks to increase stability and reduce erosion, the benefits outweigh potential risks.

Method #9: Dirt or rock access roads are repaired by dumping dirt or rock from a dump truck over the areas of road, spreading the material with a grader, and using a roller/compactor to compact the surface. There would be no immediate sediment input or direct injury of fish. If rock is spread over a dirt road, long-term erosion may be decreased.

Method #10: Undercut pipe outfalls are repaired by replacing rock in scour holes below the pipe and reshaping the channel to direct flows away from the affected areas. If the erosion is deep, method #6 is applied. Short-term sediment input to the stream and direct injury to fish are possible, particularly if the work extends to the stream. Long-term erosion may be decreased. Some riparian vegetation may be removed, but if bank stability is increased, vegetation may become reestablished.

Method #11: Grouted rock is repaired by clearing the area of broken or damaged material with an excavator with an extended arm or a backhoe operated from the service road. Bank disturbance is kept to minimum because equipment is not operated on the bank. Deeply eroded areas are repaired if necessary with method #6. Rock rip-rap is placed on the bank of the stream channel bottom with method #5 and grouted with ready-mix concrete from a shoot or a concrete pumper. Direct injury to fish and increased sediment input to the stream are possible, particularly if method #6 is needed. Long-term bank stability will be increased. However, a grouted bank would prevent establishment of riparian vegetation. Grouted areas in a stream generally decrease the amount of instream cover available to rearing salmonids, and may make potential spawning sites unavailable.

Method #12: Minor underlining of a lined channel is repaired by accessing the area behind the lining from the top of the bank using hand tools or a backhoe to open a small access. A concrete/sand slurry ready mix would be distributed using a shoot or a concrete pumper. Direct injury to fish or increases in sediment input to the stream are not likely. Because disturbance to the streambank is minimal, erosion and vegetation removal are not likely to be significant.

Method #13: Major undermining repair would be contracted out. Historically, significant undermining has not occurred.

Method #15: When drop structures or check dams are repaired, water is diverted around the affected area. Isolation from flow would minimize sediment input and direct injury to fish. If the diversion is large, a dozer with a blade brings in or moves on-site material for construction of a berm or diversion dam. This would decrease sediment input to the stream. Cracks are filled with concrete or epoxy. Broken sections are cut and broken out, saving reinforcing that can be used to tie existing structure to replacement structure. Concrete form work and concrete pouring is done as necessary. Vegetation removal would be limited to providing access to equipment if necessary.

Method #16: Three to four person crews repair chainlink, field and barbed wire fences, and pipe stepover and smaller swing gates. Fence parts, whole fences or gates may be repaired or replaced. The equipment used may include hand tools, welder, fence stretcher, winch *etc*. Smaller pipe stepover and swing gates are fabricated on-site or at SCWA’s shop. Effects on fish or their habitat are minimal or non-existent. Minor amounts of vegetation may be removed if needed to provide access to crews to the project site, but this is not likely to significantly affect the riparian corridor.

In general, the greatest potential, direct, short-term effects to fish or their habitat could occur from repair of eroded banks (method #s 5 and 6), and shaping of constructed channels (method #8), particularly if work is done near the toe of the channel. Because a gravel berm is used to control potential downstream sedimentation, a score of 3 is applied for these methods (Table 3-28). No bypass or fish rescue/escape is provided, so there is a potential for injury to fish, as reflected by a score of 2 in Table 3-28. However, heavy equipment is not generally operated in the streambed, so the overall risk is low. Other methods may have potential, localized effects that are smaller in scale.

Long-term effects from these projects may include decreased erosion when banks or landslides are stabilized. Instream cover may increase if rocks fall into the stream. The extent of these effects depends on how much work is required in the streams or river, and are discussed in the following sections. The extent of these effects also depends on the condition of the riparian corridor and the streambed, because poor habitat conditions may be improved.

3.5.1.1 Mark West Creek Watershed

Maintenance activities are performed on levees and bank stabilization structures on waterways in the Santa Rosa urban area. Maintenance of rip-rap is often needed in various channels in the Mark West Creek Watershed (B. Oller, SCWA, pers. comm., 2000). A channel alignment project was completed at the confluence of Hinebaugh and Wilfred creeks. This was an old flood control project and this kind of project is not planned for the future. When rip-rap is repaired, methods # 5, 6, and/or 7 may be used. Sediment containment evaluation scores for these methods are given in Table 3-27. Opportunity for injury evaluation scores are given in Table 3-28.

Isolation of the work area with a gravel berm when it affects a wetted portion of the stream minimizes direct injury to fish. Effective sediment control BMPs limit input of sediment from work on stream banks and instream work. Because the work is generally performed on eroding banks, this bank stabilization measure is likely to decrease sediment input to the stream and is not likely to have large effects on existing native riparian vegetation. However, hard armoring techniques such as rip-rap can prevent the establishment of a native riparian corridor over the long-term that could provide benefits to salmonid habitat, like riparian cover and cooler water temperatures. SCWA has a developed set of BMP's and other guidelines to limit the amount of hard-armoring in natural channels associated with bank stabilization work. These guidelines give priority to the use of bio-engineering and revegetation whenever feasible in order to prevent the loss of riparian habitat and to protect aquatic habitat for listed species. Potential bank stabilization effects on riparian habitat is discussed in Section 3.2.1.2.

3.5.1.2 Warm Springs Dam Channel Improvement Sites

A biennial post flood season inspection of the Dry Creek Channel Improvement Project was conducted on July 26-27, 1999 by the USACE. To ensure the flood control works remain eligible for rehabilitation under Public Law 84-99, a non-federal project must meet the minimum USACE requirements before any request for assistance can be provided. It is required that the work be performed prior to the flood season or within six months of the inspections. Table 3-29 lists information about fifteen bank stabilization structures located on Dry Creek, as noted in the 1999 USACE inspection. Rock bank structures are usually located on one bank. The 1999 inspection gives an idea of the amount and type of work that is generally needed. Locations of these projects are given in Figure 1-4.

Table 3-29 Channel Improvement Sites on Dry Creek

Site	Type	Length (ft)	Summary of Comments on Repairs needed
1	Rock Bank	600	Heavy vegetation prevented close inspection, but probably helps hold toe in place. No apparent scour.
2	Rock Bank	750	Heavy vegetation above the toe should be trimmed to allow inspection.
3	Board Fence	700	Some fallen trees in the creek should be cleared. Large trees will begin to damage the fence if not trimmed or removed. Fence and posts still in good condition
4	Rock Bank	200	Only upper rock is accessible. Vegetation needs to be trimmed or removed above toe of rock.
5	Concrete Weir		Good condition
6	Rock Bank	450	Weir in good condition. Trees in the channel have been trimmed. The downstream grouted rock is undercut. The channel between the weirs is steep and eroded, and further bank protection should be considered.
7	Board Fence	900	Only the upper rock is accessible due to heavy vegetation.
8	Rock Bank	480	No land access is available. Large trees are falling and should be cut before the fence is damaged
9	Concrete Weir		Site in good condition. Heavy brush on the right side of the channel should be cleared or trimmed to maintain the channel capacity.
10	½ Rock Sill and Bank		Sill is probably buried and the rock protection in good condition. Dirt has apparently been moved over the sill apron by the landowner, making it very hard to locate.
11	Rock Bank	200	The rock is in place, mostly covered with low brush.
12	Concrete Sill		There is a large sand bar with large trees in the center of the channel, downstream from the fish ladders. Trees should be removed or trimmed. Grout is wearing out and should be redone. Trash racks need cleaning.
13	Concrete Sill		Driftwood should be removed. Rocks are coming loose from grout, which should be redone.
14	Concrete Sill		Several small boils are coming through the sill, and rocks are coming loose. Needs regrouting to attach rock and fill boil paths.
15	Rock Bank	500	Heavy vegetation should be trimmed above the toe. There is some sediment aggradation in the lower reaches of the project, mainly upstream from the sills.

It was noted that in all bank protection sites, vegetation should be trimmed to allow inspection. At the board fence sites, it was noted that large trees and other vegetation would begin to damage the fence if not trimmed or removed, and that large trees and other vegetation are beginning to choke the channel. Tree removal and regrouting were recommended for concrete sills. Tree trimming and/or removal at the board fence sites would reduce the amount of woody debris that may otherwise have been available in sites 3, 8 and 12.

Grouted areas that need repair would require method #5. As the channel between weirs at site 6 was steep and eroded, it was recommended that further bank protection should be considered. The largest effects are likely to occur where bank protection and undercuts need repair, as in site 6, where methods 5 or 6 are required (see Section 3.5.1 for a detailed assessment of effects from these practices). Methods 5 and 6 could introduce turbidity and sediment to Dry Creek during work on the toe of the stream channel, but a gravel berm used during construction reduces suspended sediment concentrations. There is a risk of injury to fish because no bypass, rescue or escape is provided.

There is a substantial negative habitat-altering effect associated with the combined individual project obligations to the USACE. The removal of riparian vegetation and replacement with rip-rap is likely to result in a decrease in riparian corridor shading and cover. This is likely to be the most significant habitat-altering effect on Dry Creek.

3.5.1.3 Coyote Valley Dam Channel Improvement Sites

The SCWA maintains a 22 mile stretch of the Russian River between Cloverdale and Healdsburg, between approximately River Mile 42+00 (downstream of the Jimtown Bridge) and River Mile 62+00 (near the Cloverdale Bridge). Channel improvements installed between 1956 and 1963 included channel clearing, construction of trapezoidal pilot channels, wire mesh-gravel bank revetments, various combinations of single and multiple row jack lines, flexible fence, tree pendants, pervious erosion checks and willow sprig plantings. A section of the right bank at river mile 94.0, opposite the confluence of the East Fork Russian River was protected by rip-rap.

Historically, activities involved maintenance of levees, jacklines, and vegetation removal in the floodway. SCWA is obligated to the USACE to implement the recommended maintenance activities, although they have not recently performed channel maintenance activities in the Russian River. Anticipating restrictions on flood control maintenance after the recent listing of steelhead trout, the SCWA completed prioritized desiltation, bank stabilization and levee repair projects by the end of 1997. Current maintenance practices are limited to levee repair, bank protection, and removal of damaged jack lines (SCWA 1997).

Non-Federal Portion of the Russian River Channel Improvement Project

Most of the sites in the non-federal portion of the Russian River channel improvement project are levees. Levee repairs generally involve the use of rip-rap, mostly in a 10 mile reach between Cloverdale and Asti. A USACE inspection of the non-federal levees was conducted in June of 1999 (Table 3-30). It was found that the majority of these levees required upgrading. Recommendations for upgrading often involves regrading steep slopes, trimming of vegetation to allow inspection, repair of eroding stone protection, repair of toe erosion, and repair of depressions, erosion, cracking, animal burrows, or encroachments.

Table 3-30 1999 USACE Inspection Results for the Non-Federal Portion of the Russian River Channel Improvement Project (River Mile 42 +00 to River Mile 62+00)

Levee Name	River Mile	Rating	Criteria Summary
All Coast Forest Products	61.5 RM-R	Minimally Acceptable	Embankment, vegetation, steep side slopes
City of Cloverdale	61.1 RM-R	Minimally Acceptable	Embankment steep side slopes
Marc Lyons (Black, H)	60.0 RM-L	Unacceptable	Embankment, river side slope erosion
LP Forest Products	59.7 RM-R	Unacceptable	Hydraulic and embankment, riverside slump
Cloverdale Airport	58.8 RM-R	Minimally Acceptable	Hydraulic and embankment, levee height
CALTRANS (Black, J (#3))	58.5 RM-L	Unacceptable	Embankment breached
Black, J (#1)	57.9 RM-L	Unacceptable	Hydraulic and embankment, levee breached
ISC Levee	56.9 RM-L	Minimally Acceptable	Embankment, steep side slopes
Vittori (Dayton)	53.0 RM-L	Unacceptable	Hydraulic and embankment, riverside slump
Murphy	51.3 RM-L	Unacceptable	Embankment, channel side slope erosion
Peterson	49.0 RM-R	Minimally Acceptable	Hydraulic and embankment, levee height
Wassen	49.0 RM-L	Minimally Acceptable	Embankment, dense vegetation riverside
Cadd	48.6 RM-L	Minimally Acceptable	Embankment, steep side slopes
Erburu	47.8 RM-L	Minimally Acceptable	Embankment, steep side slopes
Jelton	43.7 RM-R	Minimally Acceptable	Embankment, steep side slopes

Note: USACE convention for River Mile stationing is facing downstream

Mostly, repair is needed to prevent erosion of the levees. Channel maintenance methods 5, 6, or 8 would generally be required. These methods could introduce turbidity and sediment to the Russian River during work on the toe of the stream channel, but a gravel berm used during construction, if necessary, reduces potential for downstream sedimentation. When the bank has been regraded or stabilized, there would be reduced long-term erosion from the streambank. There is a small risk of injury to fish because no bypass, rescue or escape is provided, but limited, if any, instream work would be required. Removal of riparian vegetation without replacement is likely to result in a decrease in the riparian corridor on one or both banks.

Construction activities may have an affect on rearing or migrating coho salmon, steelhead, and chinook salmon. Loss of native riparian vegetation would have a negative effect on salmonid habitat, including increased water temperatures, a loss of cover, and reduced aquatic insects available for feeding juveniles. Localized areas where the work is done would be affected, but many of these levees appear to need work. Stabilization of an eroding bank would result in reduced sediment input to the river, resulting in a beneficial effect on feeding ability of rearing salmonids and spawning for steelhead and chinook salmon.

Federal Portion of the Russian River Channel Improvement Project

The bank stabilization sites in the federal portions of the Russian River channel improvement project consist primarily of levees, anchored jacks, and rip-rap banks. Additionally, flexible fencing projects were installed in some places. Table 3-32 is a list of sites that were inspected in September 2000 (USACE 2000). Sites are identified by the river mile location of the downstream end and indicate right or left bank looking downstream. A previous inspection report categorized numerous sites as destroyed, functioning, or buried, and a list of these 21 sites was presented to be reinspected. The amount of work recommended on these sites is fairly typical of what is recommended each year.

Table 3-31 Field Inspection of 21 Sites in the Federal Portion of the Russian River Channel Improvement Project (River Mile 42.4 to River Mile 61.3) (September 2000)

Site[1]	Summary of Comments on Repairs needed
42.4R	Heavy vegetation on a stable bank. Some jacks visible. Cable not anchored downstream
43.5R	Stable bench, with jacks about ½ buried in heavy vegetation along a tree line
46.7R	High exposed bench with some rock protection. Large wooded island in the riverbed. No jacks or fence could be found. Site is buried, hidden in heavy vegetation on the island, or gone.
49.2R	Bank stable, with heavy vegetation. Jacks could not be seen.
50.8R	Jacks probably buried under a stable bench with heavy vegetation.
53.1R	High stable bench, but the only jacks visible appear damaged, separate parts in a ditch.
53.9R	There is a bench and heavy vegetation. Jacks are buried or gone.
54.4R	There is a high bench with heavy vegetation. The site is buried in the bench or gone.
56.5R	The bench has been cleared. Jacks are buried or gone.
57.7R	Jacks are about 2/3 buried on a stable bench. Last year the line was found to be cut for a road access to the river.
61.1R	Bank appears stable. Only rock could be found. Jacks may be under the rock.
46.8L	Stable bank with heavy vegetation. No jacks found.
48.7L	Bank appears stable. Jacks in heavy vegetation at upstream end. No jacks for at least the downstream 300 feet, except for a pile at the downstream end. There is rock protection on the downstream 300 feet.
Site	**Summary of Comments on Repairs needed**
50.0L	Bank appears stable. Site has jacks below rock protection along much of the bank.
50.3L	Entire bank appears stable. There are some jacks upstream, some buried, some loose. The downstream slope has rock protection.
50.6L	Not a bank stabilization site. Loose jacks noticed on the riverbank.
51.0L	Jacks are in place along a stable bench with a levee on the water side.
51.3L	Bank stabilized by a tree line. Many pieces of jack, cable and rod indicate the jack line has been destroyed and need not be inspected in the future.

Table 3-31 Field Inspection of 21 Sites in the Federal Portion of the Russian River Channel Improvement Project (River Mile 42.4 to River Mile 61.3) (September 2000) –Continued–

Site	Summary of Comments on Repairs needed
52.9L	High bench may conceal the jack line. No jacks found along the bank, one was in the river channel.
57.8L	Downstream jacks are damaged, unburied, and not anchored. The upstream ½ of the jack line is in heavy vegetation on a stable bank.
58.9L	Bank looks stable. Some jacks visible downstream, some found further upstream with about 2 feet protruding last year. Some are probably missing.
61.3L	Bench looks very stable. Site has a fence upstream and jacks downstream in heavy vegetation. Downstream jacks are at the water line.

[1] "R" and "L" after the river mile refer to right or left bank, looking downstream.

Most of these sites are in stable condition and do not require work in the near future. Based on this inspection, the USACE recommends that the downstream anchors of the jack lines at sites 49.2R and 57.8L be repaired or replaced so they will not be displaced during high water. It is also recommended that bank erosion protection be added at sites 46.7R, 52.9L, and 57.8L, and possibly some channel dredging or realignment to reduce river flow velocities causing erosion. The USACE recommends that a vegetation management program be implemented to reduce blockage of the river channel and increase access for maintenance and inspection of the banks, and that all loose, nonfunctional jacks be removed from the project reaches.

Anchored jacks are structures imbedded in the stream bank, usually installed roughly 20 feet above the channel, that are designed to stabilize the bank. A fair number of these have worked well. They have trapped a fair amount of sediment, are currently buried, and have a cottonwood riparian forest established over them. Where the anchored jacks have not been buried, banks are inspected for erosion. If serious erosion is found at a failing site, the anchored jacks are probably not replaced, but rather some other bank stabilization structure would be put in place in that site. In recent years, however, there have not been serious problems. Occasionally a jack comes loose and falls down to the river, and is taken out so that it is not a hazard.

Levees are composed of compacted substrate and generally have a great deal of vegetation. USACE obligations would require trimming or removal of vegetation on levees . Repairs using rip-rap would also be made if the levee is failing.

The work would be done as described in the projects for Dry Creek and the non-federal portion of the Russian River channel improvement project. While there may be some effects related to short-term sediment input to the river, or potential injury to fish, BMPs described earlier would be used to minimize these direct effects.

In combination, the federal and non-federal obligations to maintain levees and bank erosion control structures on the Russian River would be a substantial habitat altering effect. This effect would be primarily related to a reduction in the extent of riparian corridor by tree removal, trimming, and placing rip-rap on streambanks. This would reduce available shading and cover. In addition, maintenance activities such as re-aligning the river channel to prevent bank erosion may other consequences, including reducing hydraulic and associated habitat complexity.

3.5.1.4 Bank Stabilization Projects in the Upper Russian River

The MCRRFCD grades gravel bars in the channel that are determined to be threatening bank stability and/or dividing a single channel into multiple channels. The gravel is moved to the side of the channel and vegetation growing on the gravel bars is removed. Some of this vegetation is moved to the margin of the channel where it takes root along the streambanks. Approximately one-third of the upper Russian River, about 12 miles, in Mendocino County is maintenanced each year.

Since the MCRRFCD bank stabilization work is performed using sediment and vegetation maintenance activities, the evaluation is discussed under Section 3.1.3 Sediment Maintenance in the Russian River Under ACOE Obligations, and Section 3.1.4 Vegetation Maintenance (Natural Channels).

3.6 NPDES PERMIT ACTIVITIES

The City of Santa Rosa, County of Sonoma, and SCWA (Permittees) entered into an interagency agreement for coverage under a National Pollutant Discharge (NPDES) Permit for storm water discharges, which was adopted by the North Coast Regional Water Board in March, 1997. The NPDES Permit includes a storm water management program (SWMP), a monitoring plan, and an assessment plan (Plans) for managing discharges from the storm drain system within the Permit boundary. SCWA has jurisdiction over approximately 45 miles of flood control channels (see Table 1-4), representing 5% of the public storm drain pipes, ditches and channels that flow through the Permit boundary. In addition to maintaining most of the open channels, SCWA maintains five detention basins within the Permit boundary. The City of Santa Rosa and County of Sonoma maintain jurisdiction over 40% and 55% of the storm drainage system, respectively. SCWA's permit and area of responsibility may increase with Phase II of the SWMP.

The SWMP emphasizes pollution prevention activities through various storm water management strategies, including:

- Development of policies and standards
- Monitoring equipment installed in stream channels, and water quality samples taken during storm water events
- Reduction of runoff from public streets and highways
- Flood control facilities and structural controls
- Municipal waste facilities
- Programs to reduce the use of pesticides, herbicides, and fertilizer
- Control of sediment input from construction sites
- Reduction of contamination from industrial facilities
- Field screening for illicit discharge
- Spill response and prevention
- Public outreach
- Infiltration from sanitary sewers

The SWMP provides the basic approach for reduction of discharge of pollutants to permittees' storm drains. SCWA pollution prevention activities are primarily achieved through management strategies associated with flood control facilities and maintenance, spill response and prevention, and public outreach.

The monitoring and assessment plans are designed to monitor and assess the implementation and effectiveness of Best Management Practices (BMPs) associated with the SWMP. The monitoring and assessment programs are reported annually, with three such reports to date. The NPDES Permit does not contain numerical effluent limitations for any water quality constituents. Potential effects of urban storm water discharges on water quality have not been fully determined, but it is an important purpose of the NPDES Permit to monitor and assess water quality data in order to make that determination. The Regional Water Quality Control Board (RWQCB) has reviewed the Plans and has determined that their implementation constitutes a reduction of pollutants in discharges to the maximum extent practicable (RWQCB 1997). The SWMP, monitoring plan and assessment plan are considered dynamic documents that will be modified over time as water quality information is collected and experience gained in managing storm water discharges.

3.2.1 Storm Water Management Program Activities

SCWA pollution prevention activities are primarily achieved through management strategies associated with flood control facilities and maintenance, spill response and prevention, and public outreach. SCWA also collaborates with the permittees on other SWMP programs as well as monitoring and assessment activities.

3.6.1.1 Flood Control Facilities

Maintenance of flood control facilities includes sediment removal and channel clearing, vegetation maintenance, and bank stabilization. SCWA is presently in the process of reviewing these maintenance activities, and is adopting revised BMPs associated with maintenance practices specifically to address concerns related to protection of water quality and aquatic habitat. SCWA is participating with the Bay Area Stormwater Management Agencies Association's (BASMAA) Operational Permits Committee (OPC) to obtain a regional flood control maintenance permit from the USACE. The OPC was formed to facilitate flood control maintenance strategies to meet NPDES storm water permit requirements, and to assist with developing BMPs which are environmentally sensitive. Currently, SCWA BMPs are similar to those adopted by BASMAA. SCWA has also been actively training staff to use a new preventative maintenance software called Maximo which assists with maintenance scheduling and tracking.

3.6.1.2 Spill Response and Prevention

SCWA's existing Emergency Operations Manual contains a Hazardous Materials Incident Plan that directs staff in the response to a hazardous material spill at any facility. The Plan addresses chlorine, sulphur dioxide, radiation hazard, anhydrous ammonia, sodium hydroxide, sodium sulfite, and sewage spills. The SCWA Hazmat Team is trained to respond to spills at Agency facilities, unless the spill is too large to be contained, in which case the City or County Emergency Service's Hazardous Material Team is notified.

SCWA has also developed a Hazardous Waste Management and Reduction Plan which summarizes policies and procedures related to the collection, storage, recycling, and disposal of hazardous wastes generated at SCWA facilities. This Plan has been revised to specifically address storm water pollution prevention measures.

3.6.1.3 Public Outreach

SCWA's Water Education Program addresses storm water pollution prevention through various activities including:

- Classroom instruction for primary school students emphasizing reduction, reuse, and recycling of household products potentially harmful to the environment
- Printed brochures for the classroom and community containing pollution prevention methods
- Storm drain stencil program
- Tree planting program along flood control channels
- Sponsoring Adopt-A-Watershed training

The City of Santa Rosa and SCWA collaborated on a public outreach program to reduce pesticide use through an Integrated Pest Management Program (IPM) targeted for the landscape industry and the general public. The City, SCWA, and County Transportation and Public Works Integrated Waste Management section entered into a cooperative agreement for implementation of the IPM program in Sonoma County with the City as lead agency. The goals of the IPM program are to:

- Increase public awareness of pesticide effects on water quality
- Reduce environmental risks associated with pesticide use
- Provide information on less toxic pest management techniques and proper use and disposal of pesticides
- Provide training for personnel to disseminate information about pesticides

The IPM program promotes integrated pest management techniques as a means to manage household and garden pests while protecting water quality. Garden pests that are treated with the pesticides that contain diazinon and chlorpyrifos are the target of the program. The IPM program contains the following components:

- Store partnership including store displays, employee training, and educational materials
- Partnership with UC Master Gardeners as trainers for public workshops about IPM
- IPM workshops for the landscape industry including pesticide related businesses such as applicators and exterminators

There is a growing concern about the effects of diazinon on aquatic systems. Diazinon is a common household pesticide widely used in yards and gardens that has been found in rivers and streams of California and the Pacific Northwest. It is found in both agricultural and urban areas. Like all insecticides, diazinon is toxic to the nervous system and kills insects by interfering with their normal function. Studies have shown that river basins that drain urban areas, or agricultural areas with crops on which diazinon is used, are likely to be polluted with diazinon (US EPA, 1999). A survey of storm water in urban creeks draining into the San Francisco Bay found potentially toxic levels of diazinon in 27 percent of the storm samples (Cox 2000). Diazinon may harm fish by disrupting behaviors that usually help young salmon escape predators, reducing the insect food base available to juvenile salmon, inhibiting reproductive behavior, and causing genetic damage.

EPA has not established an aquatic life criterion for diazinon, so that there are currently no legally enforceable guidelines under the Clean Water Act. Additionally, with respect to EPA's registration of diazinon as a pesticide, no consultation has been made between EPA and the National Marine Fisheries Service under the Endangered Species Act for threatened salmon and trout species. Diazinon is being re-evaluated by EPA for allowable residue limits in food, and there has been concern in some areas about effects on aquatic ecosystems. There are guidelines recommended by the National Academy of Sciences (NAS) or the International Joint Commission. Local surveys in California, Oregon, and Washington found diazinon concentrations that exceeded NAS guidelines in 60 to 100 percent of the samples (Cox 2000).

No streams or flood control channels within the NPDES permit boundaries are currently identified on the RWQCB 303D list as impaired for diazinon. Sampling for diazinon (as for other pesticides) is not performed under NPDES as part of a regular monitoring program, although one sample was obtained for analysis which indicated low concentration levels (A. Harris, SCWA, pers. comm. 2000).

Diazinon is high soluble in water, entering streams and rivers during storm runoff events. Diazinon may continue to be found in runoff from patios, driveways, and lawns for several weeks after application (Cox 2000). The half-life of diazinon is approximately 38 days (US EPA, 1999). Although it is known that diazinon is highly soluble, the EPA has not yet determined mobility related to other pathways such as adsorption to sediments (US EPA, 1999). Therefore the ability of diazinon to be transported into streams or to persist in the aquatic environment due to erosion and sedimentation is unknown. Dazinon is a non-point source pesticide which may pollute rivers and streams. Therefore, measures to reduce diazinon should be focused on source control, such as promoting alternative non-chemical strategies for managing pests and producing educational materials for distribution that describe appropriate rates and types of application procedures.

3.6.2 Monitoring and Assessment Plans

SCWA collaborates with the City of Santa Rosa and County of Sonoma to perform monitoring tasks in order to characterize storm water runoff quality. Currently, chemical monitoring takes place at two locations and biological monitoring occurs at six locations on an annual basis, but more locations may be added. Chemical monitoring is performed for metals, organics, nutrients, physical and other parameters. Biological monitoring includes a survey of the benthic macroinvertebrate communities in riffle areas of perennial streams, and a bioassay is conducted using rainbow trout in sampled storm water runoff.

The SWMP is expected to improve the quality of urban runoff by promoting practices that reduce introduction of pollutants into waterways, promote environmentally sensitive storage and disposal practices, and removing pollutants that enter the storm drain system through maintenance operations such as pipe cleaning and response to spills. Effectiveness of the SWMP program is assessed by direct and indirect measurements. Direct measurements include comparing results at chemical and biological monitoring stations, and estimating reduction in pollutant loading through removal of illicit connections, spill response, maintenance operations, and implementation of BMPs. There are various indirect indicators, for example, number of storm drains stenciled, number of industrial sites inspected and enforcement actions, number of pamphlets and educational materials distributed, number of spill clean-ups, *etc*.

Monitoring and Assessment plan results are reported annually. As of June 2000, the permittees have achieved the overall objectives of the NPDES Permit (City of Santa Rosa, Sonoma County Water Agency, County of Sonoma, 1998, 1999, 2000), including:

- Updated identified sources of pollution including industrial dischargers
- Characterized discharges through chemical, bioassay, and macroinvertebrate monitoring
- Developed various management programs including street sweeping, storm drain cleaning, pesticide management, development policies, and spill response and prevention
- Increased enforcement of existing and new regulatory standards such as the Vineyard Erosion and Sediment Control Ordinance
- Public outreach such as the SCWA Water Education Program in the elementary schools and dissemination of educational materials to the general public
- Implemented public education programs for the automotive, food service, construction, and landscape industries, and multi-residential housing.
- Developing procedures to assess both SWMP effectiveness and effectiveness of specific elements

3.6.3 Conclusions

Overall, the permittees have determined that the Plans and associated activities have been effective. Chemical and biological monitoring results since 1998 indicate that there have been no consistent trends or specific water quality constituents of concern identified (City of Santa Rosa, Sonoma County Water Agency, County of Sonoma, 1998, 1999, 2000). Bioassay results indicate very low toxicity of storm water from sampled runoff events. Indirect indicators, including number of inspection and enforcement actions, amount of educational materials distributed, and amounts of pollutants removed through maintenance, spill response, and implementation of BMPs, indicate that the SWMP has been successful to-date. NPDES Plan activities likely have a beneficial effect on listed species and their critical habitat.

Potential effects to protected coho salmon, steelhead, and chinook salmon and their designated critical habitat in the Russian River basin that may arise from channel maintenance activities were evaluated. SCWA's scope of responsibilities include channel maintenance activities in the Central Sonoma Watershed Project and Mark West Creek Watershed, and activities related to USACE dams on the East Fork Russian River (Coyote Valley Dam) and Dry Creek (Warm Springs Dam). In addition, MCRRFCD has channel maintenance responsibilities to the USACE on the Russian River. SCWA's activities in the Santa Rosa area covered under a NPDES storm water discharge permit were evaluated.

Four general types of channel maintenance activities are addressed:

1. Sediment maintenance
2. Channel clearing (debris removal)
3. Vegetation maintenance
4. Bank stabilization

Short-term, direct effects related to direct injury to fish and long-term changes to critical habitat were evaluated for each type of activity. Key findings are summarized in the table below. Where an effect is identified, an assessment is made as to the degree or extent of risk to the overall population of listed fish species. These effects are discussed in the following sections and then they are synthesized to indicate the overall risk to listed fish species and their habitat.

Table 4-1 Summary List of Adverse and Beneficial Effects Related to Maintenance Activities

Maintenance Activity	Significance and Nature of Effect	Risk to Population	Species Affected*
Sediment Maintenance			
Direct, short-term effects	No negative direct effect from sediment input or direct fish injury in flood control or natural channels.	None	
Long-term, habitat effects	Negative effect on migration in constructed flood control channels.	Moderate	St, Co, Ch

Table 4-1 Summary List of Adverse and Beneficial Effects Related to Maintenance Activities –Continued–

Maintenance Activity	Significance and Nature of Effect	Risk to Population	Species Affected*
	Negative effect on rearing habitat in Todd Creek and Laguna de Santa Rosa.	Low	St, Co, Ch
	Negative effect from SCWA activities in Russian River by reducing pool habitat formation and loss of high-flow refuge.	High	St, Ch
	Negative effect from MCRRFCD activities on Russian River by reducing pool habitat formation and loss of high-flow refuge.	High	St, Ch
	Negative effects in natural channels (other than Russian River) in association with bank stabilization activities following catastrophic flood events.	Low	St, Co, Ch
Vegetation Maintenance			
Direct, short-term effects	No negative direct effect from vegetation control practices.	None	
Long-term, habitat effects	No negative effect on constructed flood control channels with current vegetation maintenance practices. Future maintenance practices may be modified, with potential for negative effects to populations.	None	
	Negative effect on natural channels by reducing streambank and instream vegetation in important rearing/spawning streams, with loss of high-flow refuge, shade canopy and cover.	Low	St, Co, Ch

Table 4-1 Summary List of Adverse and Beneficial Effects Related to Maintenance Activities –Continued–

Maintenance Activity	Significance and Nature of Effect	Risk to Population	Species Affected*
	Negative effect from extensive SCWA obligations to USACE in Dry Creek and the mainstem Russian River, Sonoma County. Effects include loss of high-flow refuge, reduction in cover, and potential increases in water temperature.	High	St, Co, Ch
	Negative effect from extensive MCRRFCD USACE obligations in the mainstem Russian River, Mendocino County. Effects include loss of high-flow refuge, reduction in cover, and potential increases in water temperature.	High	St, Ch
LWD Removal			
Long-term, habitat effects	Negative effects associated with LWD removal in constructed flood control channels and flood control reservoirs. Reduction of cover or scour.	Low	St, Co, Ch
Bank Stabilization			
Direct, short-term effects	Negative effects from maintenance of bank stabilization structures and levees in Mark West Creek Watershed, Dry Creek, and Russian River that involve repair of rip-rap and levees, and regrading eroding banks in wetted channels.	Low	St, Co, Ch
Long-term, habitat effects	Negative effects associated with USACE obligations at existing bank stabilization and levee sites on both the Russian River and Dry Creek. Removal of riparian vegetation at multiple sites reduces cover and shading.	Moderate	St, Co, Ch

Table 4-1 Summary List of Adverse and Beneficial Effects Related to Maintenance Activities –Continued–

Maintenance Activity	Significance and Nature of Effect	Risk to Population	Species Affected*
Flood Control Reservoirs			
Direct, short-term effects	Negative effect due to risk of entrapment of salmonids into Spring Lake.	Low	St, Co
Long-term, habitat effects	Negative effect from predation. Release of predators from Spring Lake during high flow events may help maintain established populations in Santa Rosa Creek.	Low	St, Co
	Negative effect from decrease or delay of downstream flow on Matanzas Creek due to reservoir flood capacity may affect early part of coho salmon spawning and early winter rearing habitat.	Low	St, Co
	Negative effect from retention of spawning gravel in Matanzas Creek Reservoir that may affect downstream spawning habitat. Spawning habitat may also be affected by other issues unrelated to reservoir function such as channel geomorphology.	Low	St, Co
NPDES Permit Activities			
Long-term, habitat effects	No negative effect. Implementation of SWMP monitoring indicates low toxicity of storm water runoff.	None	

*If no species is listed, then effect of maintenance activity is not considered to be an adverse impact
*St = Steelhead, Co = Coho salmon, Ch = Chinook salmon

4.1 SEDIMENT MAINTENANCE

Sediment maintenance activities are performed in constructed flood control channels in the Central Sonoma and the Mark West Creek watersheds, and in the Russian River mainstem under obligation to the USACE. They are also performed in natural channels (other than the Russian River and Dry Creek) in conjunction with bank stabilization work at landowner request. As salmonids use natural channels for migration, rearing, and spawning, and constructed flood control channels primarily for migration, potential effects to protected species and their critical habitat could occur in either type of channel.

Without adequate controls, direct, short-term effects from sediment maintenance activities could potentially include an increase in sediment input to the channel and a risk for direct injury or mortality to fish. Current maintenance practices limit streambed and streambank disturbance and reduce the frequency and amount of channel work that is performed. As sediment removal in flood control channels is performed during the summer or fall, potential direct effects are limited to rearing and some migrating juvenile steelhead, chinook salmon and coho salmon. Sediment removal activities are often performed in dry channels, limiting the risk of direct effects to protected species and their habitat. Effective BMPs keep streambank disturbance to a minimum and control sediment input to the channel. There is a potential for direct injury to rearing salmonids when equipment performs work in a wetted channel. However, SCWA staff biologists routinely identify areas where salmonids may be utilizing habitat, and if protected species are present, fish rescues are conducted. Because sediment removal activities performed in constructed flood control channels that contain poor quality rearing habitat for listed species, few, if any, fish are exposed. Therefore, the risk of direct injury to protected fish species is low.

Long-term, habitat-altering effects from sediment removal activities in flood control channels include a widening of the channel bottom that reduces flow depths. This substantially diminishes the opportunity for flows that are suitable for passage, and therefore has a negative effect on coho salmon, steelhead and chinook salmon migration. Since all flood control channels are potentially migration corridors, all channels that are subject to sediment excavation may be affected. The most extensive sediment removal activities occur in the channels draining the Rohnert Park-Cotati area.

Summer rearing habitat is rarely available in the majority of flood control channels that are subject to sediment excavation (due to low-gradient, lack of streamflow, and warm water temperatures). Therefore, effects to rearing habitat are not substantial. However, there are two channels historically subject to sediment maintenance work that have been identified as potentially supporting rearing habitat; Laguna de Santa Rosa and Todd Creek. Potential loss of rearing habitat associated with reduced pool availability, lack of instream cover, canopy cover, habitat complexity and hydraulic complexity due to sediment excavation is a significant effect on these streams. Steelhead, chinook salmon and coho salmon may be affected.

Since the most extensive maintenance work is primarily done in channels where habitat has already been degraded by sediment deposition, and these flood control channels are not considered to provide good rearing habitat or to support spawning habitat, the overall risk to listed fish species is considered to be low. Reduction of sediment input to flood control channels is related to land use activities in the watershed. SCWA restoration and conservation actions to reduce sediment loads are discussed in *Interim Report 6: Restoration and Conservation Actions*.

Sediment maintenance to control bank erosion is a USACE obligation for the SCWA on Dry Creek and the Russian River in Sonoma County, and the MCRRFCD on the upper Russian River in Mendocino County. While the obligations are similar, SCWA has not conducted these activities in recent years. MCRRFCD conducts sediment maintenance activities every year.

The sediment maintenance work is performed in conjunction with vegetation maintenance activities, whereby gravel bars are graded and vegetation is removed from the gravel bars during the grading procedure. There are no short-term direct effects associated with impairment of water quality or direct injury to fish associated with this work based on the best management practices and erosion/sedimentation control methods that are employed.

Sediments and gravels are not removed from the Russian River by MCRRFCD as part of their maintenance practices. Therefore, there are no habitat-altering effects related to the supply or transport of spawning gravels. SCWA does occasionally remove sediments from the Russian River, and this work is usually contracted out with firms that perform gravel extraction (pers. comm, Bob Oller, SCWA). Gravel removal can alter sediment transport characteristics of the river, resulting in changes to channel geomorphology (such as channel incision) and changes to aquatic habitat. The specific nature of such changes associated with gravel removal on the Russian River are not known.

Sediment maintenance activities practiced by SCWA and the MCRRFCD in the Russian River have a substantial effect on critical habitat for steelhead and chinook salmon. The sediment maintenance activities potentially alter channel geomorphology by inhibiting the development of stable gravel bars. This practice tends to reduce channel sinuosity that has a significant negative effect on habitat conditions. The habitat effects include reduced potential for pool development on the outside of meander bends, and reduced high-flow refugia due to the loss of the bedform topography created by stable bars with established vegetation that provide velocity breaks and resting areas. There is also a general loss of hydraulic and associated aquatic habitat complexity.

Sediment removal is occasionally required in natural channels when landowners request SCWA to remediate problems associated with reduced channel flood capacity and bank erosion that threatens property or infrastructure. SCWA does not perform routine sediment removal activities in natural channels. In the past, sediment excavation has almost always been related to landslides or following significant storm events. It is estimated based on past activities, that sediment removal in natural channels occurs about once in every 10 years (Bob Oller, SCWA, pers. comm. 2000). Sediment removal in natural channels could be requested by a landowner on almost any stream in the Russian River basin. Any of the ESA-listed fish species may or may not be present in the stream, and habitat conditions may vary widely.

Sediment removal activities in natural channels occur on a very limited and infrequent basis. SCWA has developed best management practices and other guidelines for planning and implementing sediment removal and bank stabilization work performed in natural channels in order to protect listed species and to minimize significant habitat alterations. Negative habitat alterations could occur from installation of rip-rap (reduction in riparian vegetation), removal of sediments, or alteration of channel morphology. However, given the infrequent need for maintenance activities in natural channels, the prescriptions for limiting the size of any project to 1,000 ft, and the guidelines for incorporating bio-engineering, revegetation, and fish habitat elements into bank stabilization work, the potential for substantial habitat altering effects associated with sediment maintenance activities on natural channels is small. Therefore the risk to listed fish species is low.

4.2 Debris Clearing

Woody debris removal is performed only in constructed flood control channels, flood control reservoirs, and to a very limited extent in natural channels associated with emergency sediment maintenance and bank stabilization activities. Debris clearing in flood control reservoirs is discussed in Section 4.5.2 *Direct Effects to Salmonids and Indirect Habitat Alteration Effects from Passive Operation of Flood Control Reservoirs.*

In recent years, SCWA has coordinated with NMFS and CDFG to limit removal of large woody debris (LWD) or other important fish habitat structures to situations when there is a serious flood threat or bank stability problem. LWD is allowed to remain in flood control channels if it does not threaten bank stability or the flow capacity of structures such as bridges and culverts. LWD does not play a significant role in providing aquatic habitat structure in constructed flood control channels since there are very limited tree sources in the riparian corridor (flood control channels are not located in forested areas) and limited opportunity for recruitment process (*i.e.*, stable bank design with minor bank erosion). Therefore, LWD removal in constructed flood control channels results in reduction of a small amount of cover or scour, but the overall effect on the population is low.

In natural channels, LWD is removed only in conjunction with emergency sediment maintenance and bank stabilization activities (described in Section 4.1). LWD is removed if it threatens streambank stability that would result in loss of property or infrastructure. Given that this type of maintenance work is performed infrequently and at a small scale (projects are limited to no more than 1,000 linear feet in size based on SCWA guidelines), LWD maintenance practices will not negatively affect salmonid habitat in natural channels.

4.3 Vegetation Maintenance

Vegetation maintenance practices are performed in order to maintain flood capacity and to reduce the potential for streambank erosion. Vegetation maintenance practices differ between natural and constructed flood control channels in the Mark West Creek Watershed. Natural waterways maintained by SCWA are listed in Table 1-2, and include 13 miles along Dry Creek and 22 miles along the mainstem Russian River. Current vegetation maintenance methods retain canopy cover as much as possible, and are a dramatic improvement compared with past practices that resulted in more widespread removal of riparian vegetation.

Since 1987, heavy equipment has not been used in the bottom of natural channels; rather, hand labor is used. This practice has reduced disturbance in the channel and on the banks. Herbicides are used in natural and flood control channels, to control in-stream vegetation such as tules, cattails, and blackberries. This practice has become more important in urbanized areas where return flows support vegetative growth throughout the summer, reducing flood capacity. Only Rodeo, an aquatic contact herbicide, is used, and this substantially reduces the risk to protected species and aquatic invertebrates that support them. Roads are mowed and sprayed with Rodeo, but care is taken to spray in only a narrow width on the streamside, and to not spray the herbicide too close to the edge of channels. Limited use of herbicides approved for aquatic use avoids direct injury to fish.

Constructed flood control channels were historically cleared to maintain hydraulic capacity and reduce fire dangers. Current practices call for removal of understory vegetation in the lower third of the channel bank, including the base of the channel bank, only as needed, by hand, and leaving native riparian species wherever possible. An emphasis is placed on allowing native trees to establish a shade canopy. There will be an increase in the riparian corridor over time as these trees mature and could potentially reduce vegetation removal activities in the understory. Approximately one-third of the constructed flood control channels have some portions with developing tree canopies. The other two-thirds of the flood control channels are dominated by willows, blackberries, cattails and tules.

SCWA also has vegetation maintenance responsibilities on a section of Santa Rosa Creek for the Prince Memorial Greenway restoration project and for a restoration project on the lower reaches of Brush Creek. In general these responsibilities include maintaining vegetation that has been planted along the streambanks for each of these projects (on Brush Creek vegetation is not cut on the lower one-third of the streambank), so that there is no loss of the riparian canopy. SCWA is also responsible for maintaining the hydraulic capacity of these restored flood control channels. Since these projects require no greater removal or trimming of vegetation than is already practiced for other constructed flood control channels, there are no negative effects to habitat conditions associated with these vegetation maintenance responsibilities.

Based on the current maintenance practices in flood control channels, vegetation is removed from between 25% up to 50% of the channel cross-section (score of 3, Table 3-14). Since most of the flood control channels provide no or very limited rearing habitat, and primarily function as migration corridors, current maintenance practices do not significantly alter critical habitat conditions in flood control channels.

Present-day vegetation maintenance practices in constructed flood control channels are currently being reviewed by SCWA in order to determine the influence on channel flood capacity. Because SCWA has an obligation to maintain flood capacity, it is possible that the current maintenance practices may need to be modified in the future. As vegetative growth on the streambanks becomes more dense and mature, channel capacity could be significantly reduced, and flooding could occur. At this time the nature and extent of modification to existing vegetation maintenance practices, if necessary at all, is unknown.

If it is necessary for SCWA to revert to prior maintenance practices, then only some vegetation near the top of the bankfull channel and set back from the top of bank would likely be allowed to establish. This would represent about a 75% or greater reduction in vegetation within the channel cross-section and the resulting score would be a 1, indicating a potentially significant effect. For the flood control channels supporting migration habitat, the risk to the overall population of steelhead, coho salmon and chinook salmon would be relatively small since few individuals are likely using these flood control channels. Effects would be of greater significance to the population as a whole for those flood control channels that support rearing and/or spawning habitat. There are eight flood control channels identified that potentially support spawning and/or rearing habitat (see Table 3-13), and they are listed below:

- Crane Creek
- Paulin Creek
- Todd Creek
- Laguna de Santa Rosa
- Rinconada
- Brush Creek
- Oakmont
- Santa Rosa Creek

Potential vegetation removal on these channels under more aggressive maintenance practices may potentially result in increased water temperatures that could be detrimental to salmonids. Removal of understory vegetation may result in a decrease in cover for salmonids and invertebrates on which they feed.

Alternatively, other vegetation maintenance practice scenarios may be developed, if needed. An estimate of the long-term indirect effects on habitat depends on the extent of vegetation removal practices. Any maintenance practice that requires between 50% and up to 75% removal of vegetation would score a 2, which would be considered to have a substantial effect. For the flood control channels that do not support rearing or spawning habitat, there is not expected to be a significant effect on habitat conditions. However, for those 8 channels (above) designated as providing potential rearing and/or spawning habitat, the effect is of greater importance and would therefore be considered a significant habitat alteration.

Under obligations to the USACE, SCWA is required to provide vegetation maintenance activities to maintain flood capacity and to prevent bank destabilization and erosion in Dry Creek and the lower Russian River. The MCRRFCD is also under obligation to the USACE to conduct vegetation maintenance activities on the upper Russian River. More stringent evaluation criteria were developed for vegetation maintenance practices in natural channels, including the Russian River and Dry Creek. The scoring for Dry Creek is a 1 based on estimates of greater than 50% reduction in vegetation (Table 3-8), and a 1 based on estimates of greater than 50% reduction in the Russian River (Table 3-9), indicating that vegetation maintenance activities are likely to have a substantial effect. Given the multiple life history stages of listed species supported by the Russian River, and relatively large linear extent of vegetation clearing that is likely to be necessary over time (both SCWA and the MCRRFCD have obligations over a combined total area of 58 miles), this practice is considered to be a substantial habitat alteration. Steelhead and chinook salmon critical habitat would be negatively affected, and there would be a high risk to the populations as a whole.

The habitat-altering effects are similar to those discussed for sediment maintenance activities in the Russian River and Dry Creek. Vegetation removal potentially alters channel geomorphology by inhibiting the development of stable gravel bars. This practice tends to reduce channel sinuosity and has a substantial effect on habitat conditions. The habitat effects include reduced potential for pool development on the outside of meander bends, and reduced high-flow refugia due to the loss of the bedform topography created by stable bars with established vegetation that provide velocity breaks and resting areas. In addition, reduced shading from loss of riparian vegetation (particularly near the thalweg in the summer) will increase water temperatures and reduce cover. Overall, there is a general loss of hydraulic and associated aquatic habitat complexity.

The MCRRFCD has planted and maintained riparian vegetation in a two-mile stretch along the upper Russian River. Furthermore, MCRRFCD has supported the Ukiah Rod and Gun Club's Spawning Habitat Channel installed on the West Fork of the Russian River. Such restoration activities are likely to improve habitat for steelhead and chinook salmon.

For the natural channels (other than Dry Creek and Russian River) where vegetation removal may occur (Table 1-2), SCWA does not have routine or regularly implemented maintenance obligations. SCWA will remove vegetation on these natural channels only where there are site-specific problems with flood capacity. Therefore, the length of vegetation removal is limited to small projects. Most projects are about 300-600 ft in length (pers. comm. Bob Oller, SCWA). When willows are removed from gravel bars, winter refugia could be reduced for coho salmon and steelhead. Since SCWA practices in natural channels call for underbrush removal and retention of a shade canopy over stream channels, it is reasonably estimated that no more than 25% of the in-channel vegetation is removed resulting in a score of 3 (Table 3-10). Given the small scale of current vegetation removal activities, there is a relatively low risk to populations from long-term habitat-altering effects (particularly coho salmon and steelhead and possibly chinook salmon) in natural streams.

4.4 BANK STABILIZATION

4.4.1 MARK WEST CREEK WATERSHED, DRY CREEK, AND RUSSIAN RIVER

Current bank stabilization activities by SCWA involve maintenance of existing structures. No new structures are being constructed. Maintenance of bank stabilization structures and levees in the Mark West Creek Watershed generally involves the repair of rip-rap. A significant amount of work is required under obligations to the USACE on 15 bank stabilization sites in Dry Creek. The largest projects are in a 22-mile stretch along the upper Russian River between Cloverdale and Healdsburg, including both non-federal and federal levees and bank stabilization structures. All three listed fish species use Dry Creek and the upper mainstem Russian River. Steelhead, coho salmon, and chinook salmon use streams and constructed flood control channels in the Mark West Creek Watershed.

The most extensive short-term direct effects would occur from maintenance methods that involve repair of rip-rap and levees, regrading banks where they are eroding or landslides have occurred, and re-alignment of the channel. Other bank stabilization methods are likely to have localized effects that are smaller in scale. Increased turbidity may affect rearing salmonids. Erosion control BMPs, such as installation of a gravel berm to reduce sediment input from the construction area, are routinely used to control potential increases in turbidity or sedimentation. Re-grading a bank and re-aligning a channel section could potentially result in a high level of disturbance to the bank, but by using effective erosion control methods and by scheduling the work in the summer, sediment input to the stream is minimized.

Because there is no bypass, rescue, or escape provided during construction activities, there is a risk of direct injury or mortality to juvenile salmonids. This risk is due to construction equipment that is in contact with the channel bed in a wetted stream channel where listed species are present. However, since work within the wetted stream channel is infrequent and focused on site-specific locations, the overall risk to populations is low.

Habitat is negatively affected on Dry Creek and the Russian River in association with bank stabilization work required under obligations to the USACE. Much of this work requires vegetation removal, tree trimming, and rip-rap on unstable banks and levees at multiple sites. Where rip-rap is used, growth of new vegetation can be inhibited. At least one site on the Russian River has been recommended for re-alignment to reduce bank erosion. In combination, the federal and non-federal obligations to maintain levees and bank erosion control structures on the Russian River would be a substantial habitat altering effect.

4.4.2 Upper Russian River: MCRRFCD and SCWA Obligations to USACE

The MCRRFCD and SCWA grade gravel bars in the channel that are determined to be threatening bank stability and/or dividing a single channel into multiple channels. The gravel is moved to the side of the channel and vegetation growing on the gravel bars is removed. MCRRFCD moves willows that are growing on the bars to the banks, where they may take root and provide improved bank stabilization. SCWA completely removes the willows from the channel. Approximately one-third of the upper Russian River in Mendocino County is maintained each year. SCWA has not performed this type of work in the Russian River since 1993, but remains under obligation to the USACE to do so.

Since the MCRRFCD and SCWA bank stabilization work is performed using sediment and vegetation maintenance practices, the summary evaluation of habitat-altering effects is discussed separately in sections 4.1 and 4.3 above.

4.5 Central Sonoma Watershed Project Flood Control Reservoirs

4.5.1 Direct Effects from Maintenance Activities

Maintenance work on the flood control reservoirs includes removing sediments to restore flood control capacity or removing noxious pondweeds. Small amounts of vegetation and sediments are removed from the outlets. Sediments are also removed from inlet structures at diversion facilities. Potential effects include changes in downstream water temperatures and flow when reservoirs are drained, changes in turbidity, injury to fish, and reduction in vegetation.

Sediment removal or weed removal from flood control reservoirs does not increase turbidity or cause downstream sedimentation, because there is no flow from the work area. There is no injury to listed fish species because there are no anadromous runs of salmonids past the structures on Brush, Paulin, Matanzas or Spring creeks. Anadromous fish trapped in Spring Lake are considered lost to the anadromous population, and this effect is discussed separately. Desiltation and vegetation removal on the outfalls of the reservoirs are done when the outfalls are dry, so there are no immediate effects on fish or their habitat. The areas affected are so small there are no long-term effects on salmonid habitat.

When the large, shallow Spring Lake is drained to Santa Rosa Creek before maintenance work, effects to water quality are likely to be minimal. Because Spring Lake is a large, shallow lake, lake stratification is not likely to occur, and therefore low dissolved oxygen water is not likely to be released. Water is pumped, not released from a low-flow outlet, so there is not likely to be an increase in fine sediment input to the creek. There is a potential to increase water temperatures in the creek. It may take four to six weeks to drain the reservoir, and this activity may occur about once every twelve years. Spring Lake is drained as early as possible during the spring season while water temperatures are cooler and creek flows are higher to avoid increasing water temperatures above threshold limits for salmonids.

In general, maintenance activities on the flood control reservoirs are not likely to negatively affect salmonids. While there is likely to be an increase in Santa Rosa Creek water temperature when Spring Lake is drained, this effect is minimized because water is released as early as possible in the spring.

4.5.2 Direct Effects to Salmonids and Indirect Habitat Alteration Effects from Passive Operation of Flood Control Reservoirs

The flood control reservoirs and diversion facilities operate passively. Potential long-term effects evaluated include changes to salmonid habitat, including increase in downstream water temperature and a reduction of sediment and LWD transport from upstream areas. By capturing stream flow in detention storage until they fill and spill, on-stream reservoirs can alter the magnitude and timing of downstream flow. The release of predators to Santa Rosa Creek from Spring Lake was also evaluated. A direct effect of passive operation of Spring Lake is that downstream migrants may be trapped in the reservoir during high flood flows.

Attenuation of peak floods is not likely to negatively affect downstream channel geomorphology through alteration of channel maintenance flows. Only a small drainage area is captured by the Brush Creek, Piner Reservoir and Spring Creek diversion facilities, so effects are not likely to be substantial. Matanzas Creek Reservoir generally fills and spills after mid-December, so channel maintaining peak flow events are likely to pass to the natural downstream reach later in the year. Because most of Santa Rosa Creek downstream of Spring Lake has been altered for flood control, attenuation of peak flows is not likely to negatively affect the geomorphology of the creek.

There is no outflow from these reservoirs during the summer so downstream water temperatures are not altered in these streams.

During the time the onstream reservoirs (Matanzas, Brush and Piner) refill in the rainy season, downstream flows are reduced. Brush and Piner reservoirs are small and are located fairly high in the watershed, so the reduction of flow to downstream habitat is not likely to be substantial.

Sediment and LWD retention on Brush Creek and Piner reservoirs and the diversion on Spring Creek are low because these facilities are small, so effects to downstream habitat are likely to be minimal. The sediments removed from the Spring Lake diversion on Santa Rosa Creek usually contain finer rather than coarser sediments, and the diversion of some small amounts of gravel is not likely to affect the availability of spawning habitat in this reach of Santa Rosa Creek. LWD is only rarely trapped in Spring Lake, and if it is removed it is likely to be used in revetment work elsewhere. LWD has not been removed from Matanzas Creek Reservoir in the past, so it appears that it is generally not recruited there.

Matanzas Creek Reservoir has a larger capacity and affects a larger drainage area than the structures on Brush, Paulin and Spring Creeks. It may have some effect on downstream flow and on retention of spawning gravel. Matanzas Creek reservoir generally begins to spill in mid-

December, so flows during the early portion of the coho salmon spawning season (December through mid-February) may be affected. However, this affects only about 20% of the coho salmon spawning season, so while some fish may be affected, the overall population effect is low. Sediments entrained or removed from Matanzas Creek reservoir are not recruited to downstream areas and this may contribute to a loss of spawning gravel. However, loss of spawning gravel could be affected by other issues related to the geomorphology of the downstream channel, for example high water velocities may contribute to the lack of suitable spawning gravel. Although there may be a negative effect to spawning habitat from the loss of some spawning gravel, the overall population effect is likely to be low.

Spring Lake provides warmwater habitat and a source population of predators. Predators are established in Santa Rosa Creek and warm summer water temperatures favor predators while they can stress salmonids. When predators from Spring Lake are released during high flow events they do not introduce a new risk, but they may help to maintain the local population of predators.

The most significant effect of the flood control reservoirs is the potential to trap salmonids in Spring Lake. Anadromous salmonids face a risk of entrapment into Spring Lake during high flow events about once every 1.5 years. Storm events that result in flows high enough for diversion of water into Spring Lake generally occur in January and February. After March, flows are generally lower and the risk of entrapment is reduced. While juvenile steelhead are sometimes trapped, their migration period occurs after February, so the risk is not high. Juvenile coho salmon face a higher risk of entrapment because their migration period extends from February through mid-May. Because good quality spawning and rearing habitat occurs upstream of the diversion, it is expected that some individual steelhead and coho salmon may be trapped. However, there is not a long overlap between juvenile salmonid migration periods and the period of time high flow events result in water spills to Spring Lake. Furthermore, water spills to Spring Lake on average only once every 1.5 years. Therefore, the risk to the populations of coho salmon and steelhead is low.

4.6 NPDES PERMIT ACTIVITIES

Overall, the permittees have determined that the Plans and associated activities have been effective. Chemical and biological monitoring results since 1998 indicate that there have been no consistent trends or specific water quality constituents of concern identified (City of Santa Rosa, Sonoma County Water Agency, County of Sonoma, 1998, 1999, 2000). Bioassay results indicate very low toxicity of storm water from sampled runoff events. Indirect indicators, including the number of inspection and enforcement actions, amount of educational materials distributed, and amounts of pollutants removed through maintenance, spill response, and implementation of BMPs, indicate that the SWMP has been successful to-date. NPDES Plan activities likely have a beneficial effect on listed species and their critical habitat.

4.7 SYNTHESIS OF EFFECTS

Multiple maintenance activities are likely to overlap in time and in space. Both natural and constructed flood control channels are affected by the combination of maintenance activities. Effects of multiple maintenance activities on critical habitat conditions can become more substantial, persist over longer time periods, or extend over larger areas, than if only one type of maintenance activity is implemented. This section discusses the syntheses of multiple maintenance activities on critical habitat and populations of the ESA-listed fish species.

4.7.1 Russian River Flood Capacity and Bank Erosion Control Activities

SCWA conducts maintenance activities under obligation to the USACE along 22 miles of the mainstem Russian River in order to maintain hydraulic capacity and to reduce bank erosion. These activities include sediment maintenance work such as gravel bar skimming operations and vegetation maintenance work that includes removing vegetation from gravel bars. Up to a 400-foot wide section of channel is maintained free from riparian vegetation within the high-flow area of the channel.

Sediment maintenance activities by SCWA in the mainstem Russian River have been determined to have a substantial negative effect on channel geomorphic and critical habitat conditions associated with high flow refuge, development of pools (rearing habitat), and overall habitat diversity. Vegetation maintenance activities by SCWA have also been determined to substantially affect channel geomorphic and critical habitat conditions, including loss of high flow refuge, loss of cover, and potential increases in water temperature.

Vegetation maintenance activities interact with the sediment maintenance activities, compounding the effects on gravel bars and resulting critical habitat conditions. Without the stabilizing influence of vegetation on gravel bars, these bars do not function effectively to trap and store sediments. This results in changes to channel geomorphology, by reducing sinuosity and reducing hydraulic complexity. In combination, the vegetation and sediment maintenance practices probably reinforce the already substantial effects on high flow refuge and rearing habitat for steelhead and chinook salmon.

MCRRFCD also conducts sediment and vegetation maintenance activities in Mendocino County under obligation to the USACE along 36 miles of the mainstem Russian River in order to maintain hydraulic capacity and to reduce bank erosion. These activities consist of gravel bar skimming and removal of vegetation from bars that are then placed along the bank for erosion control. The changes to channel geomorphology and critical habitat conditions resulting separately from sediment and vegetation maintenance practices are similar to those described above. In combination, the vegetation and sediment maintenance practices by MCRRFCD probably reinforce the already substantial negative effect on high flow refuge and rearing habitat for steelhead and chinook salmon.

The gravel bar grading operations and vegetation maintenance activities conducted for streambank stabilization on the Russian River by both MCRRFCD and SCWA combined are likely to adversely modify critical habitat for steelhead and chinook salmon. This is a substantial adverse effect that extends over an approximate linear distance of 60 miles along the mainstem Russian River.

SCWA is obligated to perform maintenance activities to stabilize streambanks and maintain levees at multiple sites on Dry Creek and the maintstem Russian River. Most of these sites have existing structures such as anchored steel jacks that were installed when Coyote Valley Dam and

Warm Springs Dam were constructed. Much of the work requires removal of vegetation, including trees. In combination, the multiple sites represent several thousand feet of channel on Dry Creek and several thousand feet on the mainstem Russian River. This maintenance work is considered to have a negative effect on critical habitat conditions, with a moderate overall effect on the population of all three listed fish species.

4.7.2 Constructed Flood Control Channel Sediment Maintenance and Vegetation Maintenance Activities

The constructed flood control channels in Zone 1A are maintenanced to ensure that they have adequate flood capacity. Some vegetation maintenance is performed on almost all of the constructed flood control channels. This vegetation maintenance can consist of removing vegetation from the lower one-third of the streambanks, removing vegetation from stream bottoms, and removal of vegetation along access roads, and fencelines. This work is not performed unless it is deemed to be necessary for flood protection. Vegetation maintenance, as it is currently practiced, does not have a substantial negative effect on the habitat in flood control channels.

In addition to the vegetation maintenance activities, sediments are removed from constructed channels for the same flood protection purposes. The sediment maintenance work is performed when the clearance between the bottom of the channel and the invert of storm-water outfalls are within one foot. Most of the sediment maintenance work occurs in the Rohnert Park-Cotati area, although there are a few other channels in the Santa Rosa area and other areas within Zone 1A that have historically required some sediment maintenance work. Sediment maintenance activities increase the width of the channel bottom and thereby reduce flow depths. This substantially alters fish passage conditions and reduces steelhead, chinook salmon and coho salmon migration in these channels. This effect may persist for several seasons, until new sediments have deposited (usually as lateral bars) and they have become stabilized by vegetative growth.

Those channels that are subject to sediment maintenance (Table 3-3) are also generally maintenanced for vegetation. Most of the channels that require sediment maintenance function only as migration corridors, and provide little rearing habitat, except Laguna de Santa Rosa and Todd Creek. The combined effect of sediment maintenance and vegetation maintenance on flood control channels is not expected to be greater than either of the individual maintenance practices alone. Current vegetation maintenance practices on Laguna de Santa Rosa and Todd Creek are not considered to have a negative effect. Sediment maintenance activities on these two channels, as well as all of the other channels where sediment maintenance is practiced, are likely to restrict salmonid migration. In combination, the two types of maintenance practices are not considered to have any greater effect on the Laguna de Santa Rosa or Todd Creek. Once migration is affected, listed species (steelhead, chinook salmon and coho salmon) do not have access to upstream areas on these two channels. Therefore, loss of vegetation in upstream areas will have no additional effect. In areas downstream of the migration barrier created by sediment maintenance, vegetation removal (as currently practiced) has already been determined not to have a negative effect in flood control channels.

4.7.3 EFFECTS ON LISTED FISH SPECIES AND DESIGNATED CRITICAL HABITAT

Channel maintenance activities performed by SCWA are likely to adversely affect the listed fish species due to:

(1) Bank stabilization maintenance activities that occasionally occur in natural channels, when there is streamflow present, including Dry Creek, mainstem Russian River, and the Mark West Creek watershed. The overall risk to populations of steelhead, coho salmon, and chinook salmon is low.

(2) Passive operation of Spring Lake Reservoir that may entrap salmonids into Spring Lake during high flows. The overall risk to populations of steelhead and coho salmon is low.

(3) *Channel maintenance activities performed by SCWA are likely to adversely modify the designated critical habitat of the listed fish species.* Adverse modifications to designated critical habitat are associated with sediment maintenance, vegetation maintenance, large woody debris removal, bank stabilization activities, and passive operation of the flood control reservoirs. Adverse effects to critical habitat are due to:

(4) Sediment maintenance activities in constructed flood control channels that reduce fish passage to spawning and rearing habitat and restricts downstream migration. The overall effect to the populations of steelhead, chinook and coho is moderate.

(5) Sediment maintenance activities in the flood control channels that provide summer rearing habitat in the Laguna de Santa Rosa and Todd Creek by reducing pool habitat, cover, shading, and habitat complexity. The overall effect to the populations of steelhead, chinook salmon and coho salmon is low. In addition, any of the identified 6 flood control channels that have a potential to support rearing habitat (Crane Creek, Paulin Creek, Rinconada Creek, Oakmont Creek, Santa Rosa Creek, and Brush Creek), although they have not historically required sediment maintenance, could require sediment maintenance in the future. These channels would also be subject to negative effects on rearing habitat. The overall effect to the populations of steelhead, chinook and coho salmon would be low.

(6) Sediment maintenance in the Russian River affects species by reducing pool habitat formation and loss of high flow refuge. The overall effects to populations of steelhead, coho salmon, and chinook salmon are high.

(7) Vegetation maintenance effects on natural channels (other than the Russian River or Dry Creek), by reducing vegetation and associated loss of high-flow refuge, shade canopy, and cover. Overall effect to populations of steelhead, coho salmon, and chinook salmon is low.

(8) Vegetation maintenance on Dry Creek and the mainstem Russian River by substantially reducing vegetation with associated loss of high-flow refuge, shade canopy, and cover. Overall effect to populations of steelhead, coho salmon, and chinook salmon is high.

(9) Potential adverse effects to critical habitat in flood control channels associated with vegetation maintenance practices, should the existing practices be modified in the future. The potential for adverse effects depends upon the extent to which vegetation is removed

from flood control channels, and if the maintenance practice is performed on those channels identified as potential rearing habitat.

(10) Loss of large woody debris in constructed flood control channels and flood control reservoirs (Spring Lake and Mantanzas Reservoir), due to loss of cover and scour. The overall effect to populations of steelhead and coho salmon is low.

(11) Bank stabilization activities under USACE obligations on Dry Creek and the mainstem Russian River, primarily due to loss of riparian vegetation and associated reduction in shade canopy and cover. The overall effect to populations of steelhead, coho salmon and chinook salmon is moderate.

(12) Passive operation of Spring Lake due to release of predators. Overall risk to population of steelhead and coho salmon is low.

(13) Passive operation of Matanzas Creek due to delay or decrease of downstream flow during early part of coho salmon spawning season and rearing habitat. Also loss of transport of spawning gravel to downstream spawning habitat. Overall risk to population of steelhead and coho salmon is low.

Channel maintenance activities performed by MCRRFCD are likely to adversely modify the designated critical habitat of the listed fish species due to:

(1) Vegetation maintenance activities on the mainstem Russian River by reduction in cover, shade canopy, and loss of high flow refuge. Overall effect to populations of steelhead and chinook salmon is high.

(2) Sediment maintenance activities on the mainstem Russian River by reducing pool habitat formation and loss of high-flow refuge. Overall effect to populations of steelhead and chinook salmon is high.

It may seem to the reader that it is contradictory to state that there is a low risk of adverse effects to protected populations, along with the statement that the proposed project is likely to adversely affect the listed species. However, the first statement is a general assessment of the risk to the larger population of the protected fish species, while the second statement reflects the possibility that one or more fish might be harmed by certain activities. These conclusions will assist NMFS with preparing a BO which may include an incidental take statement (with regard to the individual fish that may be harmed by the proposed action), as well as a determination of whether the proposed action is likely to jeopardize the continued existence of the species.

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